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THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

ELECTRIC-BELL CONSTRUCTION.—VII.

By F. C. Allsop.

A MECHANICAL throwback of American design, and one which can very readily be constructed, is shown in Figs. 42 and 43, Fig. 43 being a side-view of Fig. 42. To the frame *b* is fixed the electro-magnet *a*, opposite the pole of which is the armature *c*, pivoted at *d*. Into the top of the armature, which is bent over at right angles to the bottom part, is fitted the screw *f*, this screw regulating the distance of the armature from the pole of the electro-magnet. To the bottom of the frame *b* is pivoted at *e* the vane *m*, which, in its normal position, is supported by the armature catch *n*. By the weight of the top part of the armature the lower part is kept off the pole of the electro-magnet; but on a current passing through its coils, the armature is attracted and the vane slipping off the catch *n*, falls into the position in which it is shown in Fig. 42, and by the dotted lines in Fig. 43. It will be seen from this that there are no springs required for either the armature or vane, the movement of both being controlled by gravity alone.

Fig. 44 A shows the frame, which should be either of wrought or cast iron; it must be filed away at *d* and *e*, the recess at *d* being that in which the armature is pivoted, while that at *e* is for the vane. Two holes must be drilled at *t*, Fig. 42, by means of which the movement is screwed to the back of the

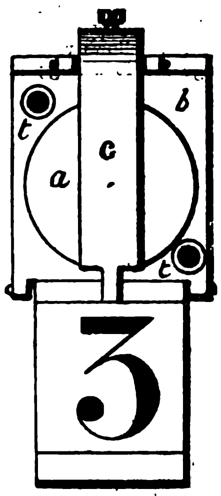

Fig. 42.

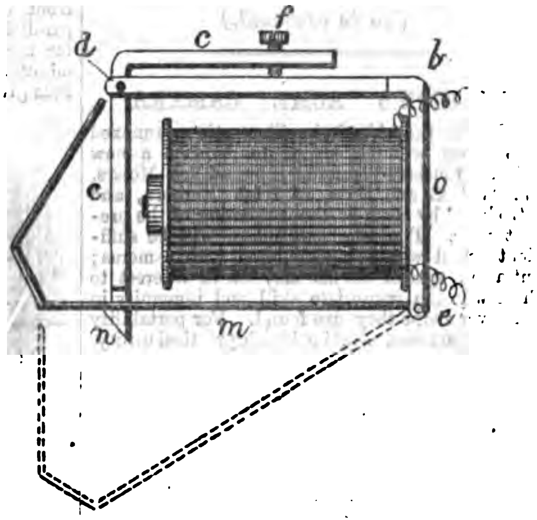

Fig. 43.

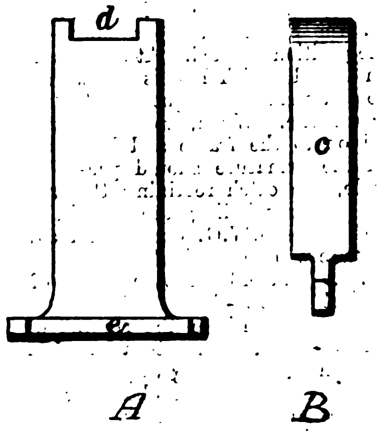

Fig. 44.

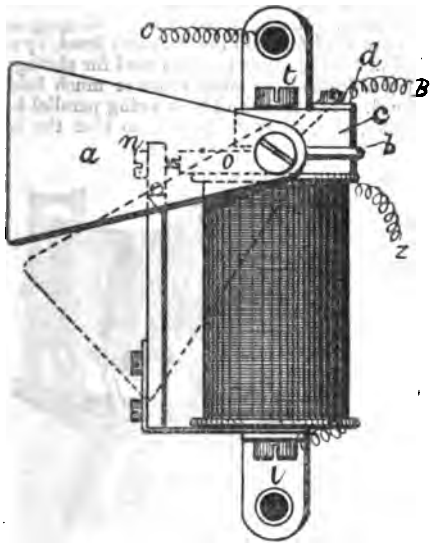

Fig. 45.

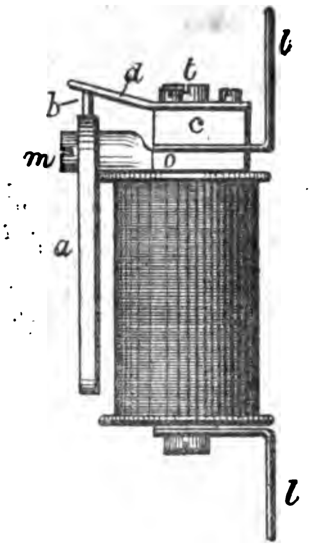

Fig. 46.

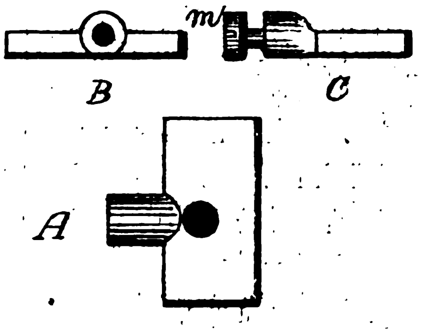

Fig. 47.

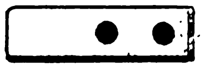

Fig. 48.

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wooden case. A hole is also drilled at *o*, Fig. 43, to receive the countersunk screw that carries the iron core of the electro-magnet. This iron core is of the same diameter as that shown in Fig. 38 (article VI.); but ⅛in. longer, there being also a screw fitted into one end only. The boxwood bobbin is of the same size as that shown in Fig. 38 A. The iron armature, Fig. 44 B, should now be made, being either forged or cast. Just below the bend, a hole is drilled through the side of the armature, the hole being of such a size that the pin which forms the pivot fits easily into it. Next the catch *n* is filed to the shape shown, and the adjusting screw *f* fitted into the top part of the armature. The armature is then pivoted to the frame, a hole being drilled through the two projecting lugs at *d*, the holes being of such size that the pin which forms the pivot fits tightly into them. The armature is afterwards put in place and the pin driven through. For the vane a piece of 1-16th sheet brass 3⅛in. long by ¾in. wide is cut out and bent to the shape shown in Fig. 43. A hole is next drilled through the two projecting lugs at the point *e*, and a tight-fitting pin driven through. The end of the vane is then bent round so as to surround this pin, which forms the pivot for it. Having adjusted the armature by means of the screw *f* to the right distance off the pole of the magnet, the vane *m* is lifted up till it touches the bottom of the armature catch and the position marked. At this spot a hole is then drilled, which hole is afterwards filed square and made the right size by a small triangular file. When, now the vane is refitted on to the frame and lifted up, the end of the armature should pass through this hole, the catch retaining the vane in position. For winding the bobbin about 1¼oz. of No. 24 B.W.G. double silk-covered copper wire will be required.

Figs. 45 and 46 show a form of the mechanical throw-back fitted with an attachment to continue the ringing of the bell until the vane is reset—a form of indicator which, besides being very useful where trouble is experienced in obtaining immediate attention to the summons, also insures the vanes being replaced. The movement is of similar construction to that shown in Fig. 36 (Article VI.), only the disc is replaced by a vane *a*, from the end of which projects the pin *b*. Above this pin is a contact spring, *d*, insulated from the frame of the movement by the vulcanised fibre block *c*. When the armature is attracted the vane is released, and falls into the position shown in Fig. 46, and by the dotted lines in Fig. 45. This causes the pin *b* to make contact with the spring *d*, keeping the bell circuit closed until the vane is reset. The same size bobbin, iron core, and armature as described for the movement in Fig. 36 is used; the pole-piece *a*, however, is different, being of the form shown in Fig. 47, A B C. A pattern should be made for this piece, and a casting obtained from it, which casting must afterwards be well annealed. Into the face of the rounded part a hole is drilled, and tapped to receive the shouldered screw *m*, which carries the vane *a*. A hole is also drilled into the front end of the pole-piece for the screw *n*, which screw by passing through a hole in the armature limits its movement. The vane *a* should be filed out of a piece of ⅛-sheet brass, a hole being drilled in the back into which the brass contact pin *b* is driven. The supports *l*, by which the movement is fixed to the case, are made out of some 1-16 sheet brass, and out of this same size brass the contact spring *d* (shown in plan in Fig. 48) should be cut. The tip of this spring at the point where it makes contact with the brass pin must be faced with platinum. Two holes are also drilled (as will be seen from Fig. 48) in the spring, through which holes pass the two screws that secure it to the vulcanised fibre block *c*. This block is cut out from ⅛ sheet vulcanised fibre (if this is not to be obtained, boxwood will do), and a hole drilled in the top of such size as will allow the threaded part of the screw *t* to pass through.

The different parts being finished, the movement can now be fitted together as described in the last article. In putting the top part together, the pole-piece is first laid on the top of the iron core, then the support *l*, above which comes the vulcanised fibre block *c*, with spring attached. The threaded part of the screw *t* is then passed through these three pieces, and the whole screwed well together. The head of the screw, if desired, can be countersunk into the vulcanised-fibre block. The same amount and size of wire will be required for this bobbin as for that mentioned above. As will be seen from Fig. 45, there are three terminals to this movement. One end of the coil to the bobbin is taken to the bottom screw of the iron core, while the other is left free and forms one terminal. Another wire is taken to one of the screws on the contact spring for the second terminal, while the third is connected to the frame of the movement itself. The method of connecting up the bell, battery, &c., to this movement was shown in the eighth article of "Practical Electric Bell Fitting," Fig. 58, which appeared in the "E. M." of March 23rd, 1888.

(To be continued.)

WATSON'S "ACME" CAMERA.

WITH the aid of the illustrations annexed we will endeavour to describe a new pattern tourist's camera, patented by Messrs. W. Watson and Sons, of High Holborn, and introduced by them at the beginning of the present year. The bare description will be sufficient for all who are acquainted with cameras; but a few special details may be of interest to those who can appreciate skill and ingenuity in whatever shape they are found. For portability and compactness, combined with practical utility, this camera may fairly be said to take the lead, and to be deserving of the title "Acme." As we have recently gone over the workshops of the Messrs. Watson and seen their cameras in every stage of manufacture, we can speak as to the solidity and quality of the work, while the finished appearance leaves nothing to be desired. In Fig. 1 we have the camera as it appears when lifted out of the travelling-case, showing the base as on one side, and exposing a newly-designed and remarkably light and firm turn-table — so light, in fact, that it practically weighs no more than the wood which has been removed. In Fig. 2, which will give an idea of its thickness, we have the camera mounted on a tripod, and in Fig. 3, having moved a spring, we have lifted the body to the position shown, the struts running in grooves, and with the assistance of clamping-nuts, holding the body at right angles to the base. The front is now lifted up, and two little projections are placed in grooves cut in the front of the base, where they are held by spring latches. If the clamping screw of the brass strut is then placed in its appointed place, the front will be at right angles to the base, and parallel to the back, when the camera is ready for use. These operations occupy about half a minute. Fig. 4 shows the bellows racked out, thus giving a wide range for focussing; but in Figs. 5 and 6 are shown two most important features. It will be seen that a swinging motion is provided for both the back and front, by means of which the camera can be used for photographing objects either much above or much below its level. The front and back swing parallel to each other, and exactly vertical, so that the lens is opposite the centre of the plate, and working from its centre instead of from its edge. To save thickness, the ordinary screw used for clamping the rising front has been replaced by a rack and ratchet. Now, referring to Fig. 6, it will be seen that the back is arranged to slide close up to the front when it is desired to use a wide-angled lens, thus avoiding a projecting baseboard which would cut off the angle of view.

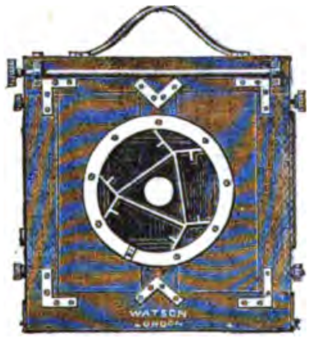


Fig. 1.

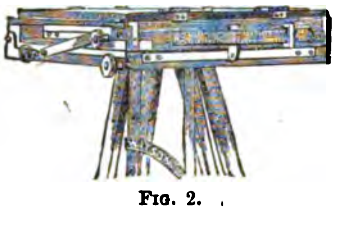


Fig. 2.

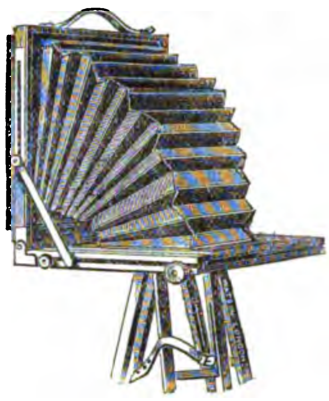


Fig. 3.

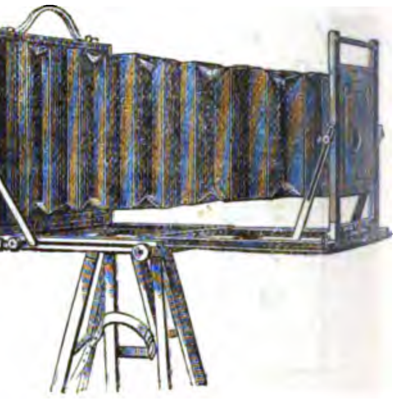


Fig. 4.

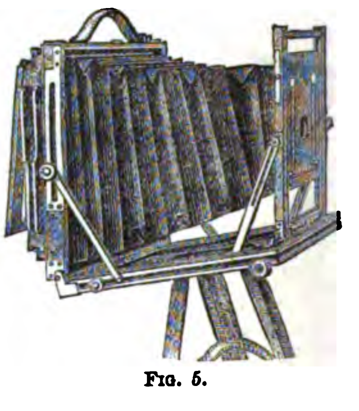


Fig. 5.

The dark slides are fitted with patent stops and springs to the shutters, which avoid the objectionable projecting screws in the one case, and effectually and automatically hold the shutters in the other—two little details which help to make this camera as near perfection as probably can be reached. The importance of lightness will be appreciated by all photographers who use cameras 15in. by 12in., but, if it can be attained without reducing the solidity of the apparatus, it is a distinct advantage even in the small sizes. This camera has taken much time and skill to bring it to its present condition, for every little detail has been well thought out and experimented with until a satisfactory result has been obtained. For instance, the little spring latches which hold the front are made to automatically release it when it is desired to close the camera. The "Acme" camera was awarded the only medal for cameras at the Richmond Exhibition held in January last.

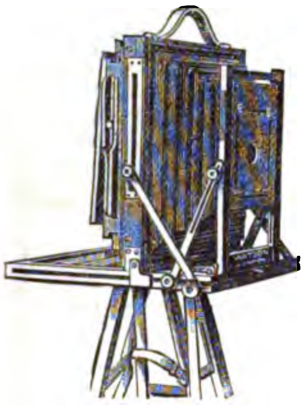
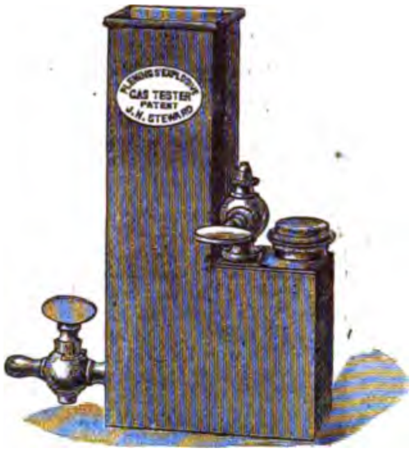


Fig. 6.

FLEMING'S GAS-TESTER.

THE recent deplorable accident in Dublin through the explosion of a gas-cylinder lends interest to the following remarks on an "explosive gas-tester," devised by Prof. Fleming, of University College, London, which we illustrate herewith. Mr. Baker, writing in reference to the explosion, says:

As there is not the slightest doubt from the evidence adduced that the explosion was caused from ignition of two *mixed* gases, it naturally occurs to one what can be done to obviate a similar occurrence, and make a certainty of the safe use "of oxygen and hydrogen." *First* and foremost, the two gases must be kept *separate*, and to this end the vessels containing them should be distinctly marked. *Second*, a test must always be applied before using, to see that each gas is in no way mixed. *Third*, the pressure exerted on the vessel must never be nearly equal to its bursting limit. *Fourth*, the pressure for the delivery of the gas must be sufficiently equal (or at any rate so great) that by no possible means can one gas be driven back into the other vessel. Now, as regards the separate vessels, if they are cylinders (and by common consent the days of gas-bags, at least in Great Britain, are numbered), if they are distinctly painted—oxygen, *black*; and hydrogen, or house gas, *red*—by no possible means, without gross carelessness, could one be used for the other, and if they were, the error would be soon discovered by the test now suggested. This test may be made in one or two ways, but on my representation of the importance of the subject, Dr. J. A. Fleming, Professor of Electrical Engineering in University College, London, has designed a little apparatus that anyone can use in a few minutes and satisfy himself that he is working with pure or known gas. It consists of a little metal tank or open-top box, 6in. high, and about 1½in. wide and deep, having a second compartment about half the height and the same width and depth as the other. The long one is open at the top, and the short one is closed by a light indiarubber cap. An inlet tube, fitted with stopcock, passes from the outside of the larger compartment along the inside base and into the second compartment, while an outlet pipe, with stopcock and fine-drawn orifice, is fitted to the smaller compartment. Perforations are made in the side connecting the two chambers, so that when water is poured into the open end of the large chamber, it may find its level in the other; or when gas is allowed to pass into the second chamber, it shall displace the water in it and cause the water to pass through the perforation and rise in the first chamber. The test is applied by connecting the gas vessel with the inlet pipe (after first filling the vessel up with water until it reaches the top of the indiarubber-capped aperture, and turning off outlet stopcock), and then turning on the gas from cylinder, bag, or other vessel. As soon as this is done the water will commence to rise in the open compartment, and when it reaches to within half an inch of the top, or when bubbles commence to rise, the gas is turned off again by the inlet stopcock, and from the vessel. Gas will now be in the second compartment instead of water, and if it is supposed to be oxygen a piece of brown paper can be lighted and blown out, then held at arm's length opposite the jet with small orifice, so that when the tap is turned on the gas blows on the glow. If it fans it into a flame and continues to burn satisfactorily, it may be known to be pure oxygen, but if with small explosions, then the gas should not be used, but be at once allowed to escape in the open air. Supposing it was the worst kind of mixture of gases for exploding, the only result would be a small explosion in the little compartment of the test apparatus, blowing off the indiarubber cap and spilling a little water. If the gas is hydrogen, or house gas, it should burn with a steady flame, just in the same way as the hydrogen does when turned on at the lantern jet; but if it is mixed it will snap or perhaps cause a small explosion, as previously described. In case of doubt the experiment should be repeated.



This little "test apparatus" is the subject of a patent, and will be sold by Mr. J. H. Steward, London; but the price will be very low, so that everyone may be in a position to satisfy themselves and reassure the public at a moment's notice. It goes without saying that the vessel must be emptied before a different kind of gas is tested. As regards "the pressure of the gas on the vessel not being nearly equal to its bursting power," no one should use a steel or iron cylinder without it has first been marked as "tested," or a guarantee given of the number of pounds pressure to which it has been subjected before filling with gas.

A great safeguard to the public is that all cylinders filled by Brin's Oxygen Company, and which can be sent through any of their many agents for the purpose, are tested in this way—the steel to pressure stated above, and iron to forty or sixty atmospheres, or about 900lb. pressure to the square inch, and then filled to thirty or forty atmospheres. By this means no risk is run by the users of gas from compression, for those that are faulty burst harmlessly in the water when tried.

A MODEL LOCOMOTIVE.—II.

The Framing.

THE framing of a locomotive is the skeleton of the structure, which forms the base of attachment for the various fittings, and receives and sustains the stresses due to the moving parts. The frames are supported on the journals of the wheels, and carry the boiler and its parts, together with cylinders and valve gear. Being subject to perpetual stresses of opposite kinds, they are made very stiff, not so much by the addition of mass in the form of extra metal as by judicious disposition of material, and by staying.

In some of the older engines composite framings of timber and iron were used, the timber being riveted between the plates; but one seldom sees such constructions at the present day. The plates now used are either of Yorkshire iron of frame-plate quality, or of mild steel; in the former case they range from 1in. to 1⅛in. in thickness; in the latter they are usually ⅞in. thick. The frames are "single" or "double," according as there are two frame-plates or four in the structure. Each system is in common use. The single plate-frames are advocated on the ground that they are more elastic than the double plates, whose greater rigidity is not always an advantage—as, for instance, when an engine is running round quick curves. Then the single frames will yield and accommodate themselves to the curvature, to a greater extent than the more rigid double frames, and less strain will be thrown upon the axle bearings.

The violent stresses to which the enormous moving mass of the locomotive is subjected, render necessary the adoption of the strongest form of framing which is consistent with lightness. Enormous steam pressures, reversal of stresses, sudden and oft-repeated shocks, complicated forces, operating partly through the engine itself, partly through the permanent way—would prove utterly destructive to a motor less strongly constructed than the locomotive. No inferior materials can be used, no second-class workmanship permitted; but specifications have to be stringently carried out. The frame-plates themselves are usually planed over the inside face, frequently over both faces, and are planed or slotted over ends and edges. They are cut out to receive the axle-boxes, and bolted by means of angle irons to the buffer beams. The structure is rendered rigid with one or more transverse ribs, by the cylinders, when the latter are situated inside, by the motion-plate, drag-plate, and foot-plates. So much depends on the frames that the greatest care is exercised in their preparation and setting.

For our model, which is one having single frames only, the two frame-plates will be made from sheet iron or steel, not exceeding ⅛in. in thickness. Two such pieces, each measuring roughly 3ft. in length, will, after having been carefully straightened by hammering on a level block of cast-iron, be whitened, marked to the dimensions shown in Fig. 1, centre-popped and cut out. To cut the curved outlines and the recesses for the axle-boxes, it will be necessary first to drill a number of contiguous holes, preferably using a twist-drill, as being less liable to run than the common form, and drilling close to the lines to save excessive labour in the light chipping and subsequent filing by which the outlines will be presently completed. This section of the work will be facilitated if the two plates are done at the same time. Two of the rivet-holes near the ends, and two of those for the cross stretcher, may be utilised for the purpose, temporary rivets being inserted. In workshops, these plates are marked from templet.

The plates are to be attached to the buffer-beams with angle-irons. These beams may be of iron, or of wood, or of wood protected with iron. Say we use timber for the front end and iron for the back. Prepare one piece of thoroughly well-seasoned oak for the former, measuring 9¼in. by 1⅞in. by ¾in., and a piece of sheet-iron for the latter, measuring 9¼in. by 1⅞in. by about $\frac{5}{32}$in. thick. To these the frame-plates are to be attached at a distance of 5⅝in. between—4ft. 1in. or 4ft. 2in. is the usual distance between the frame-plates in narrow-gauge inside-cylinder engines. The correct method of attachment is by means of angle-irons. Small angle-irons are obtainable of the model makers; but if any difficulty is experienced in getting them of correct proportions, make a pattern, and cast them in gunmetal. Figs. 3 and 4 give sections to the half of the full size required for these joints. The angle-irons will be permanently riveted to the plates with rivets, as shown; but the buffer beams will be attached with bolts. The bolts through the timber beam are permanent fastenings; but those in the opposite end are of a temporary character, to be replaced by-and-by with rivets. This is simply a convenient arrangement for model making, in order to the

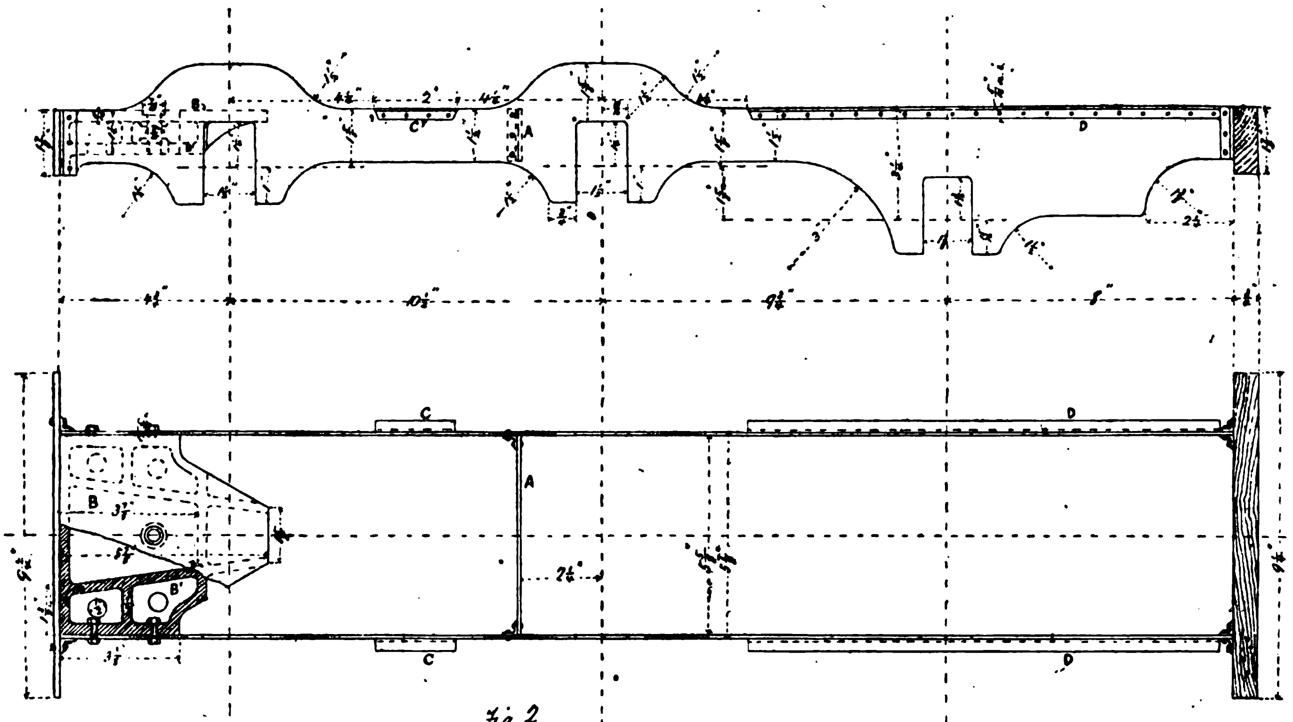


Fig 2

better fitting of parts by the temporary removal of the buffer beam at a subsequent stage.

Care will be necessary in making these first fittings at absolute right angles. First, be sure that the frames are parallel throughout their length, using a gauge strip for the purpose, one bolt only being inserted at each corner. Then try a lath of wood across corners diagonally, and alter and adjust the frames, if required, until the dimensions across both opposite corners are precisely alike. Then the frames, being both parallel and of equal length, must be at right angles, and if then the angle-irons abut quite fair on the buffer-beams, the remaining bolts may be put in. If the abutment is not perfect, a little judicious easing with the file will be necessary.

To stay these frames, we shall have, first, the cylinders occupying a position immediately in front of the leading wheels, the motion plate between the leading and driving wheels, the cross stretcher at A before the firebox, and the drag plate B at the hinder end. The two last we may make and fix at once.

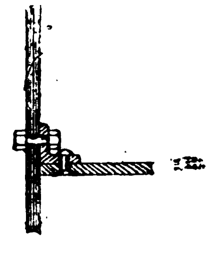


Fig 3

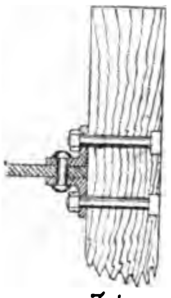


Fig 4

The stretcher A is a plain piece of plate of about the same thickness as the frame-plates, riveted to the latter either with pieces of angle-iron, or by flanges turned round out of the solid, or by flanges and angle-iron in combination. It will not matter which method is adopted. We will use angle-irons simply, riveted to the stretcher and then to the frame-plates. The rivets are properly placed zigzag; but it will be simpler here to put them in line. The diameter of the rivets will not exceed ⅛in. Fig. 3 will serve to show the joint to full size, supposing the bolts in that joint to be replaced by rivets.

Rivets of copper will be preferable to those of iron, as being softer and easier to work; but those made of soft iron rod of best quality will do. Copper rivets can be procured of the model makers; but where a large number are required—several hundreds will be wanted to complete such an engine as this—and where cost is a consideration, the following description will show one method by which the rivets can be made at the cost of material and time only.

Get two cubical blocks of mild steel, make one face of each quite true in the lathe, dowel the two together with dowels, standing up, say ½in. or ⅝in. from the face of one A (Fig. 5), and entering into holes of equal depth in the block B, opposed thereto. In the centre line of A drill a hole of the same diameter and depth as the tail of the rivets required, and in the centre of B bore out with a round-nose tool of proper curvature, a cup-shaped depression, the counterpart of the rivet head. By the pressure of the two blocks together, the cup-shape form will be readily imparted to the soft copper or iron wire, while the dowels entering their holes before the formation of the cup commences will insure the concentricity of the head and tail. The pressure may be exerted between the jaws of a parallel vice, if of sufficient strength; one of the ordinary workshop vices will answer. Where an amateur has only a small vice, then the slower plan which is shown in Fig. 5 may be adopted. Holes are drilled for the reception of bolts whose heads are sunk into recesses cut in block A, by which the bolts are prevented from turning, while the nuts above B are tightened with a spanner. The block A may be held in a vice the while, and the bolts be prevented from falling out by a little solder run round the heads, or by a bit of sheet-iron soldered on the bottom of the block. Or studs tapped into A will do instead of bolts, if they are screwed tightly in with a stud block. I have spoken at length on this matter of rivets because a large number will be wanted, and this description will serve for all. After the block is made, scores of such rivets can be turned out with little trouble. Rivets of similar diameter, but shorter, can be made by putting a steel pin in the bottom of the hole in A, to diminish the depth, while for rivets differing in diameter, a new pair of die blocks can be made by the labour of three or four hours. Two sizes of rivets can be made in one pair of blocks, by drilling their holes on opposite sides of the centre, as shown at C, D, in Fig. 5.

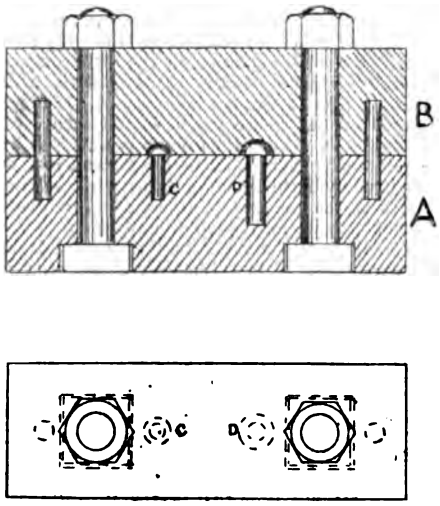


Fig. 5.

The rivet-tails, after insertion in their holes, will be hammered out roughly to shape with a narrow-paned hammer, a hand-hammer being held underneath the head the while. A neat finish will then be imparted by means of a snap, like Fig. 6, for small rivets. This may be held in the hand; but for large rivets the snap is encircled by a withy handle to prevent painful jar to the hands.

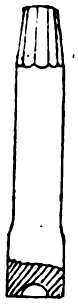


Fig. 6.

The forms of drag-plates are very numerous. They are not always used. But the heavy casting affords a convenient method of adding the weight required to the trailing wheels, and it moreover increases immensely the rigidity of the frames. A casting suitable for this model is shown at B (Figs. 1 and 2). The pattern can be made precisely like the casting, except that the lower plate B′ will be dowelled loosely to the vertical ribs, allowance is to be made for planing the edges where they fit between the frame-plates, and the pin-holes in the bosses will be drilled. Bolts passing through drilled and reamered holes will unite the casting to the frame-plates.

Angle-irons will be riveted at C, D (Figs. 1, 2), to receive the foot-plates. But it will be better to leave these plates, and the outer angle-irons by which their outer edges will be carried, and the wheel splashers, steps, buffers, draw-hooks, &c., until the engine is nearly done, as by that means we shall have more working space at command.

The fitting of the horn-blocks and axle-boxes should have properly preceded the putting of the frames together. But, as I said in my first article, the proper sequence of operations will have to be sometimes departed from. The exigences of space have compelled me to omit the axle-fittings, therefore, from this their proper place, and to defer their description until the following article, which they will entirely occupy.

J. H.

ASTRONOMICAL NOTES FOR MARCH, 1889.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 12 28·00 P.M.	22 50 23	7 23 35	22 37 55·36
6	0 11 21·99 ,,	23 9 0	5 28 8	22 57 38·12
11	0 10 5·56 ,,	23 27 27	3 30 54	23 17 20·89
16	0 8 41·10 ,,	23 45 45	1 32 40	23 37 3·65
			North.	
21	0 7 11·45 ,,	0 3 58	0 25 49	23 56 46·41
26	0 5 39·66 ,,	0 22 9	2 23 49	0 16 29·17
31	0 4 8·18 ,,	0 40 20	4 20 38	0 36 11·93

The method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 348 of Vol. XLVIII.

On March 20th at 10 a.m. the Sun is technically said to enter Aries, and Spring is supposed to begin. It is also the theoretical epoch of the Equinox; but the nearest practical approach to the equality of day and night in London will happen on the 18th, when the Sun will be 11h. 59m. above the horizon, and, of course, 12h. 1m. below it. Although the Sunspot minimum is definitely past, signs of solar activity are inconsiderable and very rare. The Zodiacal Light may now be seen in the West after sunset.

The Moon

Is new at 10h. 0·7m. on the night of March 1st, enters her First Quarter at 5h. 59·4m. p.m. on the 9th, and is Full 12·5 minutes before Noon on the 17th. She will enter her Last Quarter at 6h. 54·4m. a.m. on the 24th, and be New, for the second time this month, at 11h. 36·8m. a.m. on the 31st.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	29·1	11 58·2 a.m.
6	4·6	3 47·8 p.m.
11	9·6	7 42·1 ,,
16	14·6	11 52·2 ,,
21	19·6	3 15·5 a.m.
26	24·6	8 3·8 ,,
31	0·0	0 13·0 p.m.

The Moon will be in conjunction with Mars (5° 2′ south of him) at midnight on March 3rd, with Venus at 11h. a.m. on the 5th (Venus 8° 57′ N.), with Saturn at 6h. a.m. on the 14th (Saturn 1° South of the Moon), with Jupiter at Noon on the 24th (0° 41′ North of the planet), and with Mercury at the same hour on the 29th (Mercury 2° 2′ North).

At Noon on March 1st the Moon is in Aquarius, out of which constellation she passes, at 4h. 30m. in the afternoon of the 2nd, into Pisces. At 9 o'clock the next morning she plunges into an outlier of Cetus. Through this she is travelling until 4 p.m. on the 4th, when she re-enters Pisces, only, however, to pass again into another part of Cetus at 1h. 30m. p.m. on the 5th. When she finally quits Cetus, at 3h. a.m. on the 6th, it is to pass into Aries. By 8h. a.m. on the 7th her journey through Aries terminates, and she enters Taurus. During her passage over the last-named constellation she arrives, at 10h. a.m. on the 10th, on the Western edge of the extreme Northerly part of Orion; but by 4 o'clock the same afternoon she has traversed this and come out in Gemini. At 6h. 30m. p.m. on the 12th she crosses from Gemini into Cancer, and leaves Cancer in turn for Leo at 9h. 30m. a.m. on the 14th. She remains in Leo until 1h. a.m. on the 17th, when she quits it for Virgo. She is travelling through Virgo until 5h. a.m. on the 20th, at which hour she enters Libra. Pursuing her course through Libra she arrives, at 10h. 30m. p.m. on the 21st, on the Western edge of the narrow Northern spike of Scorpio. By 7h. o'clock the next morning she has traversed this and emerged into Ophiuchus. At 8h. p.m. on the 23rd she quits Ophiuchus for Sagittarius. Here she continues until 2h. a.m. on the 26th, when she passes into Capricornus. By 10h. 30m. p.m. on the 27th she has crossed Capricornus and entered Aquarius. At midnight on the 29th she passes out of Aquarius into Pisces. As at the beginning of the month, the path of the Moon through Pisces cuts outlying portions of Cetus, and she enters the first of these at 5 p.m. on the 30th. As she does not re-enter Pisces until midnight on the 31st, we leave her in Cetus at that hour.

Occultations of (and a Near Approach to) Fixed Stars by the Moon.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
9	B.A.C. 1651	6½	†5 34 p.m.	S. by E.	167	176				
10	B.A.C. 1733	6½	12 36 a.m.	Dark	63	24	1 28 a.m.	Bright	293	257
16	l Leonis	5	2 30 ,,	Dark	174	140	3 4 ,,	Bright	236	199
22	B.A.C. 5408	6½	2 32 ,,	Bright	114	130	3 45 ,,	Dark	288	292
26	4 Capricorni	6	‡3 19 ,,	Bright	119	155	4 15 ,,	Dark	237	268

†A near approach. ‡Before moonrise. An illustrated explanation of the above table will be found on p. 349 of Vol. XLVIII.

Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites, visible at Greenwich.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
1	Tethys	12.9 a.m.	13	Mimas	2·0 a.m.	20	Rhea	8·2 p.m.
1	Dione	6·1 ,,	13	Enceladus	8·1 p.m.	22	Enceladus	1·3 a.m.
2	Rhea	7·5 p.m.	14	Mimas	12·7 a.m.	23	Dione	3·3 ,,
2	Enceladus	9·1 ,,	14	Dione	10·3 p.m.	25	Dione	8·9 p.m.
2	Tethys	10·2 ,,	14	Mimas	11·3 ,,	28	Enceladus	9·8 ,,
3	Dione	11·7 ,,	15	Mimas	9·9 ,,	29	Mimas	2·5 a.m.
4	Tethys	7·5 ,,	16	Tethys	3·2 a.m.	29	Rhea	8·8 p.m.
6	Enceladus	11·7 ,,	16	Mimas	8·5 p.m.	30	Mimas	1·1 a.m.
11	Enceladus	2·3 a.m.	17	Mimas	7·0 ,,	30	Mimas	11·7 p.m.
11	Rhea	8·1 p.m.	17	Enceladus	10·8 ,,	31	Mimas	10·3 ,,
12	Mimas	3·5 a.m.	18	Tethys	12·5 a.m.			
12	Dione	4·7 ,,	19	Tethys	9·8 p.m.			

A description of the construction and use of the above table will be found on p. 349 of Vol. XLVIII. The Greatest Eastern Elongation of Saturn's brightest Satellite, Titan, will happen at 3h. a.m. on the 18th.

Mercury

Is a Morning Star throughout the month, attaining his greatest elongation west of the Sun (27° 35′) at 11h. a.m. on the 13th. He has, though, rather too much South Declination to be favourably placed for the observer. His angular diameter dwindles from 9·0″ on the 1st to 5·8″ by the end of March.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	21 19·3	14 2·4	10 41·6 a.m.
6	21 28·3	14 27·8	10 31·0 ,,
11	21 44·3	14 8·2	10 27·3 ,,
16	22 5·0	13 7·8	10 28·2 ,,
21	22 28·9	11 30·2	10 32·5 ,,
26	22 55·2	9 18·4	10 38·9 ,,
31	23 23·3	6 34·8	10 47·2 ,,

This slightly erratic path commences in Capricornus and extends over a large part of Aquarius; but the planet does not approach any conspicuous star in that rather straggling constellation.

Saturn

Continues to be visible during the entire working hours of the night. He is receding from us, and his angular equatorial diameter continues imperceptibly to diminish from 18·0″ on March 1st to 17·4″ by the last day of the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	9 11·4	17 27·4	10 31·8 p.m.
6	9 10·1	17 33·3	10 10·8 ,,
11	9 8·9	17 38·5	9 50·0 ,,
16	9 7·9	17 43·1	9 29·3 ,,
21	9 7·0	17 47·0	9 8·7 ,,
26	9 6·2	17 50·2	8 48·3 ,,
31	9 5·7	17 52·6	8 28·1 ,,

Whence it will be seen that Saturn will describe a short retrograde arc in the barren Eastern portion of Cancer.

Venus

Is an Evening Star all through March, and is a glorious object after sunset to the north of west. She attains her greatest brilliancy on the 25th, and at and about this time may be distinctly seen with the naked eye in the sunlit sky by anyone who knows exactly where to look for her. Her angular diameter increases from 26·9″ on the 1st to 41·2″ on the 31st, and *pari passu*, her crescent grows thinner and thinner.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	1 37·2	13 14·7	2 58·8 p.m.
6	1 53·4	15 20·3	2 55·3 ,,
11	2 8·6	17 16·3	2 50·7 ,,
16	2 22·5	19 1·2	2 45·0 ,,
21	2 34·8	20 33·3	2 37·6 ,,
26	2 45·1	21 50·9	2 28·2 ,,
31	2 52·9	22 51·7	2 16·3 ,,

The path indicated by the above ephemeris commences in Pisces and extends partly across

Aries. It is through a very blank region of the sky.

Mars is invisible, and Jupiter does not rise until nearly 4 a.m. at the beginning of March, nor until 2 a.m. at the end of it, and moreover, his great South Declination practically prevents his observation. He is in quadrature with the Sun at noon on the 27th.

Uranus

Does not south until after midnight throughout March, but as he rises shortly after a quarter past nine at night on the 1st, and between 7 and 8 p.m. at the end of the month, we resume our ephemeris of him. His angular diameter increases quite insensibly from 3·8" to 4" between the 1st and the 31st. He is not in a specially favourable position for the observer.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	13	20·4	7	46·3	2	43·9	a.m.
6	13	19·8	7	42·8	2	23·7	,,
11	13	19·2	7	39·0	2	3·5	,,
16	13	18·5	7	34·9	1	43·1	,,
21	13	17·5	7	30·5	1	22·8	,,
26	13	17·0	7	26·0	1	2·4	,,
31	13	16·3	7	21·3	12	41·9	,,

The short retrograde. arc exhibited in the above ephemeris is described some 3° or so to the North of Spica Virginis.

Neptune

Is now rapidly approaching the West, and Souths in sunlight; but as he may be picked up after dark during the earlier part of the month, we give an ephemeris of him for the first three-quarters of it.

Day of month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	3	51·3	18	28·3	5	12·5	p.m.
6	3	51·5	18	29·5	4	53·1	,,
11	3	51·9	18	30·8	4	33·7	,,
16	3	52·3	18	32·2	4	14·5	,,
21	3	52·7	18	33·8	3	55·2	,,

Whence it will be seen that Neptune is still in that void part of the sky to the South and East of the Pleiades.

Minima of the Variable Star Algol

Will happen on March 3rd at 2h. 41m. a.m.; on March 5th at 11h. 30m. p.m.; on March 8th at 8h. 19m. p.m.; on March 23rd at 4h. 23m. a.m.; on March 25th at 1h. 12m. a.m.; and on March 28th at 10h. 1m. p.m.; as well as on other occasions, when the phenomena will be invisible here.

Shooting Stars

May be watched for between the 1st and the 4th and again on the 16th. Fire-balls may be expected during the first of these periods, between the 5th and the 10th, and for a night or two after the 16th.

Greenwich Mean Time of Southing of Eleven of the Principal and Fixed Stars on the Night of March 1st, 1889.

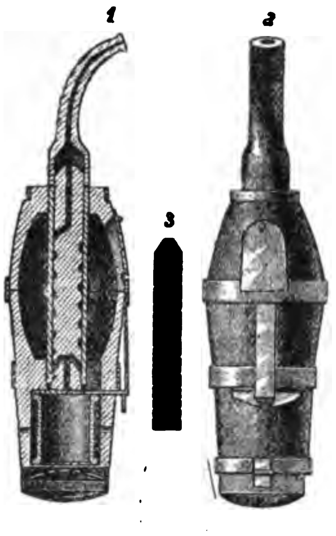
Star.	Souths. h.	m.	s.	
α Leporis	6	48	47·41	p.m.
α Orionis	7	10	3·60	,,
Sirius	8	1	1·19	,,
Castor	8	48	9·31	,,
Procyon	8	54	6·69	,,
Pollux	8	59	7.84	,,
β Cancri	9	31	1·08	,,
α Hydræ	10	42	27·80	,,
Regulus	11	22	40·84	,,
α Ursæ Majoris	*12	16	57·78	a.m.
δ Crateris	*12	33	49·17	,,

* On March 2nd.

The method of ascertaining the Greenwich Mean Time of Southing of either of the stars in the above list for any other night in March, as also that of determining the Local instant of its Transit at any other station will be found on p. 350 of Vol. XLVIII.

COLQUITT'S TOBACCO PIPE.

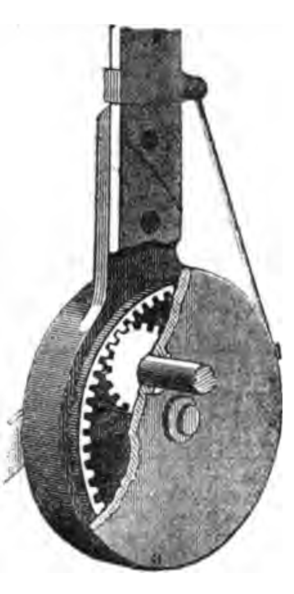
HERE is yet another pipe for smoking tobacco, designed to prevent the "nicotine and other unhealthy substances" entering the smoker's mouth. It has been patented by Mr. E. F. Colquitt, Denison, Texas. The pipe has an oval-shaped barrel surrounding the central tube, as shown in Fig. 1,



for the storage of tobacco, the tobacco being introduced by an outside door, shown in Fig. 2, while immediately beneath this door is a gate, closed by a spring bar, by means of which the tobacco is admitted to the combustion chamber below, having a perforated bottom. A tube is held centrally in the barrel, the pipe stem being held in this tube, a spiral groove being cut on the stem, as shown in Fig. 3, leading to a central aperture in the upper part of the stem, opening at the top into the mouthpiece. The tobacco in the barrel is separated from that in the combustion chamber by the spring gate, after sufficient has been allowed to pass down, and fire is communicated through an opening in the bottom cover. In smoking, the nicotine is mainly deposited on the conical end of the plug in the lower part of the central tube, while the smoke travels a long distance around the spiral groove before it reaches the smoker's mouth. This device should be compared with that illustrated on p. 191, No. 1232.

GEAR FOR BICYCLE.

AN "improved" gear for cycles has been patented by Messrs. Spencer, of Piqua, Ohio, by means of which, it is said, increased speed can be obtained compared with that to be had with an ordinary crank driving-wheel. The



fork of the bicycle, which is secured to the spindle of the wheel, has rigidly fixed therein a casting, in the centre of which is the bearing of an internal gear crown wheel meshing with a spur wheel fixed to the spindle of the bicycle wheel, the crank being connected to the spindle of the crown wheel. The casting can be readily attached or removed, and its connecting parts greatly strengthen the portions of the vehicle where the greatest strain comes, while a removable cap or cover serves to protect the operating parts.

PHOTOGRAPHIC CHEMICALS AND THEIR IMPURITIES.

AMONG the many chemicals used in photography, the alkaline salts are the most important, and often contain the greatest quantity of impurities. A number of these impurities are incidental to the processes by which the salts are manufactured, and not being easily eliminated in the course of purification, may cause very serious trouble when used for photographic purposes. Taking sodium carbonate as the first, and, perhaps, most useful alkaline salt in the process of development, let us stop a moment to consider the several processes by which it is made, and the impurities it is likely to contain.

There are three processes from which the sodium carbonate of the American market may be obtained. The first of these is the old Leblanc process; the second, the Solvay or ammonia-soda process; and third, the cryolite process of the Pennsylvania Salt Company. It is probable that most of the soda crystals are made from products produced by the Leblanc soda process, as practised in England. Without going into details, this process consists in first converting sodium chloride (common salt) into sodium sulphate by the aid of sulphuric acid; then by roasting this sodium sulphate with coal and limestone, the sulphate is converted into sodium carbonate ("crude soda ash," as it is called); this last product after crystallising gives us the soda crystals of commerce. The sources of the impurities in this method of manufacture are numerous. The common salt used for the purpose is reasonably pure; at least, the impurities are generally only lime and magnesium salts, which do no harm so far as photography is concerned. But as soon as the sulphuric acid is added, we begin to introduce a number of impurities. This acid as made in England often contains arsenic and nitrous compounds, which, when brought into contact with the sodium chloride, form compounds with it that are by no means easily eliminated from the subsequent products. When we remember the exceedingly minute quantities of material that affect the photographic image, we are constrained to believe that the traces of arsenic often found in soda crystals may have some important effect upon photographic results. Yet the quantity of arsenic is exceedingly small in even the crude soda crystals, and possibly its presence is unimportant; nevertheless, it is very active in its reactions, and may have an influence far exceeding our expectations. But this is not the most important impurity in soda crystals. The most serious trouble comes from the impurities introduced during the conversion of the sodium sulphate into carbonate by roasting with coal and limestone. Having made this roasting, the crude semi-fused mass is treated with water, which dissolves the sodium carbonate formed, and gives the liquors from which the sodium carbonate crystals are ultimately obtained. An examination of these liquors reveals the fact that in addition to the sodium carbonate which they contain, there is also present sulphite, hyposulphite, sulphide, and cyanide of sodium. It is obvious that unless the sodium carbonate is crystallised several times, traces of all these compounds find their way into the crystals. Their effect upon the photographic work done with such crystals is the more dangerous, according to their amount.

It is too true that there is much crude soda crystals in use that contain considerable quantities of sodium sulphate. This impurity is harmless, but is an index of imperfect purification, and such crystals should not be used for photographic purposes. If one impurity is present in large amount, it is reasonable to suppose that others of more importance, and not as easily eliminated, are also present.

Fortunately, we are not confined to the use of soda crystals, and there are two products in the American market that are admirably fitted for photographic use. Only they must be used with judgment. These products are the sodium carbonate made from cryolite, and a like product made from common salt by the ammonia process.

The first of this is perhaps the purest commercial sodium carbonate made, its only impurities being traces of alumina and lime. In using it, remember that it is dry sodium carbonate without any water of crystallisation; consequently only about 37 per cent. of the weight given for the crystals should be used.

The sodium carbonate made by the ammonia process is perfectly free from the dangerous impurities incidental to the Leblanc process; but it contains two products that result from its method of manufacture. One of these is ammonia salts, and the other is an excess of carbonic acid. Dry sodium carbonate made by the ammonia process often gives a faint odour of ammonia, due to the volatilisation of the ammonic carbonate which it contains. The presence of the excess of carbonic acid in this last variety of sodium carbonate is due to the imperfect heating of the sodium bicarbonate which is one of the steps in the process of manufacture. There is no particular harmful influence exerted by this excess of carbonic acid, but it makes it very difficult to determine the true strength of the material. It is almost impossible to know how much real sodium carbonate there is in such a product, the sodium bicarbonate being of little use as a developing agent.—*Anthony's Photographic Bulletin.*

COMPARATIVE VALUE OF CHEMICAL SUBSTANCES AS ANTISEPTICS.

At a recent meeting of the Society of Chemical Industry, held in London, Mr. C. T. Kingzett, F.I.C., F.C.S., read an instructive paper upon the comparative values of chlorides, nitrates, sulphates, and other chemical substances. The experiments carried out were of the simplest character. An extract of beef was made by digesting 5lb. of fresh lean beef in water at a temperature not exceeding 40° C.; this, after filtration, was cooled and made up to five litres. Ninety-five cubic centimètres of this extract were taken, to which were added five cubic centimètres of a 5 per cent. solution of the antiseptic to be tested. The solutions were then examined from time to time, and the days upon which they became putrid were recorded. In those cases where the antiseptic is not soluble in water to that extent, the boiled solution containing that quantity was used. The author believes that the true antiseptics, as they act in relation to any *one* micro-organism, so do they to any *other* micro-organism, either by destroying it or bringing about such a change in the composition of the medium as to render it incapable of sustaining the life or subsequent development of the respective species. According to this view, he therefore claims for his experiments truly comparative results, which were briefly as follows:—

The solutions containing the chlorides of potassium, sodium, ammonium, barium, strontium, calcium, and magnesium, as well as the standard extract, were putrid on the fourth day; chlorides of iron, lead, zinc, and tin were putrid on the ninth day; chloride of aluminium was putrid on the fifteenth day; chlorides of copper and mercury remained unchanged.

The nitrates of potassium, sodium, ammonium, barium, strontium, calcium, magnesium, and iron were putrid on the fourth day; nitrate of zinc on the sixth day; nitrate of lead on the ninth day; nitrates of copper and mercury remained unchanged.

The sulphates of potassium, sodium, ammonium, magnesium, iron, and manganese were putrid on the fourth day; sulphate of zinc on the fifth day; sulphate of aluminium on the eleventh day; sulphates of copper and mercury remained wholesome during the whole period of observation—viz., sixteen days.

The following other substances, with some selected chlorides, nitrates, and sulphates, were then examined:—Five cubic centimètres of a saturated solution of "salufer" (Thomson's fluosilicate of sodium); five, ten, fifteen, and twenty cubic centimètres of ordinary "sanitas" fluid; five cubic centimètres of bactericide (i.e., a solution containing 5 per cent. mercuric chloride in peroxide of hydrogen of five-volume strength). The mixtures became putrid in the following order:—The standard beef solution on the third day; the sulphate of zinc and nitrate of lead mixtures on the fifth day; the 5 per cent. "sanitas" on the sixth day; the chlorides of lead and tin mixtures on the seventh day; the "salufer" and sulphate of aluminium mixtures on the eighth day; the nitrate of mercury and chlorides of iron and aluminium mixtures on the twelfth day; the chloride of zinc mixture on the fifteenth day; the nitrate of zinc mixture on the twenty-first day. The mixtures containing ten cubic centimètres and upwards of "sanitas," as well as those containing "bactericide" and the chlorides and sulphates of copper and mercury, remained unchanged during the whole period of observation—viz., thirty-four days.

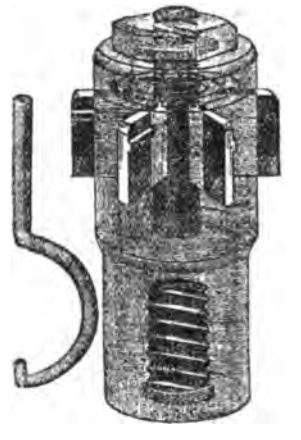
Finally, experiments with 5 per cent. solutions of the following substances in peroxide of hydrogen of five-volume strength were made:—Potassium hydrate, potassium chlorate, bisulphate of potash, borax, borax neutralised with boric acid, sodium benzoate, ethylic ether, glacial acetic acid, quinine disulphate, quinine sulphate dissolved in slight excess of sulphuric acid, chloroform (5 cubic centimètres chloroform + 50 of absolute alcohol + 45 of peroxide of hydrogen, ten-volume strength), phenol, chloral, hydrochloric acid, oxalic acid, boric acid, and sulpho-phenic acid.

The results were as follows:—The standard extract and the sodium benzoate and neutral borax mixtures were putrid on the third day; the quinine disulphate mixture on the fourth day; potassic chlorate mixture on the fifth day; chloroform mixture on the seventh day; borax mixture on the tenth day; boric acid and the quinine sulphate dissolved in excess of sulphuric acid on the thirteenth day; bisulphate of potassium on the seventeenth day; acetic acid mixture on the nineteenth day; chloral and oxalic acid mixtures on the twenty-fourth day; sulpho-phenic acid on the twenty-seventh day. The hydrochloric acid and phenol mixtures were still good after thirty-nine days.

These results are not without interest. Corrosive sublimate appears to be by far the most powerful antiseptic known, but it also ranks as one of the strongest poisons, and hence objection must be taken to its general use except in the hands of medical men. That nitrate of mercury failed to preserve the beef solution longer than the twelfth day is curious to note. The solution of the red iodide of mercury in potassium iodide, the sulphites and bisulphites, and salicylic acid, all of which are generally recognised as possessing valuable antiseptic properties, do not appear to have been experimented with. However, all through the paper we find a clear record of facts, and an investigation of this character merits the appreciation of all those interested in sanitary science.

CRANSTON'S ADJUSTABLE REAMER.

The illustration shows an adjustable reamer, made by Cranston and Co., of New York.



It is constructed upon the same general plan as an ordinary scroll chuck, the reaming cutters (4 to 6 in number, according to size) being expanded and contracted to the desired size by turning a collar which is at the end of the reamer, the inner face of which is provided with a scroll thread which engages small projections upon the ends of the cutters. The collar is held in place by a small nut, which, when tightened, gives it just sufficient room to work freely, and when the cutters are adjusted, the larger nut is tightened, binding all the parts rigidly together and relieving the working parts of all strain. The reamer was invented to meet a want found in the shop where it is made, and is intended not only to enable the reamer to be kept to standard size, but to afford a ready means of reaming holes which are not of standard size, and of restoring the reamer to standard afterwards. This can be done by means of a standard collar to which it can be set. They can be used in the lathe or boring mill, and are made in five sizes, enabling any size hole to be reamed from 1$\frac{3}{16}$in. to 4¼in. They have been used in the shops of Cranston and Co. on general machine and jobbing work for the past two years, giving entire satisfaction.

ELECTRIC RAILWAYS IN AMERICA.

The following account of the performances of the Daft electric locomotive, known as the "Benjamin Franklin," will be read with interest by many. It is extracted from the *Electrical World*, New York.

Since Jan. 28 last, with the exception of two days, when the multiplication of elevated trains caused by the strike on the street railways interfered, the Daft electric locomotor "Franklin" has been running with the steam locomotives, and same number of cars, from 11 a.m. to 2 p.m., between the Fourteenth and Fiftieth street stations of the Ninth-avenue Elevated Railway.

The restriction of these hours has been solely due to the necessity of switching the locomotor to the front of the train at both termini, and this operation, while readily accomplished in three minutes, would, in "commission hours," when the headway of the steam trains is nominally three minutes, and frequently less, delay the schedule service which it is the boast of the "Franklin" never to have interfered with in the many hundred miles it has run on the Ninth-avenue lines.

The tests for tractive capacity and speed, which had been varied and many from the latter part of last November up to the beginning of the present schedule service, were eminently satisfactory in all respects and unattended by the slightest mishap, delay, or disappointment. They were an unbroken success from beginning to end, and though noticed before in these columns, it is not out of place to refer to the more salient instances among them.

With eight empty cars in train, making a load of 122 tons, a speed of 7½ miles an hour was obtained up a gradient of nearly 2 per cent. without the slightest noticeable strain upon the locomotor, although the development of horse-power exceeded 120. With a four-car train, the standard for the Ninth-avenue line, carrying an average load of passengers, 15½ miles an hour were easily made up the same gradient, an excess of 2½ miles over the running time of the steam trains between stations.

The "Franklin" has on several occasions attained a speed of thirty miles per hour, and it is a thoroughly safe statement to make that in its present stage thirty-five miles per hour may be considered the ultimate.

While these special tests indubitably established all, and more, than was looked for, there yet remained a quality that only regular and continuous service for some length of time would fully demonstrate, and which may, for want of a recognised term, be styled reliability—a word essentially American, and rather sniffed at by lexicographers, but one for which there is no complete synonym in the language. To be "on deck" in the thousand and one unforeseen and unforeseeable emergencies that occur in the practical use of machinery of any kind; to show a minimum liability to accident or derangement; a not unreasonable wear and tear and a permanency of adjustment are qualities before which abstract economy must often give away. It is needless to say that the "Franklin" ranks high on all these counts.

There has been no noticeable sparking or flashing at the brushes, either of conductor or commutator, which have for themselves shown a surprising and unexpected uniformity of contact and endurance. Under the heaviest work it has been subjected to no journal has ever heated, neither field nor armature has been perceptibly warmer, and everything unmistakably indicates that in all respects the "Franklin" possesses a large factor of safety, and so far has not approached in any direction the limit of its powers.

It may be noticed that, in the present schedule work, the electric train does not stop at stations to pick up and drop passengers, and the omission, not unnaturally, may excite some curiosity. The primary reason is that the locomotor at present is not supplied with means of utilising the air brakes. Though the designs are completed and will soon be carried out, the necessary reduction of speed in approaching stations with limited brake-power would so increase the duration of the trip as to dangerously encroach upon the interval available for switching. Even now the occasional inevitable irregularity of the steam trains so trenches upon the time needed for this operation as to now and then interrupt the succession of the "Franklin's" trips, and the essential uniformity demanded by the experiment would be impossible, except at the risk of further impeding the delayed steam train, which it is particularly desired to avoid. Direct trips give the electric train ample time for switching without getting in the way of anything.

The economy in the application of power is peculiarly marked in this regular running. Indicator diagrams of the driving steam-engine are taken with the train in motion by a mechanical expert, and the weight of the train being known and its speed carefully noted between stations, as well as the instant of passing them, a very close comparison of the power developed by the steam-engine and that utilised on the track becomes possible. The results are not yet ready for publication, but will be shortly made known in full detail. The economical principles on which electric propulsion bases its claim to recognition can hardly be as yet a generally familiar one, and a brief outline of it is not out of place. It lies in the fact of the unavoidable wastefulness of small—especially locomotive—steam-engines, and the remarkable economy of large stationary compound condensing engines of modern type. The latter will readily give a horse-power hour for 2lb. of coal, while the best trustworthy quoted results of passenger steam locomotives is not less than 9lb. of coal per horse-power hour. Now, while one-third of the original power, in a circuit of ordinary length, may be lost in its conversion into current by the dynamo-generator and reconversion to power by the electric motor, and in overcoming the resistance of conductor and electromotive mechanism it still is true that in the case of electrical transmission a horse-power on the track costs but 3lb. of coal as opposed to 9lb. of the steam locomotive. There are also other reasons hinging upon the interaction of currents on a circuit including several motors which tend distinctly to economy of operation.

The theory of compensation between electric locomotors working upon the same circuit was advanced several years ago by Werner Siemens, who declared, without qualification, that two electro-motors, influenced by the same current and running upon the same track, one upon an ascending and the other upon a descending gradient, are as literally and practically connected with each other as if tied together by an actual rope.

The consequence of which is that all the electric locomotors on the same circuit may be regarded as running upon a level track. The armature of the descending motor, revolving under the influence of gravity, changes its function to that of dynamo-generator and restores current to the line which is available for the motor on the ascending gradients. A most interesting illustration of this theory has lately appeared in prolonged and elaborate investigations of the distribution of power on the Seashore Electric Railway of Astbury Park, N.J., equipped and run on the Daft system.

After accurately measuring the total power developed by the steam-engines that drive the dynamo generators, and apportioning it, by familiar methods, among engine friction, that of the countershaft of the dynamo generator and conductive system—both mechanical and electrical—there remained 26·6H.P. assignable to 14 cars in operation. A complete record had been kept of the number of passengers per car, which averaged 23, exclusive of driver and conductor. The speed, exclusive of stoppages, has been deduced by averaging an infinity of observations, and the number of trips was a matter of record, as was also the weight of the car. It only remained to calculate from the total weight of a loaded car—using a standard coefficient of traction—moving at the average speed, and assuming it to be running upon a level track, the horse-power equivalent to such work, and it proved to be 1·957. Dividing the total horse-power cited above —26·6—and arrived at by an opposite process, by the number of cars—14—in operation, it will appear that each car was consuming 1·9 horse-power. A more striking confirmation of the compensating influence of gravity could not be imagined than these almost identical results reached by perfectly distinct and dissimilar methods. The most insignificant gradient could not be mounted except by a greater expenditure of power than that quoted, and the only solution is that acceleration on descending gradients balanced the retardation on the ascending, and that all the cars were practically working on a dead level. The fact has an important bearing on the dimensions of power-station equipments, which need only be proportioned to dispose of the average work of the motors multiplied by their number; but it does not in the slightest degree modify the necessity of every electro-motor being competent for the maximum work that can ever come upon it.

What the effect of this demonstrated principle would be if applied to the 270 steam locomotives of the New York elevated railways, 90 of which stand in reserve burning a certain quantity of fuel uselessly—that is to say, in a present sense—it is surely superfluous to expatiate upon; but when applied to the thrifty electric locomotor the vista it opens is so fair and flattering as to raise suspicion with sober-sided railway financiers and managers that it is more of a mirage than an actual prospect, and heads are shaken dubiously at it. But it is no mirage, and whoever starts first for it will hold the oasis for its own.

The Manufacture of Paper from Sugar-Cane.—The *Revue Scientifique* states that it has long been known that the stalk of the sugar-cane might be used in the production of a paper of the best quality. It is therefore surprising that, with the constant decline in the value of sugar owing to over-production, and the steadily increasing price of paper, it has never occurred to sugar-planters to embark in the manufacture of paper as a supplement to sugar producing. The fibres of the cane give an excellent paper, and the necessary mechanical and chemical processes are easily carried out. A correspondent of the French National Acclimatisation Society reports that Mr. Walter Forbes, of New Orleans, has lately exhibited there a dozen samples of white paper made from the sugar-cane which were pronounced very good. The first quality costs 21f. per 100 kilogrammes; 500,000 kilos of the stalk would produce 10,000 kilos of paper, worth 2,100f. The *Revue Scientifique* concludes by recommending the planters in the French sugar-producing colonies to introduce paper-making.

In a paper on "Matter Excreted by Roots," H. Molisch says (*Journal of the Chemical Society*) it is known that roots excrete an acrid juice capable of attacking minerals. The author finds that the liquid has much more extensive powers—namely, it has both reducing and oxidising properties; turns tincture of guaiacum blue; oxidises tannins and humic substances, and consequently promotes the decomposition of humus; transforms cane-sugar into reducing sugar, and acts feebly like diastase; corrodes a plate of ivory; and modifies the organic matter of soil. The root membranes are not simply permeated with this juice; it may sometimes be seen to exude in droplets.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday, the 20th ult., at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., President, in the chair.

Mr. H. D. Richmond, F.C.S., and Dr. F. G. Smart, M.A., F.L.S., were elected Fellows of the society.

The following papers were read:—(1) "Report on the Helm Wind Inquiry," by Mr. W. Marriott, F.R.Met.Soc. The Helm wind is peculiar to the Cross Fell range of mountains in Cumberland, which runs from north-north-west to south-south-east. This range is high and continuous, and is not cut through by any valley. Cross Fell is 2,900ft. above sea-level. From the top of the mountains to the plain on the west there is an abrupt fall of from 1,000ft. to 1,500ft. in about a mile and a half. At times when the wind is from some easterly point the Helm forms over this district, the chief features of the phenomenon being the following:—A heavy bank of cloud rests along the Cross Fell range—at times reaching some distance down the western slopes, and at others hovering just above the summit; while at a distance of two or three miles from the foot of the Fell a slender roll of dark cloud appears in mid-air and parallel with the Helm cloud —this is the Helm bar. The space between the Helm cloud and the bar is usually quite clear, while to the westward the sky is at times completely covered with cloud. The bar does not appear to extend further west than about the river Eden. A cold wind rushes down the sides of the Fell and blows violently till it reaches a spot nearly underneath the Helm bar, when it suddenly ceases. The observations that have been made in the district during the past three or four years show that the Helm wind is not such a rare occurrence as it was popularly supposed to be, the bar having been observed on 41 occasions in 1885, 63 in 1886, and 19 in 1887. The phenomenon takes place usually when the sky to the eastward is covered with cloud. (2) "An Atmospheric Sketch," by Mr. F. A. Velschow, F.R.Met.Soc. (3) "The Drought in New South Wales in 1883-4, and Rainfall at Corella, 1879-88," by the Ven. Archdeacon Wynne, F.R.Met.Soc.

ASTRONOMICAL SOCIETY OF FRANCE.

THE February meeting took place on the 6th in the rooms of the Society, 28, Rué Serpente, M. Flammarion, president, in the chair.

M. Guiot, of Soissons, sent a series of Uranus with the naked eye and of Neptune with an opera-glass.

M. Flammarion read a paper on γ Arietis. He remarked that this remarkable double star has scarcely varied in aspect since its discovery. The two stars, however, seem slightly variable, which has given rise to some confusion in the measurement of the position angle. M. Flammarion, at Juvisy, found 359·1°, and a distance of 8·51″.

M. Moussette made some remarks on the lunar eclipse of Jan. 17th.

General Parmentier read a note on the small planets discovered in 1888. He called attention to the fact that they classed themselves very well in the classification of the asteroids which he had made some years ago.

M. Schmoll read a paper on the sunspots during 1888, and showed diagrams representing (1) the number of the spots, (2) their apparent surface, (3) their real surface. According to him, 190 days had been without spots.

M. Bruginère, of Marseilles, placed the minimum of sunspots at 1888·8, and Mr. Jacquot sent some observations on the same subject.

M. Gunziger remarked that the use of Thompson's discs was very convenient for drawing and accurately placing sunspots. He showed some of these discs ready for use.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the thirteenth ordinary meeting of the session the paper read was on

Alternate-Current Machinery,

by Mr. Gisbert Kapp, Assoc.M.Inst.C.E. The theory of alternate-current machines, as given in modern textbooks, was, he said, based upon the assumption that the currents were generated in wire coils, the magnetic induction through which underwent periodical changes, according to a simple sine function. A machine of this character would be represented, in its most elementary form, by a coil of insulated wire revolving round an axis of its own plane, with uniform velocity in a uniform magnetic field, the axis of rotation being at right angles to the lines of the field. The electromotive force at any moment was

$$e = 2 \pi n z \frac{\tau}{2} \sin. \alpha,$$

where n was the frequency (number of complete periods per second), τ was the number of wires in both branches A and B of the coil collectively, z was the total induction through the coil when the latter stood at right angles to the line of force, and α was the angle between this position and the position at which the electromotive force e was generated. The mean electromotive force was

$$e = \frac{\pi}{\sqrt{2}} n z \tau.$$

It was convenient to compare this value with that representing the electromotive force of a direct-current machine having the same field and external number of wires τ (but equally distributed) on the armature. The electromotive force of such a machine was given by the product $z \tau \frac{N}{60}$, where N the number of revolutions per minute, might obviously be replaced by $60n$ when the machine had two poles; because, in this case, frequency and number of revolutions per second were identical. The ratio between the electromotive forces of the two machines remained the same—namely, $\frac{\pi}{\sqrt{2}}$. Alternators as now constructed had more than one pair of poles, which were set in a circle, and were so arranged that the coils of the armature swept past them. As the interpolar space was always very small, the density of lines emerging from or entering the polar-surfaces might be taken as fairly uniform over the extent of these surfaces, and it became thus possible to determine for every shape of coil the configuration of polar surface which would produce that variation in the induction which corresponded to the simple sine function. Poles of this shape were, however, not used in practice; the poles were either trapezoidal, circular, or rectangular. In the Mordey alternator the poles had a trapezoidal face, and those succeeding each other on the same side of the armature were of the same sign, and were placed in line with those of opposite sign on the other side of the armature. Thus, along the mean pitch-line uniform fields alternated with spaces in which there was no induction. The electromotive force of this arrangement was

$$e = 2 n z \tau.$$

The type of field most commonly used in modern alternators was, however, one in which N. and S. poles succeeded each other around the armature, and the portion of the armature not embraced by the poles might be taken as equal to that embraced. The electromotive force of this arrangement was

$$e = \frac{4}{\sqrt{2}} n z \tau.$$

These results referred to machines in which the active wires on the armature were concentrated into single lines. This was of course impossible in practice; the wire coils on the armature, whether this contained iron or not, must occupy a considerable space, and this circumstance would, generally speaking, cause the electromotive force obtainable, with the different forms of fields considered, to be lower than the values given. The reason for this reduction was that, with a wide coil all the turns were not equally and simultaneously influenced by the field, and in certain positions the action was differential. The calculation of the effective mean electromotive force for any configuration of field and armature coils presented no special difficulty, though for certain complicated forms the operation was somewhat laborious. The electromotive force of an alternator could be expressed as the product of the electromotive force of a direct-current machine, having the same dimensions and weight, and a certain coefficient depending on the configuration of the field-magnets and armature coils. The winding and other constructive data of an alternator being known, it was only necessary to find this coefficient, in order to determine the electromotive force, by reference to the electromotive force which would be produced by the same machine if the armature-coils were connected in such a way as to give a continuous current. The electromotive force in volts of an ordinary dynamo was given by the formula:—

$$e = z \tau N 10^{-6},$$

where z represented the total induction in English lines of force (each equal to 6,000 C. G. S. lines), τ the total number of active wires counted all round the armature, and N the speed in revolutions per minute. If the machine was multipolar, and if the different armature circuits were arranged in series, the expression for e must be multiplied by p, the number of pairs of poles in the field. Let k be the coefficient which expressed the ratio between the electromotive forces of the alternate- and continuous current machines, then the formula for the former was

$$e = k p z \tau N 10^{-6}.$$

The following table gave the value for k for different cases, all referring to poles of rectangular shape and coils in which the active wires were straight:—

1. Width of poles equal to pitch, toothed armature and winding concentrated in the recesses	$k = 2·000$
2. Width of poles equal to pitch, smooth armature and winding spread over the whole surface	$k = 1·160$
3. Width of poles equal to pitch, smooth armature and winding covering only one-half the surface	$k = 1·635$
4. Width of poles equal to one-half the pitch, smooth armature and winding spread over the whole surface....	$k = 1·635$
5. Width of poles equal to half the pitch, smooth armature and winding covering only one-half the surface	$k = 2·300$
6. Width of poles equal to one-third the pitch, smooth armature and winding covering only one-third of the surface	$k = 2·830$

According to the ordinary sine formula the coefficient was $k = 2·220$; and this agreed fairly well with case 5, which was most frequently met with in practice. The formula for e presupposed the knowledge of the total induction z, which depended upon the shape and size of the field-magnets, their arrangement, the amount of iron in the armature, the interpolar space, and the exciting power. This subject had been very fully treated by Drs. J. and E. Hopkinson, and the author had also dealt with it. These methods had subsequently been improved by the introduction of certain terms due to Prof. Forbes, by means of which the magnetic leakage could be more accurately ascertained. With the knowledge of the total induction z, and the coefficient k, it was thus possible to determine the relation between exciting-power and electromotive force of any given alternator. The effect of self-induction was to produce an electromotive force, the phase of which was at right-angles to that of the current; and the electromotive force available for doing work in the circuit was the resultant of the induced electromotive force and that due to self-induction. The author then described some graphic methods by which the problem could be treated in a simple and easily understood manner. In alternators used for parallel distribution, the object aimed at was generally to keep the terminal pressure constant for all currents, and this could be attained by working with a constant field and suitably varying the speed, or by maintaining a constant speed and adjusting the exciting current so as to vary the electromotive force. The latter plan must be adopted if several machines were worked in parallel; and in this case the graphic method might be used, to determine the limits between which the exciting current must be varied to keep the terminal electromotive force constant for all loads, from no current to the greatest current the armature was intended to pass. The mean induced electromotive force e was found by the above formula, and its maximum value was obviously—

$$E_i = \sqrt{2}\, e.$$

The maximum value of the electromotive force of self-induction was given by—

$$E_s = 2 \pi n L I,$$

where L was the coefficient of self-induction, which could be determined by various well-known methods; or by running the armature in a constant field, and measuring the terminal electromotive force with and without a current passing through the armature. The electromotive force lost in resistance was simply the product of the current I and the resistance R of the armature. With the knowledge of these quantities it was easy to determine the strength of field required for any current. The problem of parallel working was of the greatest importance for central stations, as only by such an arrangement of machines was it possible to insure absolute continuity of the service and the greatest economy at all times. Alternate-current distribution should, if possible, be carried on in the same simple manner as direct-current distribution, that was to say, the number of machines at work should correspond as nearly as possible to the output at any time; the addition or withdrawal of machines should not even momentarily interrupt the supply of current to any part of the system of distribution. These conditions, it would easily be seen, could only be fulfilled if the machines were capable of working in parallel, and the problem might be stated somewhat in this fashion: Given an alternator, with excited field and running at a proper speed, and a pair of terminals from which any desired strength of current could be obtained at a constant pressure, and having a frequency approximately corresponding to the speed of the alternator, what would be the condition under which the alternator would fall into step with the supply current, and what would be the relation between the current passing and the mechanical energy given off? Also, how would this relation be affected by variations in the strength of the field? This problem was also treated by graphic methods, and it was found that the only and sufficient condition, for successful parallel working, was a sensible amount of self-induction in the armature-circuit. It was well-known that alternators having no iron in their armatures could not be run in parallel, except by the adoption of some such expedient as choking-coils; also that parallel running was feasible with those alternators which had iron-cored armatures. If a machine were run at constant speed on open circuit, and with different strengths of exciting current, different terminal electromotive forces were obtained. A characteristic could then be plotted, the abscissas of which represented exciting power, whilst the ordinates represented terminal electromotive force, which in this case was the same as the induced electromotive force. Having obtained this curve, which the author suggested should be called the "static characteristic," the dynamic characteristic of the machine was determined for a certain current through the armature, by so adjusting the resistance in the external circuit, that for all exciting powers the current remained the same. The curve so obtained must obviously lie wholly under the first curve, and the difference between the ordinates of the two curves depended upon the choice of current for which the second test had been made, and upon armature-resistance and self-induction. Besides these two curves there was a third—namely, that obtained when the machine was driven as a motor running light. To find this curve it would be necessary to have at disposal at least two similar machines, using the one as generator and the other as motor, and during the test the field-strength of both machines would have to be regulated, so as to keep the current at its predetermined value. Thus, a "motor-characteristic" would be obtained, lying wholly above the "static characteristic." As the last experiment was, however, only possible if two machines could be tested at the same time, and was also somewhat delicate, another method of investigation was desirable. This could be done by using one of the author's diagrams to deduct the motor-characteristic from the two other curves, the experimental determination of which presented no difficulties whatever, and would, indeed, be made as a matter of course in the ordinary test of the machine before it was sent out from the manufacturer's. Diagrams were shown which contained these various curves as determined for one of the author's machines, constructed for an output of 60 kilowatts. In any dynamo machine there were two causes for heating, in addition to purely mechanical friction. These were the resistance of the conductors, and the change of magnetisation of the iron parts of the machine. As regarded the first cause, the liability to the generations of eddy-currents in the armature conductor was much greater with alternators than with continuous-current dynamos, and in alternators it varied with the construction of the armature to a greater degree. When the armature contained no iron, the heating from eddy-currents was much greater than when such a core was used, and the armature conductor must therefore be made in the form of a very narrow strip. The other cause of the generation of heat, the change of magnetisation in the iron parts, could be minimised by lamination, but never entirely avoided. In direct-current machines the heating from this cause was, however, generally so small that no account was taken of it, except when the induction in the armature-core was pushed beyond 18,000 or 20,000. In alternators a much lower induction produced sensible heating, and it was for this reason that the maximum induction must be fixed at a very low figure. With a perfectly laminated core, the heating was attributed to an effect which Professor J. A. Ewing called "hysteresis," and which might be described as molecular friction. This scientist had experimentally determined the energy required to carry certain samples of iron through a complete cycle of magnetisation of varying degree, and the results had been published in the "Philosophical Transactions." They were given in ergs per cubic centimetre; but as these units were rather inconvenient for application in the workshop or drawing-office, the author had in the following table, which referred to annealed wrought-iron, translated them into watts per ton and H.P. per ton:

Induction.		Watts per ton $n = 100$.		H.P. wasted in Heat.
2,000	....	650	....	0·87
3,000	....	1,100	....	1·48
4,000	....	1,650	....	2·21
5,000	....	2,250	....	3·02
6,000	....	2,900	....	3·89
7,000	....	3,750	....	5·03
8,000	....	4,450	....	5·97
9,000	....	5,550	....	7·43
10,000	....	6,650	....	8·90

Modern transformers were provided with a core of laminated iron, which was symmetrically placed in respect to the two windings, so that the same induction passed through both the primary and the secondary coils. Under these conditions, the electromotive force induced in the two circuits was simply proportional to the number of convolutions they respectively contained, and the terminal electromotive forces were found by adding in the case of the primary, and subtracting in the case of the secondary, the loss of pressure due to the resistance of the coils. In a properly designed transformer, this loss of pressure should not exceed about 1 per cent. of the terminal pressure, so that the maximum difference in the pressure maintained in the secondary circuit between the lamps, when the apparatus was used for parallel distribution, did not exceed 2 per cent. between full load and no load, provided the pressure in the primary circuit was kept constant. Such a small variation in the pressure was well within the limits attainable in direct lightning, when a compound-wound dynamo was driven from an engine with a fairly good governor, and the corresponding variation in the illuminating power of the lamps was sufficiently small to be tolerated. A greater variation, especially if it occurred suddenly, would, however, not be permissible; and the question therefore arose as to what rules should be followed in designing transformers so that they might as nearly as possible be self-regulating. The obvious answer was, make the resistance of the circuits as small as possible, and this might be accomplished in three ways: 1. By using wire of large area. This expedient natually increased the weight, bulk, and cost of the transformer, and must, on account of commercial reasons, not be pushed too far. 2. By employing a core approximating to a circular or quadratic section, so as to decrease the perimeter of the coils. 3. By working with a high induction, or with a high frequency. The mean electromotive force in volts, induced in the coil of a transformer, could be expressed by the following formula:—

$$e = (q)\, 2 \pi n z \tau 10^{-8},$$

in which (q) was a coefficient denoting the ratio between the maximum and the mean electromotive force, n was the frequency, z the total induction in absolute units, and τ the number of turns contained in the coil. The larger z, and the smaller n, might be the length of wire, and therefore its resistance. On purely theoretical grounds it would thus seem that a small core strongly magnetised, and as high a frequency as the alternator could be constructed to give, would produce the best results. In practice, however, this conclusion was wrong, and the heating of the iron core in consequence of hysteresis must be taken into consideration. Since a transformer was an apparatus at rest, and was frequently placed in a position where the cooling effect of the air was small, the ratio between heat generated and availing cooling surface must be very different from that permissible in a dynamo, and it was this ratio which was the true limit to the output of a transformer. The armature of a dynamo was not subjected to excessive heating if a cooling surface of about 1sq.in. per watt was provided. In a transformer, the amount of cooling surface should be at least three times, and, if possible, four or five times as great, especially as it was somewhat difficult to determine, in a body of such complicated shape, what was and what was not effective cooling surface. From the above table, it was easy to calculate for any induction, frequency and weight of the active iron in a transformer, what the heat of the iron would be; and, adding to this the heat of copper, the total cooling surface required to keep the apparatus at a safe temperature could at least approximately be determined, or the limit of output for any given transformer could be approximately found. The question of frequency, alluded to in connection with alternators, was also of considerable practical importance with regard to the transformers, and it was much to be desired that electrical engineers should adopt a common standard. The following was a list giving the average frequencies adopted by several designers: Ferranti, 67; Lowrie-Parker, 88; Mordey, 100; Zipernowsky, 42; Kennedy, 60; Kapp, 80; Westinghouse, 133. Taking the average of European practice, the frequency was 73, or 8,750 reversals per minute; whilst the American practice was 16,000 reversals per minute. This large difference might, to a certain extent, be accounted for by the general preference of European engineers for machines running at moderate speeds; but even when making due allowance for this circumstance, it could hardly be assumed that, had actual practice shown the value of a very high frequency, electrical engineers would not have found means to obtain it. As a matter of fact, most makers of alternators had started with a much higher frequency than they had finally adopted. It should also be remembered that the higher the frequency, the greater was the loss of conductivity in the mains, owing to the unequal distribution of current throughout their cross-section. The author then discussed the questions of alternate-current motors on the Ferraris principle, and next passed on to a description of the different modern alternate-current machines most in use. Constructive data were given for the Ferranti, Mordey, Kennedy, Kapp, Lowrie-Hall, Westinghouse, and Zipernowsky machines; and in most cases the actual performance of the machine was compared with the calculated electromotive force, so as to show within what limits the author's formulas for alternators of different types were in accord with experimental results.

SCIENTIFIC NEWS.

IN a communication to the Memoirs of the Royal Bavarian Academy of Science, Prof. Seeliger, director of the Royal Observatory, Munich, confirms the results previously published by him in reference to the multiple star Zeta Cancri. He finds that the stars A, B, and C have respective magnitudes of 5, 5·7, and 5·3, and that the proper motion of the system amounts in a century to + 10·6" in R.A. and to − 11" in Dec. A and B, which were first separated by Herschel, have a motion round each other in about sixty years, while C has moved about 55° of P.A. round them since Herschel's observation in 1781. It is probable that C has a companion also.

Mr. Brashear, in a letter addressed to MM. Henry, of Paris, says that the Photographic Society of San Francisco obtained 167 negatives of the recent solar eclipse, and that he made some good observations at Winnemucca, in Nevada.

The Government Astronomer of New South Wales continues the publication of the observations on rains and rivers and the usual meteorological returns for that colony, results which will be found of increasing value as time goes on.

The committee appointed by the British Association last year in order to investigate the seasonal variations of temperature in rivers and estuaries in relation with air temperature and rainfall have now more than thirty observers at work. Ten of them are engaged on rivers in England, ten in Ireland, and ten in Scotland.

The death is announced of Herr von Decken, of Bonn, a well-known Prussian geologist, and a correspondent of the French Institute.

The Sanitary Institution has made arrangements for a series of lectures and demonstrations for sanitary officers, specially adapted for candidates preparing for the Institute's examination for inspectors of nuisances. The lectures will be delivered on Tuesdays and Fridays at 8 p.m., beginning with a lecture on the general history, principles, and methods of hygiene, to be given by Dr. B. W. Richardson, F.R.S., on Tuesday, March 5.

It is stated that the Lord Mayor, who is an expert pomologist, has granted the use of the Mansion House to the Fruiterers' Company, for the purpose of holding, some time in July, an exhibition of the "soft fruits." It is to be hoped that practical cultivators of fruit will lend their assistance, and that some useful information may be forthcoming.

An interesting work is about to be issued by Messrs. Longman under the title of "The Life of C. B. Vignoles, F.R.S., Soldier and Civil Engineer," compiled from original documents by his son, Mr. O. J. Vignoles. Mr. Vignoles was assistant-surveyor in South Carolina, 1817-20; surveyed and mapped Florida, with observations, &c., published in New York, 1822; served in Holland, and afterwards in the American war, in H.M.'s 1st Royals, in 1814. Engaged on the earliest English and Irish railways, he was afterwards employed on railways in Germany, Switzerland, Spain, and Russia, and constructed the famous suspension bridge at Kieff. Mr. Vignoles was, in fact, one of the pioneers of railways, and his experiences should be as valuable as they will no doubt prove to be interesting.

Prof. Benton, president of the South Staffordshire and East Worcestershire Institute of Mining Engineers, at the annual meeting in Birmingham, summarised the prospects of the local mineral industries. He believes that in future mining will be carried on in the great Staffordshire coalfield under such conditions as will demand from the engineers an advanced education in the many sciences allied to mining. It is improbable, he holds, that its ironstone mining will hold as high a relative importance in the ironstone mining of the country as it does at present.

At a recent meeting of the Royal Statistical Society, Mr. R. Price-Williams, M.Inst.C.E., read a paper on the "Coal Question," in which he pointed out that, although the Northumberland-Durham coalfield is still pre-eminent, there has been a considerable decrease in the output from the northern coalfields. Basing his calculations on the average rate of increase in consumption, he finds that the coal of the United Kingdom will be exhausted in 102 years, but dividing the districts, he estimates that the coal mines in the E. division of South Wales will be exhausted in 46 years, those of Warwickshire in 53 years, South Wales 79, Yorkshire 90, Scotland 92, Northumberland and Durham 94, while Denbighshire and Flintshire have enough at their present rate of output to last for 250 years. In concluding, Mr. Price-Williams observes that if the growth of the trade and prosperity of this country is to continue as it has done in the past, its coal production must necessarily keep pace with it; and he points out that unless large economies, which can and ought to be effected in its consumption, are realised, all the largest and best sources of our coal supply will be exhausted in the very short periods mentioned above. The hope is expressed that by drawing attention to this vital subject, further strenuous efforts may be made to husband our coal resources in every possible way, and to put a stop to the great waste in working the mines, and in the consumption of coal generally.

The new optical-glass of Schott and Co., Jena, is attracting much attention, and Paris and Birmingham must bestir themselves if they are to retain the monopoly which they have practically held. It is stated that the new preparation and the new methods adopted at Jena enable the glass-founders to make one "melting" exactly like any other. Voightlander and Steinheil, assisted by such theoretical experts as Drs. Lummer and Kaempfer, have been testing the new glass in a variety of ways, and have already produced some objectives which give remarkable results.

As we mentioned recently, a committee has been formed of members of the Royal Society, with Lord Rayleigh as its president, to co-operate with the local committee appointed in Munich to promote the erection of a statue to the celebrated physicist Georg Simon Ohm. An appeal has been issued by the Munich committee, which sets forth that: "In the year 1889 a century will have passed since the birth of the physicist Georg Simon Ohm (born at Erlangen, March 16, 1789; died professor at the University of Munich, July 6, 1854). His discovery of the laws of the electric current was not only a performance of the first rank from a scientific point of view, but it soon became of the highest practical importance. Ohm's laws, by shedding a brilliant light on a subject which had hitherto been enveloped in the deepest darkness, replaced by well-calculated methods unsafe and doubtful theories, and thereby rendered that powerful natural force, electricity, serviceable to the civilising aims of mankind." Profs. G. Carey Foster and John Perry have undertaken the duty of secretaries in this country, and will receive subscriptions. It may be of interest to some readers to mention that Ohm, like Faraday, was the son of a blacksmith.

Some remarkable experiments with the phonograph and telephones were shown recently by Mr. W. J. Hammer, in a lecture on "Edison and his Inventions," delivered before the Franklin Institute, the most striking being those in connection with the telephone and phonograph, consisting in the recording and transmitting of telephone conversation, music, &c. The first experiment undertaken was the recording on a phonograph in Philadelphia of music and talking transmitted over the long distance telephone line from New York, and reproducing the same to the audience. Another experiment consisted in recording music and talking by the Philadelphia phonograph, which had been talked into the long distance telephone by a phonograph in New York. The most important test consisted in reproducing to the audience, by means of the Edison motograph receiver or loud-speaking telephone and the Edison carbon transmitter, the music and talking registered on the Philadelphia phonograph which had been sent over the long distance telephone line from New York (a distance of 103 miles) by the New York phonograph talking into a carbon transmitter. This remarkable experiment employed two phonographs, two carbon transmitters, and two motograph receivers acting in juxtaposition with 103 miles of telephone wire, six miles of which was underground.

An Electrical and Industrial Exhibition is to be held in Bingley Hall, Birmingham, during August, September, and October, the profits being handed over to some of the hospitals of the city. Mr. T. C. Sharp, County-chambers, Corporation-street, Birmingham, is the secretary and manager.

An Antarctic Expedition is being again talked of. A resident of New Zealand (of Norwegian origin) has come to Europe for the purpose of taking out a contingent of his countrymen accustomed to fishing. His object is to endeavour to organise an Antarctic whale fishery. He hopes to equip two steamers with which to explore the region generally, and, if possible, he will leave a contingent of men on Victoria Land, or some other suitable spot, for a whole year. One or more scientific men will be taken, so that important results may follow.

Prof. O. Torell and Dr. Trybom have petitioned the Swedish Government for funds sufficient to enable them to continue their researches on the sea fisheries of Sweden, and to establish a biological station on the west coast.

It is stated from Marseilles that yellow fever has been imported there by a consignment of birds caught in the swamps and lagoons of Venezuela and other S. American countries.

Mr. Ouspensky, a Russian engineer sent to Central Asia on a special scientific mission, reports that the oil wells at Penjakend, near Samarcand, in the Zerafshan Valley, contain at least 9,000,000,000lb. of perfectly pure oil.

The American educational institutions endeavour to train the body as well as the mind, for, according to a paper read before the Anthropological Society of New York, the following institutions have expended the sums stated in enabling students to acquire a sound and healthy body:—Harvard University, 110,000dols.; Amherst, 65,000dols.; Cornell, 40,000dols.; Princeton, 38,000dols.; Johns Hopkins, 10,000dols.; and Yale (since 1860), 13,000; while Vassar proposes to spend 20,000dols. The minor seats of learning are also imitating the Universities. The Adelphi School in Brooklyn has accommodation for the healthful exercise of 700 pupils, and the Berkeley School in New York proposes to spend 75,000dols. in furnishing an athletic training department for women. Taken altogether, the colleges have expended in the provision of facilities for instruction in gymnastics 750,000dols., the preparatory schools 250,000dols., the athletic associations in New York and vicinity 750,000dols., the German Turn-Vereins2, 500,000dols., and the Young Men's Christian Associations throughout the country nearly as much. To this total of 6,750,000dols. is to be added 125,000dols. which Yale is anxious to invest for the same object, and 135,000dols. with which Columbia is prepared to follow suit.

USEFUL AND SCIENTIFIC NOTES.

The Population of the United States..—According to the lastest official report from America the population of the United States numbers no fewer than 61,702,000 souls. The first noteworthy increase in the number of the population of the States took place between the years 1860 and 1870, when there was an influx of seven millions of persons added to the normal population; again, between the years 1870 and 1880 the addition to the indwellers of the States was quite 12 millions. The decade from 1880 to 1890 bids fair, according to present statistics, to surpass all previous estimates, as the population is expected to reach no fewer than 15 millions; thus more than doubling the numbers of 20 years ago. Up to the year 1888 the number of persons of different nationalities who, from many causes, had ceased to find a foothold upon their native soil was given as follows:—Of Englishmen in the United States there are 114,000; Germans, 110,000; Italians, 46,000; of Norwegians there are 18,000; Swedes, 51,000; of Austrians, 20,000; and of Bohemians, 14,000 souls. The number of Frenchmen who have emigrated to the States is comparatively small, and the major part of those went on to La Plata.

The Climate of South Africa.—An important treatise on this subject has recently appeared from the pen of Dr. Karl Dove, of Göttingen, grandson of the late Prof. H. Dove, of Berlin, whose name is known to all meteorologists. Dr. Dove treats especially of the climate of extra-tropical South Africa, taking as the northern limit of his area the southern boundary of the date palm, and of the occurrence of the tsetse fly. As to this region, he has collected and discussed materials from all available sources, and has produced a record which is likely to remain for a long time the best store of information as to the climatic conditions of the whole of South Africa. The book extends to 160 pages, 8vo., with maps, and is published by Vandenhoeck and Ruprecht, of Göttingen.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE DISC OF NEPTUNE.

[29667.]—In your "Astronomical Notes for February, 1889," we read as follows:—"We need scarcely add here that it requires considerable telescopic power to differentiate him (i.e., Neptune) from a fixed star." Now, can any of your correspondents kindly inform me what was the aperture of the objective with which Dr. Galle discovered Neptune on September 23, 1846? I have looked in vain for the aperture in Sir G. Airy's "Historical Account," in the *Monthly Notices*, Vol. VII. p. 121 *et seq.*, also in Prof. Grant's detailed account, "History of Physical Astronomy," p. 192. The diameter was measured by Galle and Encke, *Monthly Notices*, Vol. VII. p. 153, showing that to those observers the planet presented a palpable disc with a power of 320.

At the request of my lamented friend, the late Mr. Lettsom, I had frequently observed Neptune with my equatorial of 8in. aperture, but never could satisfy myself that I saw a disc, though the planet shone with a steady light, different from the constant flicker of a star. Some years ago I had the privilege of seeing Neptune with Mr. Common's grand reflector of 36in. aperture, and it then presented a disc apparently larger than Uranus as seen in my instrument.

Alleyn Park, West Dulwich. **George Hunt.**

SATELLITES OF SATURN, &c.

[29668.]—I thank "F.R.A.S." for his comment ("E. M.," Feb. 22, p. 520)—a perfectly legitimate one—on my letter (29637, p. 498). I had, of course, no 6in. glass at hand to corroborate the observations of Enceladus. As to the visibility of five satellites in the 3in., I think I can satisfy anyone who is sceptical, with the 3¾in. in reserve, to show more plainly what has been seen in the 3in. I have always discarded any observations of the satellites, such as glimpses, and only referred to objects seen definitely and held. Ward's observation of Enceladus, referred to by "F.R.A.S.," is not one of recent date. I was surprised to read that no one except Ward had ever seen Enceladus with so small an aperture as a 4·3in. My observations of the satellites were made on more than 50 nights in 1882, and in subsequent years I might say, roughly, on from 20 to 25 nights in the year.

With regard to ε Lyræ, the incorrectness of the positions in the diagram in the "Celestial Cycle" (p. 540) is noticeable when attention is once called to it; but the alignment, or configuration, of the two 13 magnitude stars and the 9th magnitude star is sufficiently accurate for a student's purpose. The student will find from Webb that the debilissima lie one "on each side of the line joining ε^1 and ε^2," but he must find the direction of the imaginary line joining the two 13 magnitude stars by his own observation, and can then compare his own note with the diagram. In other words, a person might identify Ursa Major even though Alpha Ursæ Majoris, and other prominent stars were strictly out of position in the map he consulted—say, nearer Polaris than they ought to be. As I make it out, the three faint stars in the diagram are too near the upper pair, and the 9th magnitude star, in addition, too near the line joining ε^1 and ε^2.

I feel as if I ought almost to apologise for saying that Enceladus and Tethys were well seen here, near each other, on the night of Feb. 15, between 11h. 45m. and 12h., with the 3¾ aperture. On the night of the 23rd Dione was seen about 10h. 15m. (past east elongation), and Enceladus at 13h. 15m., then also past east elongation. I will try and get independent and reliable testimony of the visibility of Enceladus in my 3¾ telescope in the coming month, though, when clear nights occur and time is available, I prefer to employ the time on other objects than planets and satellites.

Hendon, Feb. 25. **P. F. Duke.**

AUTOMATIC STEAM PILE-DRIVER.

[29669.]—I have lately been watching the working of a steam pile-driver, and I have endeavoured to devise a plan whereby it could be worked automatically. I inclose a sketch of my suggestion. The steam pile-driver to which I refer is that in which the upper part of the weight is a hollow cylinder. In this works a piston which is jointed to a rod passing through the bottom of the pile-driver, its end resting on the top of the pile. The steam is admitted above the piston, by means of a tap placed on the top of the pile-driver, until it is raised to a sufficient height, when, the steam being shut off and allowed to escape, the machine falls on the top of the pile. The tap is turned by a cross-bar having a rope attached at each end, which ropes are pulled alternately by a man standing in front of the machine. What I propose is to do away with this stop-cock on the top of the machine, and to place a slide-valve V (see sketch) at the side. This slide-valve is connected with a small piston, P, working in a cylinder, from the lower part of which runs a tube, T, which opens into the interior of the pile-driver at a little distance from its lower end. The little bar connecting the slide-valve and the piston P passes through the bottom of the cylinder, and is enlarged so as to limit the movement of the valve, and to this part of it is attached a weight, W, of sufficient size to cause the valve to return to its position after it has been raised. The action of this arrangement is as follows:—Steam is admitted from the boiler through the tube A, and passing into the upper part of the pile-driver, the latter is raised by its action. When the large piston R passes below the orifice of the tube T the steam will ascend this tube and raise the small piston P, and the slide-valve connected with it. The slide-valve thus raised will shut off the steam from the port H and connect it with the exit tube O, allowing the steam to escape from the pile-driver, which will then fall. The slide-valve will be kept up until the large piston R has repassed the orifice of the tube T, when it will begin to descend by reason of the weight W; but since the whole machine is now falling, the slide-valve will not move in respect to the pile-driver until this latter is checked in its descent by striking the pile, when the valve will be carried to its original position by the momentum of the weight W. Then, of course, the pile-driver will be again raised by the action of the steam, with the same result as before. I thought it would be advisable for the slide-valve to be made rather long (see Fig. 2), so that it would pass some distance above the port H; then if the weight W should overtake the pile-driver in its descent a little, it would not have any effect.

Fig. 1.

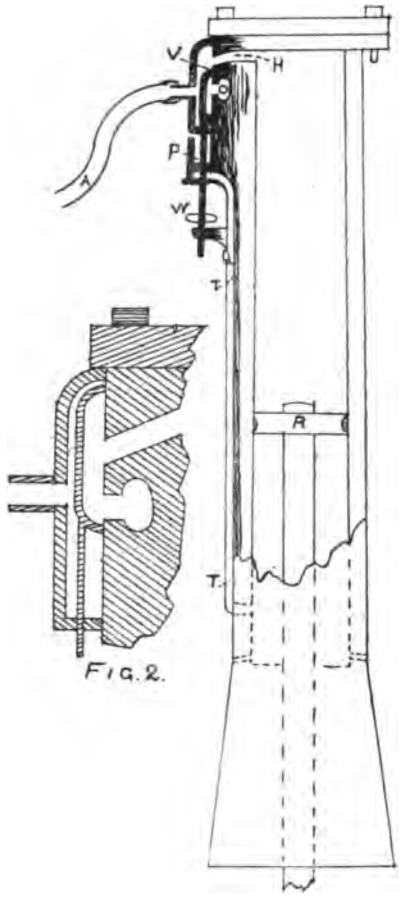


Fig. 2.

By the arrangement at present in use the steam is apparently allowed to escape free from the boiler during the descent of the pile-driver—goodness knows why. I should think this must be a great waste.

Egerius.

THE "SACRED ORIFICE"—ROSE ENGINES.

[29670.]—I was very glad to see Mr. Birch's letter, and to find he thinks it "an appalling conclusion" that the hole for the running centre cannot be got true. We discussed the question some time back, and no one disputed the conclusion then. If the hole can be got true, then there should be no need to use a dead-centre for the best work. I found my own far from true, and spent a week in trying to get it right without perfect success.

It may be well to state the method employed. Let an iron or brass rod be turned up to fit the hole as the centre does, and project about as much. Bore a hole in piece of boxwood 6in. long, and let the hole be 2in. deep, and of a size to fit the projecting end of the brass centre; then drive it firmly on and turn up the wood. Now, the wood and brass being as one, turn them half-round in the conical hole, and bring up your tool to touch the end of the wood furthest out, and if it's true—well, "I'll eat my head!" After turning out the hole with the slide-rest and a very sharp tool, it was considerably out, and I could get in a card or two between the tool and the wood at one part of the revolution, whilst it touched at another. Perhaps "Dynamite" will try this test, or some others, and let us know the result. I got my centre hole much nearer afterwards by carefully scraping inside the hole; but even now I cannot call it true. The end of the wood should project at least 6in. from the mandrel nose to make a good test, and be turned without the support of the poppet.

As to the double-driver chuck, that is no doubt a good thing, and could, I think, be used quite as well with a centre screwed into the chuck as when it fits into the mandrel.

Mr. Birch shows a very convenient kind of holder for a split wire-chuck; the rod for drawing it in would probably be bored, though it is shown solid.

As to Rose engines, I have been up to Clerkenwell to see one. Mr. Gunton, I found, has his business there, and most kindly showed me the one he advertised three weeks ago. I found it in many ways different to what I expected; it is not a lathe having no treadle or axle and no bed or poppet, but only a rocking headstock of about 7¾in. centre, mounted on a very strong table, with a slide-rest in front of it, and a little windlass or winch-handle for driving it by the left hand; the rosettes are all very fine, suited to very small work in metal, such as watch-cases and dials. There are two chucks, a "straight line" with a chain, and a composite one, double-eccentric and oval combined, which has three sides and a click wheel. The slide-rest is quite peculiar, having a quadrant under the tool-slide to bring the tool round to act upon the edge of the watch "bottom," and the centre round which it turns comes to the point of the tool, so that the point is not displaced by moving round the quadrant. When working round the edge the tool presents properly, but the rocking is still in the same direction, and is therefore not correct, but the effect is not noticeable. The depth of cut is regulated by a little steel "touch," which rubs round the plain part in front of the work; the tool-slide is pressed forward by the thumb, without a lever, till the "touch" reaches the work; it is carefully polished so as not to scratch. I will say no more now, as I do not know whether the subject is of general interest.

I saw also a straight-line engine, which was quite new to me, and was beautifully made; it was something like a straight-line chuck, bolted on to a table, with a slide-rest in front of it; the rosettes were straight, and about 4in. long.

F. A. M.

THE "SACRED ORIFICE."

[29671.]—It is the practice in workshops to mark the centre and mandrel to make sure of it running true after being tempered. Many lathe-makers are not particular enough in boring the tapered hole.

I was sorry to see that "Dynamite" was so severe on "F. A. M." in respect to the above question—it is better to be more lenient with each other; however, "F. A. M." shows his manhood in taking the blowing up so gentlemanly. I am watching his question, as it is a useful point to have a chuck for holding drills from a needle to ¼in. diameter that a mechanic can easily make himself. In the sketch illustrated this week (Feb. 22, No. 29657) I think there is a mistake. The split chuck screws into the sacred orifice, and a set screw in the detachable chuck screws on to the chuck to pinch it together to hold the wire or drill. The sketch shows a flat filed on for the set screw to pinch on to hold the chuck securely in its place. This would not do, as the chuck would be in different positions according to the thickness of the wire held in the chuck. If this flat was turned down below the surface it would be better, but should the set screw happen to pinch exactly on the slot it would damage the slot and prevent it working properly. Likewise, there ought to be two flats filed on the head behind the cone to screw it in and out with the spanner. If I am in error, perhaps Mr. Birch will explain. **E. X.**

COMPOUND LOCOMOTIVES.

[29672.]—The following trials of compound and ordinary locomotives which are about to start upon the Pennsylvania Railway of America are now engaging considerable attention, and it is probable that they will furnish much practical information which has not yet been obtained in this country. The English compound engine has been constructed from the designs of Mr. Webb, by Messrs. Beyer, Peacock, and Co., and it was landed in Philadelphia on the 28th January.

It is an important fact that in this country the working of compound engines has never been fairly compared with the working of other engines—the compound has always had an unfair advantage. Compounds have high pressure of 175lb., and their working is compared with engines having only 140lb. It is a well-known fact that high steam pressure always leads to economy in consumption of coal, and there is every reason to believe that the economy of compound engines is entirely due to the higher pressure. American engineers appear to be perfectly aware of this, as it is reported that they, finding that the English engine has 175lb., are about to construct one of their own standard locomotives with a similar pressure in order to make the comparison perfectly fair. This is satisfactory, as in this country the advocates of compound engines have carefully avoided comparison with equal pressures.

An interesting and important letter was recently read at the meeting of the Institution of Mechanical Engineers from Mr. Johnson, of the Midland Railway, in which he pointed out that "he found the results such as he would expect to be obtained by higher pressures and greater expansion, even if not accompanied by compounding."

It will certainly be very interesting to watch the results obtained in America by the Webb engine; but it is to be regretted that if the Pennsylvania Company desired to test an English engine it did not purchase one of the best standard patterns.

Clement E. Stretton, C.E.,
Consulting Engineer, Society of Engine Drivers and Firemen,
Leicester, Feb. 25.

CAT'S DISEASE—STAR FISH A POISON.

[29673.]—Having had some little experience in this I will give you my experience; and being a resident close to some oyster grounds, where there are plenty to be got in the season—they scour the oyster grounds, as they are very poisonous and destructive to oysters—the fishermen used to bring them to me for manure; and very good manure they are. Upon spreading them over the ground and neglecting to dig them in at the time, my cat, a favourite, ate some of them. In about six hours after I heard a most dismal wail, and I hunted her up. Her head was swollen, her eyes protruded as if from strangulation, but no signs of it other ways. Very restless, slowly wandering about, seeming not knowing where to go, tough, ropy saliva at the mouth. This continued all night. In the morning I saw her the same, only moving more slowly, and her hind-quarters fell first one side, then the other, as I have seen animals do who have been struck on the bottom of spine. She came to me, and as plainly as cat could do, asked me to assist her; but not knowing the cause then, I thought that someone had been brutally illtreating her. I examined her to no purpose. I was away all day, at night I found her walking about upon her front legs, dragging her hind-quarters after her. She lived until the next evening, when she died with a most piteous wail. As near as I can calculate, the course of the poison seems to have a run of about 60 hours. I have lost several, and they run about the same time; the brain and spinal cord seem to be affected, and paralysis sets in, and they die gradually from the extremity upwards. I lost a favourite cat who was troubled somewhat similar and, it was proved, had eaten a quantity of phosphor paste that was laid for cockroaches; but she was about a fortnight before she died—only difference in her case was her eyes sank into her head, and the eye holes or lids were glued up. **Jack of All Trades.**

DARWIN v. LAMARCK.

[29674.]—Some twenty to thirty years ago a melancholy instance in a Welsh seaport was to be observed of a fine young man wandering about, whose sole topic in conversation, and whose sole object of interest in and throughout his life, was iron steamships; he had, in fact, iron steamships on the brain, for he could tell you off-hand the name of, and full details concerning, every British iron steamship that had up to that date ever been launched. Bristol was, I believe, the scene of the first commercial venture in ocean-going steamships—that of the *Great Western* steamship having, I remember, created much sensation about 1845; while the loss of the *Demerara* during her passage down the five-mile length of tidal river may be said to have put the stopper on Bristol becoming a ship-building centre.

Now it so happened that the father of the said young man had become infected with the *soi-disant* mania of iron steamship building, and although possessed of capital and financial influence, yet he soon found himself in difficulties. At this very time his wife conceived, and during her gestation these troubles arrived at the crises of a financial smash—hence the above *penchant* of her progeny.

That the mental condition of the parents at the time of the mother's conception influences the issue, is clearly indicated by the above to

The Lydney Dispenser.

VASELINE: PATHOGENETIC EFFECTS OF: TO "GAMMA SIGMA."

[29675.]—Although Mr. Sohn's item (29616) has settled the most important remarks in the replies of "Gamma Sigma" and "Sm."—i.e., as to vaseline containing any paraffin at all—it still remains for me to reply to the inquiry of "G. S." as to "any publication giving the pathogenetic (disease-producing, discoverable by its symptom-producing power only) effect of vaseline, of paraffin oil, and of sulphur." Well, the library of the Homœopathic Hospital, Great Ormond-street, W.C., no doubt abounds with such data; while an American Materia Medica of recent issue, the work of a most talented M.D., the late E. A. Farrington, snatched away from his most useful sphere as teacher of medicine in the Philadelphian Medical College by death at the early age of 40, gives information fully bearing out my said statements. But observation of the effects of vaseline, of paraffin oil, and of sulphur, one and all, both in their pathogenetic and in their curative actions and results, warranted those statements of mine now in question.

The human race generally seem rather in advance therapeutically of "Gamma Sigma," judging from the popular use of vaseline, and from the anxiety of English manufacturing chemists to persuade the public that their substitutes made of paraffin oil are equal to vaseline, a trade mark term, I conclude, of American adoption.

The Lydney Dispenser.

ANIMALITY OF CERTAIN DIATOMS.

[29676.]—It has already been observed, and more than once recorded, that the diatom Rhizosolenia Shrubsolii emits a strong fishy odour. I wish now to call attention to the fact that this peculiarity also exists in the case of another marine diatom—viz., Navicula scopularum, which is figured and described in Smith's "Synopsis" as Pinnularia Johnsonii. I found this diatom on Jan. 29, in a sandy bay near the western end of the Swale, lying in patches of a rich, dark-brown colour.

It was so abundant that I could easily have collected a pailful, and in places it was difficult to avoid treading on them. As it was, I brought home as many as I had room to stow, and transferred them to a large wide earthen vessel, which was filled up with sea-water. My usual experience with diatoms treated in this way is, that within 24 hours the water becomes quite clear, and oxygen is freely given off under the stimulus of light. In this case I was surprised to find that turbidity remained, no oxygen was exhaled, no tendency to seek the light, nor of separation from the sand was evinced, and in the course of a few days a putrid film formed on the surface of the water, whilst the odour, as of stale fish such as one often meets with in the hold of a fishing smack, was still very noticeable. I also put some in bottles and jars, which had the fullest exposure to the light possible, without any alteration in the result being perceptible. Close beside these jars were others containing various Pleurosigmæ and Surirella gemma.

Here, in striking contrast, the water was perfectly bright, the diatoms had formed a layer on the surface of the sediment, and were giving off oxygen freely, as indeed they are still doing.

These last mentioned I collected the same day from the surface of mud in the rills of the saltings, close by where N. scopularum was found on sand, in which places I have found them constant for years.

I have been using the tow-net at short intervals all the winter, and whilst such forms as Coscinodiscus, Rhizosolenia setigera, Biddulphia Baileyii, B. aurita, Landeria, Mosleyana, Chætoceras Wighami, Bacillaria paradoxa, and the new genus, which, on the suggestion of Prof. P. T. Cleve, I propose to name Streptothega (a twisted box) have been constant in the open water of the Thames estuary since last November. I have never found N. scop. at the surface. Here, then, we have evidence of a diatom behaving differently from most other diatoms, and exhibiting characteristics of animality other than mobility.

From the similarity of odour, I assume that R. Shrubsolii has like peculiarities.

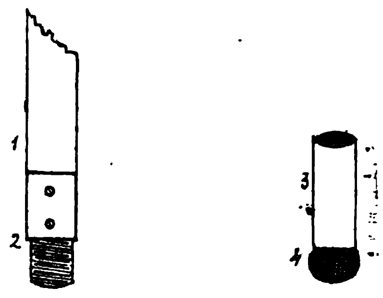
As I have but little knowledge of chemistry, and cannot readily get at books bearing on the subject of this letter, such as I suppose are to be found in the library of the Linnean Society, I venture to ask others in more favourable circumstances to indicate what other tests should be applied to determine accurately the nature of N. scop., and whether what I have stated corresponds with the experience of other observers with respect to this or any other diatom.

Sheerness-on-Sea. **W. H. Shrubsole.**

PREVENTING CRUTCHES SLIPPING.

[29677.]—In No. 1244, p. 440, a correspondent from U.S.A. gives a description, with a diagram, of a contrivance for preventing crutches slipping, and for which a patent has been recently obtained in the United States.

In leaving the merits and demerits of this elaborate invention to those who unfortunately are unable to move about without the help of crutches, I beg to be allowed also a space in the columns of our "E. M." to describe briefly, and with the aid of a diagram, a fitting in brass-work, with a plug in indiarubber which I ordered to be made and fitted two years ago on the end of crutches used by a lady quite lame, which fitting has proved most effective and satisfactory in preventing the crutches from slipping in wet or greasy weather or on slippery streets, with the advantage of being as noiseless as a person walking with list shoes on the feet.



1, Lower end of crutch; 2, brass cap or ferrule, fitted with four screws on end of crutch—a fixture; 3, brass socket to screw on cap (2); 4, hard indiarubber plug about 2in. long inserted in socket (3), one half-inch of plug is left out, and when nearly worn off the socket is unscrewed and another ½in. or so of the plug is pushed out. A good plug will last from six to twelve months, cost about sixpence. One dozen specially made for the purpose came to six shillings.

The cost of this arrangement did not exceed six shillings for the two crutches.

5, Sand-street, Jersey. **J. Binet.**

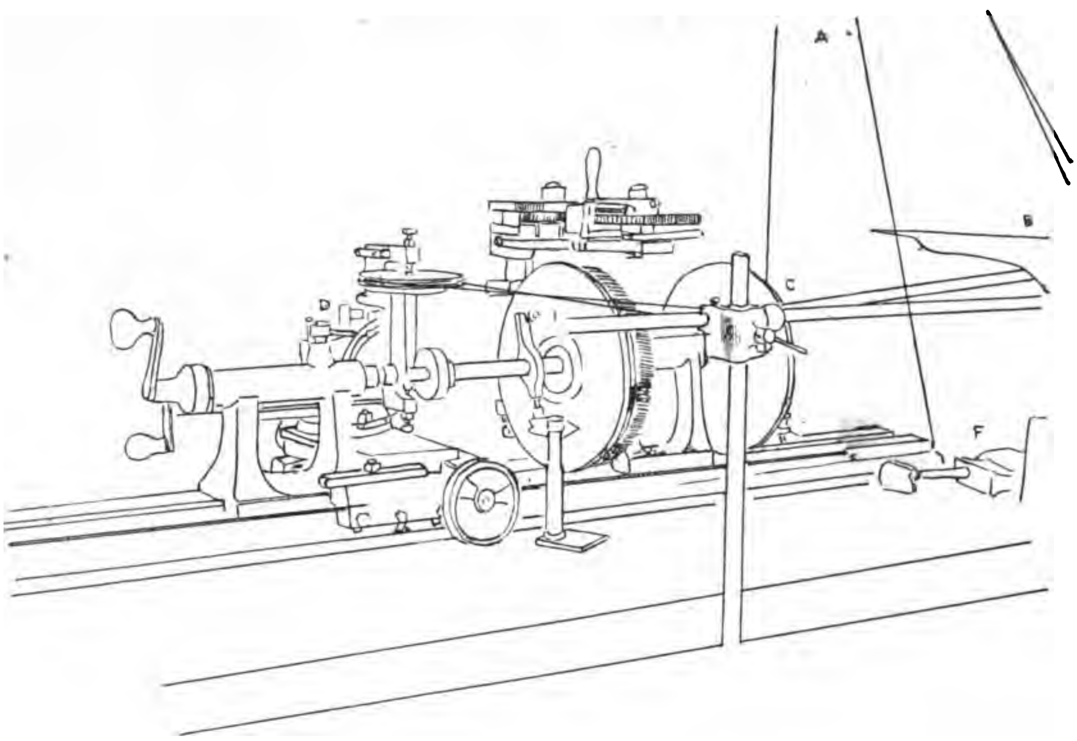
PROPULSION OF SHIPS, &c.

[29278.]—"E. C.'s" example, comparing the pipe and rod to a locomotive piston and cylinder, does not agree with his illustration. One is a continuous thrust, and the other an intermittent one. Once he draws the rod back, as in the locomotive, the air or steam used must be allowed to escape, and this is where he must look for the comparative slip, which, in this case, will be in the blast pipe, not on the rails. The slip on the rails is of quite another kind; it is, I have very little doubt, all loss, and is due to overloading, or, in the case mentioned, to the power of the engine being unable to overcome at once the inertia of the load. The same cause will have the same effect on a jet propeller.

My argument is not about propulsion on rails, but in a fluid. "E. C.'s" argument shows all slip to be loss. Mr. Moy follows in the same line. He says: "It means coals absolutely wasted," and I think I could reduce slip in water. Again, he quotes the action of a sparrow. He "abolishes slip by speed of stroke." The inference is that we can do the same. What I maintain is, that a certain amount of slip is what I may call legitimate slip. Any attempt to abolish this is, in my opinion, work in a wrong direction.

I have never stated that the maximum efficiency is 100 per cent. slip only under certain conditions. In practice, slip will vary and be reduced under the following circumstances: 1. With the density of the medium. 2. With the resistance of the medium to the projection of the matter (steam, air, or water) used in propelling, and with the form of the propeller. 3. Friction of the model creating eddies and return currents. 4. Faulty model. 5. Faulty propeller. 6. Faulty model and propeller.

My assumption was, that with [illegible] reduced to their smallest [illegible] I believed from 40 to 50 per [illegible] too much slip. This [illegible] too little for a [illegible] The follo[illegible] of



H.M. ships; the *Arrogant* is the old auxiliary style:—

	Speed (knots).	Slip.
H.M.S. *Arrogant* ..	8·29 ..	1·02 per cent. Negative.
H.M.S. *Fairy*	13·32 ..	34·55 ,, ,, ,,

The difference in slip between these two is 35·57. Can "W. T." say the one with the greatest slip is the slowest ship?

Griffiths.

CLOCK TRAINS.

[29679.]—Again answering "G. W.," who says distinctly on p. 462, "My suggestion was to increase the size of the main wheel, not *size* of pinion also." Then I say, as I said before, you must put more weight on. If you are bound to make the 'scape wheel turn any particular number of times to one turn of the great wheel (which is a mere matter of convenience), then, if you double the size of the latter you must halve that of some other wheel in the clock, in which case little or no alteration of weight would be required. It is a mere matter of leverage, and if "G. W." cannot perceive that, I can only say that his eyes are not to him as my eyes are to me.

I am very glad to know that Fred. Carre is up and about again. As he would like to have an idea of what is wanted for wheel-cutting without the possession of a self-contained special machine, I forward a photograph of my own lathe attachment. This was taken from the rear—viz., the camera put outside in the garden and directed through the opened window with a sheet hung behind the object. The driving band will be seen to go up from the flywheel to a pair of pulleys above A, then to slope downwards and backwards to another pair to the right of B, then nearly horizontally to a third pair at C, and then again forward to the pulley of the cutting-frame at D. The ordinary headstock used for turning is, in this view, removed, not that I actually do remove it when cutting wheels, as it is then not in the way, as it would appear to be in the picture. E is the counting apparatus, of which the large wheel on the right has the same number of teeth as the worm-wheel—viz., 120. Those of the worm-wheel are of ¼in. pitch, making it 30in. in circumference at the pitch line, or very nearly 10in. diameter over all, which just nicely clears the bed of 5in. lathe. The wheel at E has the same number of teeth as the wheel to be cut, or contains the same factors, intermediate wheels being used to produce other multiples of the same factors—as, for example, with a wheel of 52 teeth I get 13, 26, 39, 52, or any other number containing 13 any desired number of times, and in the same way with any other number whatever up to 150, or any multiple thereof even, were it necessary, up to 149 times 150. When desiring to obtain a prime number not already on the list, a plain disc divided into 180 parts, each part being equal to one minute of arc of the worm-wheel, goes on at [illegible] simple index or counter. Mine, in fact, [illegible] on, and the index is merely a [illegible] file in the casting on which [illegible] seen at F is only the bolt and [illegible] rest. [illegible] weather-vane is the [illegible] height of cutter to centres of lathe, and has a notch at one end and a sharp angular point at the other, for use as the shape of the cutter itself may require. Close to this gauge appears a sort of one-sided eccentric affair. This is simply a counterbalance to the weight of the winch-handle of the lower slide, but itself forms a capital thing to put the fingers through as a purchase for dragging the slide-rest from one part of the lathe to another. The projection below B is a light cast-iron bracket which, with its unseen fellow, carries a shelf, now removed for purposes of the picture. The vertical rod from C downwards is one of two, which support the horizontal one that carries the pulleys near B and C respectively.

These rods are connected by a sort of universal joint formed of two small castings riveted together, not so hard, however, as to prevent play in a vertical plane, one of them having a vertical hole, and the other a horizontal one, each provided with a set-screw and a short lever handle, admitting of all choice of deviation from the horizontal position.

A good division-plate, or "head"—as I believe the wheel-cutters call it—usually takes the place of a worm-wheel, and the larger it is the better. One owned by a friend in Clerkenwell has 38 rows of holes, from 178 to 365, giving every number up to 100 teeth, and about 80 others from 100 to 365. I have seen many very defective plates on lathe mandrels, some obviously so, without going to the trouble of gauging, which can be done by anyone for himself, by stepping round the circles with a pair of dividers set to any convenient number of holes in the circle under trial. A worm-wheel is greatly to be preferred to a drilled plate; but it must be a good one and accurately centred—points which, I am sorry to say, are not unfrequently lost sight of. I have had several in my "hospital for diseased lathes" requiring correction for one or both of these faults, and expect another patient this week. In letter 29663, last line but three, for "time" read tune.

J. K. P.

JINMAN'S LAW OF STORMS.

[29680.]—In your issue of Feb. 8, letter 29623, Mr. Herbert Sadler deplores the circumstance that in reading through Mr. Jinman's book, "Winds and their Courses," he is unable to find the "law of storms" which Mr. Jinman claimed to have discovered. Mr. Sadler is deserving of much sympathy that he should have taken so much pains with so little satisfaction; but I would console him by assuring him that the book does not, and never pretended to, give the "law."

The third and last edition was published in 1860, and, as the preface explains, was written solely to *prove the fallacy of the Circular theory of Storms*, as then adopted by the Meteorological Department, and which the officials of that department, after about 24 years' consideration, admitted by abandoning, and adopting the "spiral" theory, which Mr. Jinman contended was equally fallacious.

Mr. Jinman developed the "law" many years subsequent to the publication of that book, and proved to demonstration scores of times in the public press that our storms could be predicted by the application of his law, *weeks, months, and years* in advance. The law has never been published, but is in my possession, and with the necessary facilities, which are not at present at my command, I would engage to supply for the benefit of this maritime nation forecasts of storms for *every district weeks in advance.*

In his disappointment at not finding the "law," Mr. Sadler asks where the twelve forecasts are to be found which you were good enough to publish along with my letter in your issue of Jan. 11, and I have much pleasure in supplying him with this information. Taking the forecasts in the order in which they stand, they are to be traced through the following, among other sources:—

1	Central News Agency	Oct. 10, 1881.
2, 3	Hull Express	Nov. 1, 1881.
4, 5	Morning Advertiser.	Nov. 30, 1881.
6, 7, 8	Daily Chronicle	Dec. 29, 1881.
9	Central News Agency	Jan. 10, 1882.
10, 11	Guernsey Observer..	Feb. 7, 1882.
12	Farmers' Alliance ..	Feb. 20, 1882.
Special, Mar. 4	Daily Chronicle	Feb. 14, 1882.

Having taken the pains to supply the information, I have confidence that Mr. Sadler, when he has proved the authenticity and accuracy of them, will have the courtesy to frankly acknowledge as much for the benefit of your readers, and be able to convince them of the absurdity of Mr. Scott's statement that "no living man can forecast weather two days in advance, much less six weeks."

Permit me to give just one instance further to show that where a "law" exists *time* is no barrier to accurate forecasting. On June 16, 1881, Mr. Jinnan addressed a letter to the London *Globe* newspaper (a press copy of which is in my possession) to the effect that the Tay bridge storm was again due on Dec. 20, 1886 (viz., *five and a half years in advance*), and the storm came true to its date.

A. Wilson.

East Bank, Stamford Hill, London.

GAS BATTERIES.

[29681.]—Gilbert B. Luckhoff seems to have missed a point in my letter 29631, on which I laid particular stress—viz., the porosity of the platinised carbon plate. I contend that though the power of surface occultation is necessary in the plate of a gas battery, yet the power of so-called capillary transpiration ought to be greater in order that the gas which is given up in the plate should be quickly replaced by fresh gas from the inner side of the plate; this, then, resolves itself into a question of intermolecular porosity (*vide* Miller, p. 124, vol. I.), and not on the power of occultation throughout the mass, and therefore I believe that palladium would give no better results than platinum, since the gas is supplied to the plate, not occultated in it, and that the time taken in giving off the gas would be the same for both metals, providing both plates presented the same surface area. Anyhow, to prove this, I took copper-wire cloth with a very fine mesh, and deposited copper upon it until the capillary attraction of water between the meshes was great enough to withstand a pressure of 6in. of gas; in this condition I can just see through it, and the interstices in the mesh have the appearance of minute holes. I have transferred it to an acid bath, and pouring in a few drops of platinic bichloride proceeded in the way advised by J. T. Sprague for coating silver in Smee's batteries (*vide* his book, p. 133), until I obtained a black sooty deposit filling up the interstices. I then proceeded to do the same with a similar piece of wire mesh, and burnished it with gold leaf twice over, as the first coating was too thin. Now the rate of consumption of hydrogen gas in a given time was the same with both wire-mesh plates, used as the negative plate of the battery. This proves, I think, that though the power of occultation is different for both the metals, yet it does not affect the consumption of gas in the battery.

I use the above term "negative" advisedly as referring to the direction of current in connection wire outside the battery; for the action of a gas battery, I take it, is somewhat different to that which takes place between a zinc and carbon couple in dilute sulphuric acid, where the electricity is generated by the formation of zinc sulphate, and where the hydrogen liberated produces an opposing electro-motive force.

This platinised copper-wire plate is by way of being an improvement on the porous carbons, since it weighs one-fifth and occupies one-fourth the space, though no doubt platinum wire gauze 140in. to the oz., covered with platinum black, would, but for the expense, be more suitable.

I notice Gilbert B. Luckhoff advises me on no account to procure hydrogen by passing steam over red-hot metal, and states it is cheaper to use the metal in the battery itself. Quite so; unless the oxide of that metal is available in the battery, or has a commercial value. But still, I must say I consider, even if this is not so, the economy is very doubtful, since, in the first case, scrap metal can be used, costing an eighth of the price of plates required in a battery; secondly, there is no change of solution in the battery itself, which can be kept in a warm place, and so evaporate the water made, the gas apparatuses being placed at a distance; thirdly, there is no waste by local action when the circuit is closed, and no metal is consumed when open, and this would not be the case if the metal were consumed in a battery. G. Luckhoff advises me also to read my textbooks, for which I am much obliged. If he will refer to p. 781, Ganot, he will find there quoted: "On connecting the electrodes, the existence of a current is indicated, whose direction in the connecting wire is from the platinum in oxygen to that in hydrogen, so that the latter is negative towards the former." Again, he must be aware that the plate connected to the + pole of a battery in charging an accumulator becomes the + plate in discharging.

I, however, quite agree with him that the oxide of lead cell described by me does resemble an accumulator somewhat, as all gas batteries must do; only, instead of the gas being occulted in the metal itself, it is supplied by pressure.

If Gilbert B. Luckhoff compresses his manganese, he will find the resistance become vastly lower. It must, however, be in the form of the finest dust, commercial manganese being no use whatever, since it contains silica and foreign oxides. I hear that a form of carbon has just been brought out which resembles spongy platinum in all its catalytic actions. If this is so, the gas battery will be a success, for it is cheap; and an upper plate exposed to the air would absorb oxygen with only a little nitrogen from the atmosphere, thus constituting the positive plate of the battery, hydrogen being obtained on the Dowson system, and supplied to the under plate. I should feel obliged if Gilbert B. Luckhoff, or any of the readers of the "E.M.," could tell me where it is to be obtained. Also, I should like to know if there is any work published on gas batteries, for though I possess most of the modern works on electricity, yet one and all pass them by without much comment, and I am somewhat surprised, since I believe Grove's gas battery will eventually hold the same place in the world's history as the Planté cell does with regard to the modern accumulator in the present day.

I did not intend to write again to the "E.M." on this subject, but I could not let Gilbert B. Luckhoff's last letter pass by without a protest.

Leamington, Feb. 23. **Alfred Treeby.**

DR. HUGO ZÖLLER (sent out by the *Kölnische Zeitung*) has been doing some original exploring work in German New Guinea. He made an excursion for a considerable distance into the interior. In November last he ascended the Finisterre Mountains to a height of 9,000ft. Some of the peaks in this and the Bismarck Ranges rise to a height of over 10,000ft.

A HUGE Greenland whale, 90ft. in length, after having been seen in various parts of the Cattegat, lately went ashore in the Sound, and was killed. During the previous twenty years a whale had not been seen in these waters. The skeleton is to be forwarded to the Copenhagen Museum.

A CUBIC foot of aluminum weighs 166lb., while the same bulk of tin will weigh 445lb.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67370.]—**Chloride of Silver Battery.**—The fused chloride of silver refuses to dissolve in nitric acid because it is not soluble in that menstruum; you must first reduce it to the metallic state.

SM.

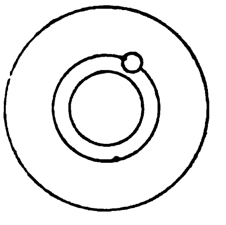
[67524.]—**Resonant Table.**—A resonant table on which to play the zither, &c., would surely be a curiosity. Has not the zither, &c. (especially the &c.), enough resonance in itself? If not, turn it up. However, the "table" should be constructed of pine, and take the form of a hollow box with the "soundholes" (sic) anywhere you please.

ORGANON.

[67530.]—**Optics.**—Surely every textbook of optics explains what is meant by a parallel beam of light. E. M.

[67550.]—**Heating.**—As the pipes are already fitted, pass hot water through them. B.

[67552.]—**Soft Soldering.**—You spoke at first as if the soldering was a necessity, but you could not accomplish it to your satisfaction. It seems to me that the soldering is quite unnecessary. I send the following idea of it, if it is of any use to you.



The small hole in the drawing is drilled half-way between the flange and the tube; it is then tapped, and a screwed wire screwed into it. The flange can neither turn round nor come off; but perhaps your tube is not thick enough to admit of this arrangement. E. J.

[67556.]—**Custom House.**—If such a book is in existence, no doubt it can be had of Effingham Wilson, Royal Exchange, E.C.; but really a "bookseller" ought to know. X.

[67557.]—**Wrought-Iron Work.**—To answer "Fal's" question would involve the writing of a treatise on the art of the blacksmith. The hammer and anvil are the principal tools used. M. T.

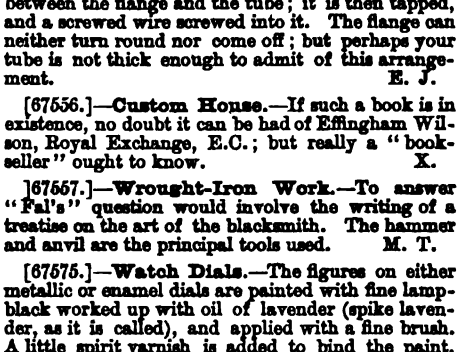
[67575.]—**Watch Dials.**—The figures on either metallic or enamel dials are painted with fine lamp-black worked up with oil of lavender (spike lavender, as it is called), and applied with a fine brush. A little spirit varnish is added to bind the paint. Where figures are raised on gold or silver dials it may be preferred to black them by the chemical process, for which see indices; but the chloride of platinum or nitrate of silver solution will do.

D. G.

[67877.]—**Graphite Battery Plates.**—Your graphite should be ground rather fine, mixed to a stiff paste with coarse treacle, and compressed into iron moulds. Bake at a red heat, and you will obtain all you require. J. S. MANDANE.

[67578.]—**Planing Machine.**—Why does not "W. J. G." look up his back numbers instead of putting queries so vague? What is it he wants to known about planers? J. M.

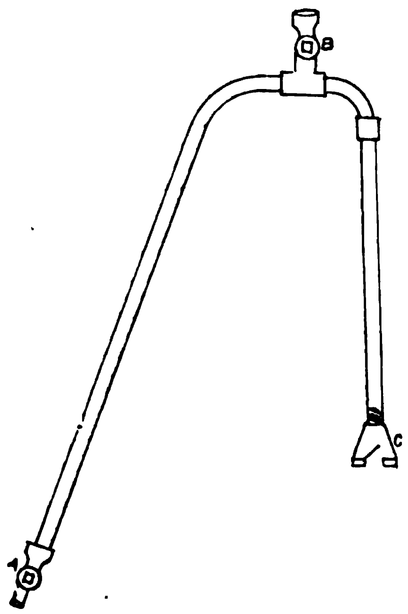
[67650.]—**Core Box.**—Many thanks to "J. H." and "L. C." for answers. I inclose particulars of cylinder, in hopes that "J. H." or some other reader will oblige with a sketch of best method of making cores. As will be seen, cylinders are of ordinary loco. type. I want to know if port cores were made separate—whether I should have to make a box for main cylindrical core, with prints in it for port cores. CORE BOX.



[67679.]—**Composition Battery Cells.**—If the querist would get some pieces of ordinary window glass, and bend them over a hot iron plate to the shape of a letter U laid sideways, thus ⊃, and put the open side against the porous plate, he could use same composition as at present. The outer casing would do made of ordinary sheet tin, and before pouring in the tar and rosin fill the pieces of glass referred to with hot sand; it will prevent the glass cracking from the sudden application of heated fluid mixture. If you do not understand, write again; but I think you will be able to see what I mean without a sketch. AN A.S.T.E.

[67730.]—**Lead Pipe.**—It is often said by fitters that the lead setting rots the iron; but I think any setting does the same. I believe it is because at the line of contact the setting forms a kind of cup, which collects and holds the moisture that would otherwise evaporate or run off. With this idea in view, about three years ago I set two pieces of ¼in. iron in stone, one with lead, the other with molten glass, and left them exposed for about fifteen or sixteen months. On taking them out of the setting I found that both had at the line of contact rusted away. F. D'A.

[67733.]—**Siphon.**—The following rough sketch will show an arrangement of siphon I made for a friend of mine. It had to rise about 18ft., the fall 22 and had to travel some distance horizontally. I only give the shape of an ordinary siphon, as shape does not matter; at A is a common gas cock, at B is another screwed into a tee-piece, at C is a light flap-valve; the box I made of sheet copper; as a cone, into the neck I soldered a 1¼in. by 1in. brass diminisher, this to screw on to the 1in. pipe; into the bottom I put a 2in. by 1¼in. diminisher this forming the seat of the flap of valve, made of a piece of insertion rubber the same as used for cocks, and screwed on with a plate the same as a pump clack: this does not want weighting so much as a pump clack, only just a thin piece of brass to stiffen it. To put it in operation cock at A must be shut, B open, the pipes filled up with water, a funnel being used, shut B and open A, and there it is at work. Of course the flap has to be put on before the diminisher is soldered in the cone.



F. G. FRANCIS.

[67735.] — **Sword Proofs.**—The mark which "H. A." refers to is stamped on gold, and denotes that the sword has been thoroughly tested, and has been found of uniform "spring temper"—viz., that it has not set from its original form after having been bent sideways and hit edgeways with very considerable force over a block of lead. Those are the two principal tests. Private swords always bear the word "proved," as denoted, but Government swords do not, although they undergo the same severe tests.

Edinburgh. FABRICANT D'ARMES.

[67762.]—**Furnace.**—I am much obliged to "Cast Iron" for his answer. My furnace is not lined with firebricks, nor has it ever been; it's not a cupola. I've always rammed or lined it up with a mixture of strong road silt and clay. It has always—at least, over thirty years—stood all right till lately. I have moved my fan further back, so instead of having a pipe 4ft. long by 6in. inside, I have now one 10ft. by 6in. inside; would that make any difference? Would too much blast do it? as I get more than I used to in its old place. Any further information will greatly oblige.

MUDDLED.

[67768.]—**Telephone Annunciator.**—I recently had an opportunity of examining two of these; both were differently connected-up. In one the ends of the white-covered wire referred to were soldered together; in the other case the ends were left loose. They are mentioned in Preece and Maier's new book on "The Telephone," pp. 217 to 229; but those do not appear to be polarised, only ordinary electro-magnets, because it states a permanent current is kept going through them from some Daniell cells. The engravings of this instrument are the same as those used in the 1884 edition of Preece and Sivewright's "Telegraphy" (where, I think, the polarised indicator is mentioned); but they are very indistinct—in fact, appear to be quite worn out. Will someone belonging to the Post-office oblige with the desired information?

An A.S.T.E.

[67783.]—**Photographic. — A Correction.**—I must thank "B. Sc." and H. Dolling Smith very much for their kind and courteous attention to my query. I have quite decided to either make or buy an enlarging lantern: in case I should make one, would it be too much to ask Mr. H. Dolling Smith to give us a little fuller description of his lantern, as I am sure it would prove acceptable to our readers who go in for photography? If I buy one I shall get Lancaster's enlarging lantern with 5in. condensers, and have a 4-wick lamp substituted for the lamp supplied, in order to get a better light; also I think I shall dispense with the objective supplied and substitute the 5 by 4 Euryscope for it. Would this do, or would it be necessary to get a good portrait lens? I suppose a small error has crept into Mr. Smith's letter (probably a printer's), as it talks about "condenser (½in.)" for half-plate lantern. Also, Mr. Smith advises me to get a ½ plate W.A.R. lens; I don't quite understand, as I should have thought you would lose the W.A. effect by using a ½-plate lens in a ¼-plate camera, since the ½-plate lens will have a longer focus than the ¼-plate. The reason I asked about Leisk's sky shutters is that it is advertised to give the fore-ground about three times the exposure of the sky, and I thought that for taking trains in motion an ordinary drop shutter might be wanted, in order to give an equal exposure all over the plate. Lastly, owing, I suppose, to my indistinct and hurried writing, my name in the query was printed G. Didon; I beg to correct it and to say that it is

Bradfield College, Berks. G. Dixon.

[67786.] — **Brickmaking.** — You should save fully 50 per cent. of fuel in a D.D. kiln over a through draught, besides getting a more regular heat all over the kiln, though yours is an awkward shape. The mouths or fire-holes should not extend more than 13in. inside face of kiln; one length of bars should be enough. As a down-draught heats quicker than a through one, you must be very careful in not having too much fire at the first start, or the bricks, &c., will rift. A little more fire should improve the colour. Salt would turn them blue.

Potter.

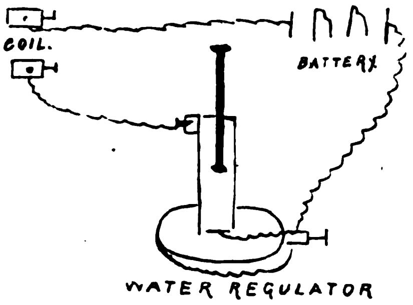
[67785.]—**Brickmaking.**—I am a burner of the kind of ware "B. B." mentions. I don't understand the class of kilns you have; but the class that I am used to are all down-draught. Out of a kiln of 15,000 (best pressed bricks) they are all uniform in colour except a few that are lighter in the centre of bottom. The kind of clay makes a difference in colour; red clay is what we use. Of course you will know that the hotter or more heat they are subject to, the more dark red they will become. Put in your stuff dry, and fire very light for the first twelve hours with all the top openings uncovered (to let steam off), and when all the flame is off your last fire shut your dampers; then after twelve hours, if bricks (longer if pipes or tiles), draw your dampers a little. In the case of pipes above 6in. in dia., the longer they stand before drawing the dampers the better; it's always in cooling that the ware will crack. Keep your fire-doors—it's all by the door that I regulate the heat; so kiln that has a furnace should be without them. I may add that I burn the above kilns with about half a ton (best dross coal) per 1,000. Fraser.

[67789.]—**Fuller Battery.**—You can use any ordinary single-fluid cell, bichromate solution. A good solution consists of—Bichromate of potash 1lb., water 4 pints, sulphuric acid 2oz.

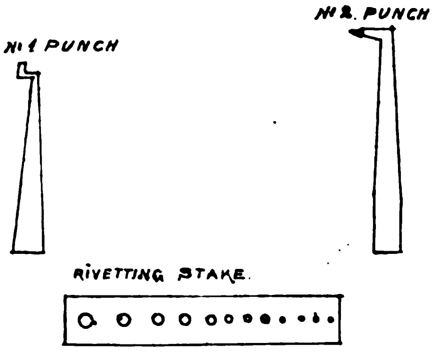
F. W. Mason.

[67792.]—**Pentograph.**—You do not say how it is arranged, though they are generally two to one—that is, your templates are double the size. Have a board with a fixed centre in it, in the shape of a piece of iron or steel wire. This is to put trammel's point or compasses in. Take a piece of sheet iron and make a couple of holes in it for two screws; place this iron upon your board, that the radius of the wheel-pitch line may cut it in half. Now strike the diameter of wheel and the bottom; now pitch what you want, drill and cut template out, and don't forget it is the outside you want—i.e., the space, not the tooth. Keep this template, and make mould from it to work from the mark, and keep the other for reference; not forgetting that the radius, pitch, &c., being double that you want to make the cutter for. Jack of All Trades.

[67794.]—**Induction Coil.**—"Victor" could regulate his battery current by passing it through a water regulator. The following sketch may perhaps be able to assist him; but it would be, of course, much better if he employed a weaker battery instead of his strong one. Also, "Victor" would be able to regulate his current by letting in a resistance in the place of the water regulator; but I think myself that the latter is by far the best means. F. W. Mason.



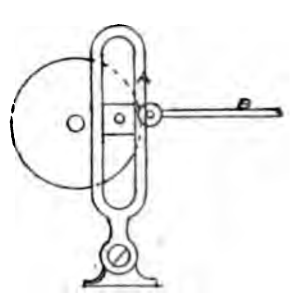
[67808.]—**Watch Repairs.** — For the Geneve watch repairs you require two punches and one riveting stake. No. 1 punch is for knocking out plug; No. 2 punch is for resting cylinder when putting new plug into cylinder. The riveting stake is for resting cylinder upon when driving out old plug. Make a new plug of tempered steel (blue colour) a little taper, and fitting nearly up to the right place. Place No. 2 punch in the vice, insert cylinder, and drive new plug up until it meets the face of the punch. Take off the end-stones, screw cock to plate, measure from outside of each jewel-hole, and make the height from end of bottom pivot to end of top pivot a small trifle more than measurement. Then centre your plug perfectly true, put on a wax verril over cylinder, then turn plug down until it nearly fits the jewel hole. Finish off on the polishing runner with a piece of steel and oilstone dust (mixed with oil), and afterwards with crocus and oil, or else you may finish the pivot with a conical pivot file and burnisher in a Jacot pivoting turns. The verge can have a new top pivot inserted by drilling into the collet of the verge with a hollow drill, which drills around the stump of old pivot. After drilling down a safe distance, break off the steel stump and insert a piece of brass wire into hole. Then centre the brass plug, and drill up a nice safe distance. Insert a piece of blue tempered steel, and finish same as the cylinder pivots. To replace a jewel hole: Firstly, push out the old hole; rise the setting nicely with a nice polished pointed steel rod; choose new hole, which must fit the setting nicely, then, with another rounded polished steel rod rub the setting over the hole again. Remember that the chamfered end of hole must in the cock be on the inside. I cannot tell you how to proceed with the escapement, as your description is very vague indeed. Describe more fully: then very likely I can assist you. But remember that you will have to exercise great patience in doing the job. Study well what you intend doing before proceeding with anything.



Welsh Horologist.

[67817.]—**Discoloured Glass Speculum.**—Perhaps "Ecnal," who replies on p. 526 to this query as well as myself, is not aware that rouge will remove some stains not readily removable by ordinary means. I would have mentioned this in my previous reply, but that it is an extremely dangerous thing for an amateur to use upon a valuable glass speculum. Possibly one hour's work would be sufficient; but if not done with judgment it might interfere very seriously with the perfection of the surface. J. C. Linscott.

[67812.]—**Reciprocating Motion.—Pin and Core.**—If you make it like the sketch shown here, you will find it work well. A, sink, in which is a block for the pin to work in; B is the connecting-rod to slide. This is connected to the back end of slides, and applicable in the shape of driving a shaper on lathe off lathe face-plate.



Jack of All Trades.

[67818.]—**Brass Castings.**—If you make your runners a little larger and dust your moulds with plumbago, you will overcome your depression and get a good colour. W. W.

[67819.] — **Emptying Pond.** — A windmill specially adapted for working a pump (described in a number of *Industries*, published somewhere in Manchester) was to be seen in operation at the Inventions Exhibition; but this is a slow and uncertain method when time is valuable. Lux.

[67822.]—**Motive Power.**—You cannot do better than try a small hot-air motor. These are made various sizes; or gas-engines if a little noise is no objection. T. M. Bear.

[67823.]—**Turning Crank with Lever.**—In reply to "J. H.," and "Jack of All Trades," my lever handle is fixed 18in. above the crank axle, and running the same way, and worked by a connecting rod, and works well, but it looks unsightly; I would thank either gentleman for a sketch, as I do not exactly understand what "J. H." means by a slotted plate. I am a poor draughtsman, and cannot describe it in a sketch, or I would do so. I have one rod and two springs at the extremes of crank. If "T. C., Bristol," would give me his idea of two rods, he will oblige Crank.

[67823.]—**Turning Crank.**—If the difficulty lies in the crank sticking at the dead point, it may be got over by the use of a spring, compressed (or extended) when the crank is nearly at right angles to the connecting-rod, and giving back its energy when the crank is near the dead points. This I have done in a model by having a second connecting-rod from crank-pin to the middle of a strip of elastic fixed either 135° or 45° round from line of piston-rod, according to the way the crank required to be turned. Of course, many other sorts of spring may be used, such as an air cylinder, both compressing and dilating the air when its piston is moved; or, indeed, any apparatus that gives a spring action at both sides and a neutral point half-way.

Otherer.

[67828.]—**Heating a Room.**—May be done in a simpler manner and much more economically than in the way proposed, as the gas-heated pipe would not give a sufficient surface to utilise one-half the heat from the gas-flame, and also being outside the room one-half the heat used would be then wasted to no purpose. The stove should be inside the room so as to obtain all the heat possible, made with a flue so as to give neither fume nor smell, and be multi-tubular, with the air passing through it amongst the tubes and issuing in a current of warm dry air at the top, no extractor or propeller being required. I can only say that I make a cheap and simple gas-stove for the purpose, and give my address in the Address Column.

Another Scott.

[67849.]—**Mechanical Drawing.**—Allow me to supplement the remarks of your correspondents on this subject by recommending all young draughtsmen, after they have mastered the use of drawing instruments, to devote some attention to the study and practice of descriptive geometry. It presents but little difficulty to any lad fairly versed in the simpler parts of geometry (as taught in schools), and will be found of almost everyday use in the drawing office. As instances of its use I may mention the following:—1. The correct representation of a screw, the axis of which is inclined to the plane of projection—i.e., to the plane of the paper. 2. The accurate construction of the curve of intersection of two large cylinders. 3. All cases in which, as in isometric projections and perspective views of a machine, the horizontal plane is neither parallel nor perpendicular to the plane of projection. Such drawings, combining as they do in one figure both plan and elevation, and generally also end view, are constantly required for works on machinery, &c. Long ago, when I was a student, the best textbook on descriptive geometry was that by Prof. Hall. Of more modern works, I am acquainted with but one—"Practical Solid and Descriptive Geometry," by Edgar and Pritchard, published by Macmillan. This appears to me an excellent treatise.

Charing. J. R. C.

[67851.]—**Lever Watch.**—Yes. Thousands of the cheap English watches have fusees. A cheap English watch is very often a nasty one. The going-barrel watch does away with the fusee, and also with the chain, because the main wheel is attached to the barrel or the spring box. I very often find that the going-barrel is the means, when the mainspring breaks, of breaking centre and third wheel pivots. So I advise you to buy a watch with a fusee, assuming you will give a substantial sum for one. Welsh Horologist.

[67852.]—**Ebonite.**—Have you tried gas-black? Jack of All Trades.

[67853.]—**Electrical "Victoria" Dynamo and Accumulators.**—The armature connections, whether of a four-pole or an eight-pole "Victoria," are almost precisely similar to those of the Gramme or Pacinotti armature; in other words, the wire which terminates one section of the armature is joined to the same commutator bar from which the wire starting the next section takes its rise. In order to do away with your brushes, in a four-pole machine, Mr. Mordey has adopted the devices:—1. Of connecting together those segments of the armature coils which occupy similar positions with respect to the poles. 2. By connecting together metallically those bars of the collector which are at the same potential. You will find detailed description and cut illustrative of this matter under the heading of "Schuckert Mordey Dynamo," in Silvanus Thompson's admirable work "Dynamo-Electric Machinery." If you cannot refer to this, and will write again, I will, with the Editor's kind permission, reproduce the article and cuts. With reference to your query of getting a potential of 2 volts between the positive plates of an accumulator when the negatives have been removed, it is simply because one or more of the positive leaden plates do actually become negative with respect to the others, the negativity or positivity (pardon these new words) depending entirely on the direction in which the charging current is sent through the series of plates. S. Bottone.

[67854.]—**Filtration.**—I should make a bay or tank of Bath bricks in a box perforated with holes or built of laths. The interior of this I would line by folding a sheet or two of filtering paper and blotting-paper, and I would pour the material into that, and let stand until ready for what I want, and cover over to keep out dust, and I think I should find all right. Jack of All Trades.

[67855.]—**Dynamo.**—Put 5oz. No. 20 on the armature, and 4lb. No. 22 on the fields. Connect up as a shunt machine. S. Bottone.

[67858.]—**Pencil for Barograph.**—If "Inquirer" uses a pencil to mark the curve on his barograph, there ought to be a spring to keep the pencil forward to the paper scale. He could easily make such an arrangement by means of a spiral spring of thin, hard wire, so as to embrace the pencil; otherwise the point of the pencil will very soon wear off, and therefore cease to record. A friend of mine has a barograph, and I observe that at the end of the recording arm there is a little cup containing aniline ink; there is a small hole in the side of the cup, through which a little ink passes, and leaves its record on the chart. It answers well. He has had it in use for years. Ecnal.

[67859.]—**Spring Motor.**—In the melo-piano which I exhibited in 1871, to drive the mechanism a spring 4in. wide, $\frac{1}{16}$in. thick, and 18ft. long before coiling was employed. This gave about one-tenth of a man-power for half an hour. From this you may deduce that a spring to give 1 man power for 10 hours would need be twenty times the size of the above. S. Bottone.

[67859.]—**Spring Motor.**—You can get full descriptions of the Leveaux spring motors at the Patent Office. If you want to store power equal to one man for ten hours without winding, it must be a very heavy apparatus. The Britannia Co., Colchester, can give you some information. They bought the models, one of which was two-horse. T. M. Bear.

[67859.] — **Spring Motor.** — Prof. Osborne Reynolds, in his "Cantor Lectures" of 1883, informed us that it takes fifty tons of steel springs to store 1H.P. for one hour; then, if we take a man-power at only $\frac{1}{10}$th of 1H.P., for ten hours you require fifty tons of steel springs, or, since india-rubber will store from eight to ten times as much as steel, five or six tons of rubber would meet your case. What percentage of the work put into any compact form of accumulator of these weights could I inquire, be expected. J. A. A.

[67860.]—**Enamelling.**—Iron that scales is not much good for enamelling. Wash it in diluted muriatic acid, then through clear water; dry quickly with heat. Potter.

[67861.]—**How to Estimate free Hydrocyanic Acid.**—Add to solution a very slight excess of caustic soda, and then solution of carbonic acid; titrate with iodine. Two eq. or 253·7 parts of iodine correspond to 1 eq. or 65·17 of potassium cyanide. This principle affords the basis of an exact method for determining the value of potassium cyanide, or solutions of prussic acid.

F. Knott, Analytical Chemist.

Woolwich Arsenal.

[67863.]—**Crank Shafts.**—This querist must have a former to bend the bar on. When collars are welded on, twist them where you want them for centring. Have two cast-iron plates with a boss on, and fix on each end with a set-screw. Centre the shaft, then strike a circle round your plate from that. Divide this out for throws, and line off and drill centres, or holes for the centre. Jack of All Trades.

[67864.]—**Screw-down Taps.**—Does not this querist suggest the cure? If the part is worn out, renew it, or have it renewed for, say, 8d. each tap.

Bristol. T. C.

[67866.] — **Resistances.** — The resistance of No. 12 iron wire is simply 0·18 ohm to the pound. Hence, to get 10 ampères from a 45-volt pressure means that there must be a resistance of 4·5 ohms; so that you will need 25lb. approximately of No. 12 iron wire to balance the resistance of your 10-ampère lamp, and about 19lb. to balance the 15-ampère lamp. S. Bottone.

[67867.]—**Battery.**—Porous cells about 6in. by 2in. will do very well. There must be no holes in these; the material itself is porous. Put a plate of carbon in the porous cell, pack it to within an inch of top with pieces of broken graphite; fill up the cell with chloride of lime, and cover with water. In the outer containing cell (not porous), place the zinc, and fill with strong brine. This battery is of little or no use for motor driving; its internal resistance is too high. To drive a motor for six hours a day, you will need three or four Fuller cells, about quart size—No. 22 will do. S. Bottone.

[67869.]—**Steel Bicycle Hub.**—Harden your drill either in some hard tallow or soap, or drive it into a piece of lead. For drilling, use turps and camphor. Jack of All Trades.

[67869.]—**"Rover" Steel Bicycle Hubs** are not hardened. You ought to be able to drill out the broken spoke without any softening. If you have broken your drill in, you might soften it with Fletcher's blowpipe, or take the wheel to pieces and soften in a fire, and remake. Ex.

[67871.]—**Motor.**—I should not think that the defect is in the batteries (if they are in good condition and freshly charged), but rather in the motor. In all probability there is electrical leakage between the wire and the iron cores, or between the two halves of the commutator. It is also possible that the said slits are not in the right position; they should be in a line with the yoke. Perhaps, also, your springs are too strong; they should bear lightly on the commutator. S. Bottone.

[67873.]—**Dyeing and Varnishing Leather.**—You must wet your article all over first with water, or some weak linseed mucilage, and when the surface is fit to receive your dye, go over it. This will be when the surface has absorbed the other. But if you want to varnish it often, you must use the mucilage pretty strong, or the glair of egg. Jack of All Trades.

[67874].—**Tracing Fluid.**—Equal parts of good white gum arabic and clear honey, with about six parts clean boiled water. I have had some prepared for years, and it is good yet. Thin as you want it. Or you may use glycerine; but not so good. Jack of All Trades.

[67874.]—**Tracing Fluid.**—For tracing in Indian ink I never use ox-gall, but simply tack the piece of tracing cloth on a drawing-board previous to using, and rub it over with pounce or French chalk. Make a rubber of a piece of blotting-paper folded up to a small pad, and keep the pounce or chalk in a small tin like a pepper-box, so that you can dust it over the tracing cloth, and rub it well all over surface, then dust it off with a handkerchief. You will find this the best plan. Ox-gall makes the ink thick, and consequently it does not work so well in a drawing-pen. Being in an architect's office, I have many tracings to do, and I never use ox-gall except for colouring.

Inkpot.

[67876.]—**Steam.**—As 10 per cent is supposed not to be evaporated, we have 10lb. raised (320 − 100) = 220°, or a total of 2,200°. The remaining 90lb. contain 90 (1,082 + 90 × 0·305 − 100) added heat = 90 × 1079·6 = 97,164. Adding the 220° above, we have a total of 97,384 as heat absorbed. The same amount of heat would evaporate 97,384 ÷ 966·6 = $100\frac{3}{4}$lb. of water at 212°.

Bristol. T. C.

[67877.]—**Graphite Plates.**—Graphite plates (known as "compressed") are made by mixing graphite powder with syrup or treacle, subjecting the pasty mass to great pressure, and then baking at a high temperature in metal mould, to drive off all the other constituents of the sugar (hydrogen and oxygen) except the carbon. The plates are again dipped in treacle, and again baked, until sufficient density is obtained. With graphite plates so cheap, it certainly would not pay you to make your own. S. Bottone.

[67877.]—**Graphite Battery Plates.**—I have never tried graphite for this purpose, but have often made plates and rods from powdered gas carbon by mixing it with syrup or treacle, ramming into a metal mould, such as a tin match-box, wiring down and heating to redness in a pot filled with sand. The carbonisation of the sugar causes it to expand very much, and if its escape from the mould be prevented, it produces a hard, dense cake, which is an excellent conductor, but soft enough to be cut into any shape. If the carbon be very dense, it will be improved by an admixture with wood charcoal; but the pulverulent kind is what I generally use, as it is more easily crushed. Sm.

[67878.]—**Glue.**—Yes; it gets brittle and flies. It will not hold. Jack of All Trades.

[67878.]—**Glue.**—Any cabinetmaker will tell you that the fresher glue is, the better it is. No doubt it deteriorates by being repeatedly re-heated.

Ecnal.

[67878.]—**Glue.**—When glue and gelatine are repeatedly melted, they become converted into metagelatine, and this does not set like glue. The same change can be more rapidly brought about by boiling with dilute nitric acid. S. Bottone.

[67878.]—**Glue.**—Yes; I have found it so in my own experience. I use glue for mounting photo prints, and after using for three or four times, when it is again melted it will not stick at all, and has to be thrown away. I have never had a reason given for this. J. S. Mandane.

[67881.]—**Slanting Wheel Teeth.** — It does not take off the pressure as stated, but makes the gear run smoother.

Bristol. T. C.

[67885.]—**Dynamo Armature.**—To Mr. Bottone.—Speaking of the punchings I employ, I may state that 25 go to the inch; hence a 4in. armature will take exactly 100. S. Bottone.

[67886.]—**Force Pump.**—It will be best to carry your pipe over the top of cistern, and much easier for the pump. Ex.

[67886.]—**Force Pump Supply.**— Practically, no difference; but, theoretically, it will take more power to carry water over top of tank.

Bristol. T. C.

[67887.] — **Accumulator.** — It will light the lamp for two hours. It will take three hours to charge with your dynamo. It will be fully charged when the acid begins to bubble freely. The lamp will become dimmer when it is nearly discharged. Connect the cells in series. S. Bottone.

[67888.]—**Worm and Wheels.** — You should procure the articles written by our friend "J. H." last year, where this is fully described.

Bristol. T. C.

[67888.]—**Worm and Wheels.**—In the articles on "Gearing," published in the last and two previous volumes of the English Mechanic, you will find the subject matter of your queries fully explained and illustrated. J. H.

[67889.]—**Powder-House.**—The two wires leading to the powder cup should not touch any metal—i.e., should be insulated from each other. If the cup is of metal, one wire may touch the cup, and the other touch the powder in the cup, but not the cup itself. If the cup is of any non-conducting material, then both wires must be brought into the powder, but must not touch each other. The distance between the wire and cup, or wire and wire, in the latter case, must be somewhat less than the distance the discharge or spark can pass over. Unless your Wimshurst machine is a very powerful one, fitted with large Leyden jars, you will not be able to explode the powder; in any case, to produce sufficient heat, you must introduce some resistance in the circuit. It is usual to put a few inches of wetted string for this purpose between the Leyden jar and one of the wires. You will have no difficulty if you tie, say, 6in. of wet string to the lower wire, rest the bottom of your charged Leyden jar on the string, and then bring the discharging-rod from the top wire to the knob of the Leyden jar. The loose pieces are blown out by the discharge of the powder. S. Bottone.

[67891.]—**Boiler.**— If the furnaces were not overheated I should have preferred running the steam down while pumping after pressure were drawn; but the other way does no harm. and perhaps saved time.

Bristol. T. C.

[67892.]—**Shoe-Making.**—The sizes for children run up to 13, then commence 1 again for men and women. The vamps are the fronts of shoes, and the backs are quarters. Goloshes are the low over vamps and quarters, as generally used for gent's lace-up half-boots—as shooting-boots, walking-boots, &c. The size-stick has the sizes marked upon one side and inches upon the other; and there is a slide with a rising style and one fixed on at one end. The tape is nothing but an ordinary inch-tape, such as tailors or dressmaker's use. I do not see any difficulty in using these.

JACK OF ALL TRADES.

[67893.]—**Storage Cells.**—Each square foot of positive lead surface in an accumulator is equal to about 6 ampère hours. Hence the cells described in my book would never give more than about 1 to 1½ hour's light from a 5c.p. lamp. S. BOTTONE.

[67896.]—**Double Bass Fiddle.**—The back, ribs, and neck are made of sycamore or plane-tree, the belly and block of pine, Swiss preferably. The ribs or sides are planed to substance, and bent into shape by steaming and working them over a hot iron. All are joined together with glue; no nails are used. "Joiner," if he wants to make a good job, better not spare a few shillings to get proper wood, and he can buy a neck ready made better and cheaper than he can make one. He should get hold of a good fiddle and take his sizes and curves of back and belly from it. If he has any taste, it will not be a difficult job. ECNAL.

[67897.]—**Telephone.**—Either may be used: permanent are best. I have found thin sheet ebonite $\frac{1}{32}$in. thick very effective.

S. BOTTONE.

[67898.]—**Liberty Statue.**—The electric torch is composed of five arc lights, each of 30,000c.p., making a total of 150,000c.p. The diadem round the head of the statue is lighted by thirteen arc lights and fourteen large incandescent lights.

E. G.

[67899.]—**Mastic Cement.**—Fine floor-sand two parts, lime air-slaked; mix with half a gallon boiled oil and one pound litharge. It is best to paint the joints before, or else the brickwork absorbs the oil, and the mastic gets rotten and falls out. JACK OF ALL TRADES.

[67901.]—**Steam Pressure per H.P.**—If, as your query indicates, you only require 1H.P., I do not think you could do it under 40lb. of feed-water per H.P. Do not complicate matters for such a small affair, but have a simple high-pressure engine. Where high powers are required, triple-expansion condensing engines are most economical.

Bristol. T. C.

[67906.]—**Dynamo and Accumulator for Bicycle.**—To MR. BOTTONE.—A small dynamo, similar in size and general proportions to that described in the "E. M.," Oct. 5, 1888, reply 66496, but furnished with an indiarubber ring on the pulley, to take the power off the tire of the bicycle, will do very well. The two storage cells will answer. You will only need a switch to cut off the current when the cells are fully charged.

S. BOTTONE.

[67911.]—**Regulator.**—Mercury, with float at top. LUX.

[67912.]—**Engine.**—2,000H.P. = 2,000 × 33,000 = 66,000,000ft.-lb. per minute. The effective pressure will be (36·55 − 2·8) = 33·75lb., and there will be 80 strokes per minute. Multiply these = 80 × 33·75 = 2,700, and divide the above with result (66,000,000 ÷ 2,700) = 24,444·4, which is the produce of the area in inches by stroke in feet. Let diameter be $5x$ feet, and length $6x$ feet; then we have this equation:—

$$(5 \times 12x)^2 \times \cdot 7854 \times 6x = 24444\cdot 4,$$

or—

$$21{,}600x^3 \times \cdot 7854 = 2444414.$$

$$\therefore\ x^3\ \frac{24444\cdot 4}{21{,}600 \times \cdot 7854}.$$

$$x = 0\cdot 88\text{ft.}$$

Diam. = 52·8in., and stroke = 5·28ft.

Bristol. T. C.

[67912.]—**Engine.**—The mean pressure must first be found as follows: 70lb. × $\frac{1 + (\text{hyp. log. R})}{\text{R}}$

R = ratio of expansion, and in this case is 5. This will show the mean pressure t = 36·5lb., which, after deducting 2·8lb. back pressure, = 33·7lb. In practice it would equal about 75p.c. of this. Knowing the mean pressure, the diameter of cylinder and stroke can then be found by the following rule:—

$$\sqrt[3]{\frac{1\text{ H.P.} \times 33{,}000}{\text{R} \times 2 \times \text{M.P.} \times \cdot 07854}} = d.$$

d = diameter; $d \times 1\cdot 2$ = stroke. Example—

$$\sqrt[3]{\frac{2{,}000 \times 33{,}000}{40 \times 2 \times 33\cdot 7 \times \cdot 07854}} = 67\cdot 75.$$

Then diameter of cylinder = 67¾in. Stroke = 67¾ × 1·2 = 81·3in. MCGILL.

[67913.] — **Blowpipe Analysis — Slag.**—To COL. ROSS.—The "Lydney Dispenser" would scarcely expect me to "give an opinion" as to the cause of the blue colour of his slag without having had an opportunity of examining it by the blowpipe. Unfortunately I have not one, or any reagents here, but hope before long to receive a case of apparatus from Mr. J. T. Letcher, of Truro, Cornwall. Surely, however, there are some of my disciples left among the contributors to "Ours" who would tell him the cause of colour, if due to an inorganic substance, in five minutes. I need not tell a chemist like the "L. D." that if his colour is really Prussian blue—$Fe_{10}(C_2N_2)_8$—it contains a so-called "organic" constituent—viz., cyanogen, when examination in boron trioxide before the blowpipe would show only the iron; but this reaction would, of course, also tell him (negatively) the cause of the blue colour. I have never examined powder of the blue sodawater bottles one sometimes sees; B.B., but believe the blue colour in them to be due to oxide of copper or cobalt. The blue colour of the sapphire has been, and is, an enigma to chemists, as it consists of alumina only, but there is a good deal about it in my latest work. W. A. ROSS.

[67914.]—**Fan.**—Run your engine faster—say 200 revs., and gear 5 to 1; then it will do it, I think. Boiler 15in. high and 9in. diameter; fire-box 8in. by 8in.

Bristol. T. C.

[67917.]—**Dynamo.**—I am doubtful whether you will be able to light 8 lamps of 25 volts from your machine, unless you drive pretty fast; say, perhaps, 2,500 revs per minute. S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

67313. Chromatrope, p. 343.
67314. Lantern Slides, 343.
67330. Storage Battery, 343.
67341. 3in. Spark Coil. To Mr. F. Carroll, 344.
67347. Pendulum Indicator, 344.

67538. Dynamo, p. 429.
67547. Choreutoscope, 429.
67558. Speeds, 429.
67562. L. and S.W.R. Goods Engines, 429.
67577. L.C. and D.R. new Bogie expresses, 430.

QUERIES.

[67919.] — **Anti-Freezing Mixture for Hot-Water Pipes.**—What chemicals would be the best to mix with water in the small-bore pipes of our heating apparatus to prevent freezing?—W. J. S.

[67920.]—**Chalybeate Springs.**—In this district—North Bucks—we have a very valuable mineral spring of the above class, which has been proved by analysis to be much stronger than that at Leamington. Unfortunately, however, the public are unable to participate in its beneficial properties owing to an unwillingness on the part of the owner of the property to having the privacy of his grounds encroached on. The hills on either side of this district have a considerable elevation—that adjoining my works is 649ft. above sea-level. The Kimmeridge clay is found in trough-like beds, traversing the summit of the hills in question. The direction of such troughs is uniformly E.—W. or nearly so. Overlying the Kimmeridge clay we have a very unctuous potter's clay of various colours. That in some of the troughs is yellow, rivalling, if not surpassing, as a pigment, the best Oxfordshire ochre, and over this clay is a bed of yellow sharp sand of considerable depth. Under the Kimmeridge clay we have a series of lime rocks, varying in thickness from 16in. to 30in. The rock lying between the white, or chalk-like stone, and the green sand, is classed as belonging to the Portland series, and consists of two blocks, each about 18in. thick, and varying in bulk from 20cwt. to 30cwt. The Gault clay traversing this district underlies all the above rocks and Kimmeridge clay. Hence we are supplied with springs of drinking water, which never fail, even in the driest seasons. I reside, on the west side, at the foot of the hill in this parish. Within a few yards of my residence is a never-failing spring. This water must have penetrated the various rocks and green sand, and runs off the Gault clay. This water is very hard (lime), but no trace of iron, so far as I can judge. I have been led to name the various strata we meet with in the hope to assist your geological readers to a knowledge as to the source of the chalybeate spring referred to, which, in my humble opinion, must lie below the Gault clay. The chalybeate spring I refer to lies in a valley on the opposite side to that I live, one mile distant, and at a much lower elevation—probably 100ft. lower. I have no doubt the Gault clay traverses the vicinity of the said mineral spring, as it is known to be on either side of it, a short distance away. Immediately to the west of me there is another hill, 647ft. above sea level, and on the other side of it, a mile distant from the spot I live, the chalybeate spring shows itself on the surface at the foot of the hill, which rather clashes with my theory that the source of it lies under the Gault clay, unless the Gault first starts there. In your next issue of the "E. M." I will endeavour to give you the depth of the mineral well, and will be pleased to send samples of the water for analysis. I think of boring through the Gault clay in the hope of tapping the iron spring. Is the prospect of success good enough to justify the cost? Many years ago a shaft was sunk in locality of the iron spring, and it is reported that a coal-like substance was found. Is this probable? What is probable thickness of the Gault?—B. B.

[67921.]—**Puzzle Lock.**—Will Mr. F. H. Wenham favour us with a description of the above, as mentioned by him in "E. M." of the 25th January?—COWAL.

[67922.]—**Water-Blower.**—I want to make a water-blower to supply air to a small blowpipe for soldering and brazing? Will "Aquarius" say what length of pipe (and size) and pressure of water will be necessary?—LUX.

[67923.]—**Photographic View Lens** consists of a double-convex lens, A, cemented to a lens, B, plane one side, concave the other. Can any reader tell me (1) the required thickness of B in the centre, supposing A to be ¼in.? 2. The difference in specific gravity of A and B to make lens achromatic. 3. What proportion this difference bears to relative thicknesses of A and B.—F. J. G.

[67924.] — **Bichromate Battery.** — Would Mr. Bottone kindly say what would be best arrangement of bichromate battery to supply a 20-ampère current of 12 volts? What size cells would be required and how many zinc-carbons in each cell and the number of cells?—ELECTRO-MAGNETIC.

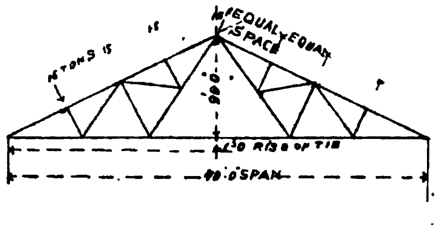
[67925.]—**Blowpipe Furnace.**—Would some reader give me sketch with dimensions? I have two ½in. pipes for gas supply and 4½lb. pressure of blast.—ROLF.

[67926.]—**Bagpipe.**—Instrument for some years out of use. Bag is air-tight, but air escapes through the pipes or drones without giving any sound from the reeds. Should I put in new reeds and will common cane do? Will feel obliged if anyone will kindly give information?—CELT.

[67927.]—**Ebonising.**—Can any reader oblige me by a little information as to the materials (and how to use them). I require to ebonise some reel ends for an induction coil? I want a nice black polish on them and am in a difficulty.—COIL.

[67928.]—**Arc Lamp.**—I wish to run a 50-volt ar lamp on a 100-volt circuit. Can this be done? If so, how? Would four Daniell cells do for charging a small pocket accumulator?—A1 COPPER TOP.

[67929.]—**Strains in Roof Principal.**—Will some reader show me how to find the strains in a roof truss, such as shown by sketch, by the principle known as the "Method of Moments"? Principal loaded as shown.—BRIDGE.



[67930.]—**Bicycle Cranks.**—Will some of our readers kindly give me instructions for drawing the cranks off an ordinary bicycle? They are keyed on very close to the bearings. The description of some simple apparatus that I could make would greatly oblige.—G. K.

[67931.]—**Granule Battery.**—I have got six granule cells, with which I wish to light a 5c.p. lamp for about 20 minutes or less at a time. I should be much obliged if some reader would kindly tell me what are the best solutions to use. Also can the zincs be left in the liquid when not in use, or must they be removed to prevent local action. Also, by using weaker solution in the porous pots, can the battery light a small lamp for a few moments to see the time at night, and last for some time without replenishing? Any information will oblige.—PERPLEXED.

[67932.]—**Governors.**—I have just completed a small vertical steam-engine, cylinder 2in. by 3½in. stroke, for running a 5in. centre lathe, but I find that the engine requires a great deal of attention, so I want to fit governors to it. Will you kindly let me know what kind are best? Also details, so that I can get out the patterns for castings. I should like them as compact as possible. The speed of engine is 120 revs. at 50lb. to 60lb. pressure.—S.

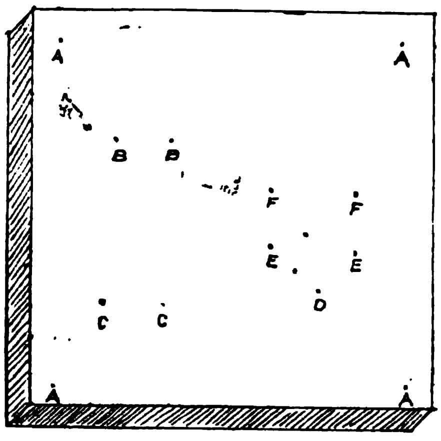
[67933.]—**Dynamo.**—Will Mr. Bottone kindly inform me—with reference to Siemens dynamo, 1½in. by 4in. armature, in his book "The Dynamo"—(1) if it will light two 10c.p. lamps or one 20c.p. lamp (incandescent)? 2. What number of revolutions per minute it should run? 3. What size wire from dynamo to lamps? 4. What size accumulator should I require to last five hours, and how long would it (the accumulator) take to charge?—SCORPION.

[67934.]—**Wire Ropes and Cables.**—Could any reader kindly inform whether there is any table published for calculating the breaking strains of iron, steel, and other wires? What is the most modern type of wire-testing apparatus? Can anyone favour with a formula for determining the proper lays of wires in compound ropes or cables, so that all the component wires shall do their proper and proportionate amount of work?—A. B.

[67935.]—**Flues.**—I shall be glad to hear if there are any rules for calculating the length and diameter of flue pipes used in the open air; the question under consideration being the efficiency of a 50ft. zinc flue pipe 9in. diam., from a very small register stove.—B. A. S.

[67936.]—**Chemical.**—1. Will some chemical friend inform me how to make barium hydrate free from iron I make the barium hydrate by heating the nitrate in fire-clay crucibles and dissolving the oxide thus produced in water; but I find it either takes up iron from the crucibles, or from the iron evaporating pans, or from the nitrate itself. 2. Has barium hydrate any action on wrought or cast iron? 3. Is there any other cheap process for making barium hydrate free from iron and other impurities?—T. H. C.

[67937.]—**Electric Coil.**—I have an electric coil, but I cannot get the right connections. Will somebody please enlighten me? On the plan, A, A, A, A are the four terminals; B B are the primary wire ends; C C is the secondary wire; D is the pillar carrying spring; E E are the pillars carrying the platinum tipped screw, and F F is the magnet.—Amateur.



[67938.]—**Turbine v. Waterwheel.**—In a certain flour mill, near to where I reside, there is an overshot waterwheel, which, when there is plenty of water, will give about 14H.P. In summer there is a scarcity of it, and I am wishful to know if one of the most recent makes of turbines would develop more, or as much, power with much less water than at present, and also what would be the probable cost. I may say that the fall for a turbine would be about 16ft. A sketch of one would oblige.—Economist.

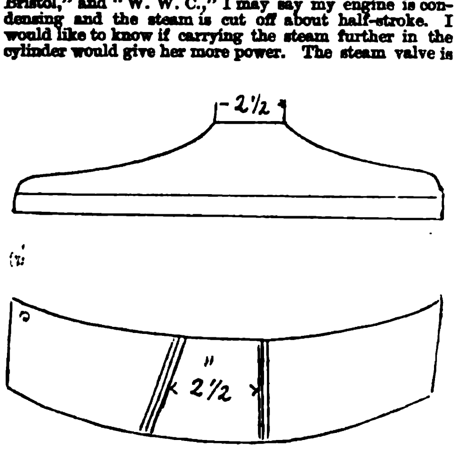
[67939.]—**Superficial Viscosity of Liquids.**—Can anyone direct me to any paper or book in which this subject and the phenomena of "frothing" in liquids is satisfactorily dealt with?—S. S. Notcutt, Jun.

[67940.]—**Practical Physiology.**—Would some one say what is the most important apparatus used in studying the physiology of muscle, nerve, the circulatory and respiratory systems, and the organs of sense? I should like a list of the apparatus given. If some brother reader who has been in for the London B.Sc. or M.B. Exams., or similar, would say what apparatus his knowledge was tested with, and how, it would be a great boon to private students, such information not being obtainable from books.—Int.B.Sc.

[67941.]—**Wind in Raising Waves and Minimum Velocity of Waves.**—Will some one kindly inform me—1. What is the least velocity of air that can raise a ripple on oil? Sir W. Thomson gives it as 660cms. per second in the case of pure water. 2. What is the minimum velocity of an oil wave (that of a water wave is about 23cms. per second)? 3. Whether there is any, and, if any, what, relation between the minimum velocity of the wind sufficient to raise a wave in a liquid, and the minimum velocity of a wave of the same liquid?—S. S. Notcutt, Jun.

[67942.]—**Accumulators.**—Can any reader give me particulars how to proceed to make an accumulator of approved pattern to run ten 16c.p. 100-volt lamps? Also how to charge from shunt dynamo.—Elec.

[67943.]—**Power of Engine.**—In answer to "T. C., Bristol," and "W. W. C.," I may say my engine is condensing and the steam is cut off about half-stroke. I would like to know if carrying the steam further in the cylinder would give her more power. The steam valve is lifted with a cam as per sketch. A full answer will greatly oblige.—Millwright.



[67944.]—**Lead Cistern.**—I want to make a cistern of sheet lead to contain sulphuric acid. How have I to braze or solder the joints with lead, not with an alloy?—A Dutch Subscriber.

[67945.]—**Parallel Vices.**—Will some who have had experience say whether they prefer these of the old-fashioned screw kind, or the instantaneous grip? I feel inclined to the former as being more reliable.—Edward M. Richards.

[67946.]—**Straight Edge.**—To "A. R., Scorrier Saw Mills."—Will you kindly tell me what gauge steel straight-edges should be from 2ft. up to 4ft? I have got an old pit-saw by me and I thought of having it made into straight edges. It is 14 gauge on tooth, and about a gauge thinner at the back.—Sawyer.

[67947.]—**Dynamo Current.**—1. What is the rule for calculating the current that a shunt-wound dynamo will give? 2. Is the power required to drive a dynamo proportionate to the watts obtained? 3. Is it not a waste of power to reduce the current by putting a resistance coil in circuit, if the current in the coil does no useful work? 4. If I have a 50-volt machine giving 2 ampères with a resistance of 25 ohms in circuit and I want to reduce the current to 1 ampère, should I have to introduce an extra resistance of 25 ohms, or could I reduce the E.M.F. to 25 volts by driving at a lower speed?—G. D.

[67948.]—**Wind Pressure.**—I have just completed a home-made instrument for measuring the pressure of the wind. I shall be much obliged if some one would kindly give his opinion as to its adaptability for that purpose. In the first place, it consists of a base board 1in. thick and 1ft. square. On two sides I have mounted a common window-sash pulley with deep grooves. On the top of each pulley a steel horizontal spindle, with the pressure plate attached, exactly 1ft. square, rides with very little friction. Connected by a collar with the spindle is one of Salter's patent spring balances, measuring 25lb. On the face of the balance is stretched a small wire, on which a thin slip of brass is placed, against which the index finger presses back and leaves at the highest point. During the late gales it has appeared to work very well side by side with one of Negretti and Zambra's Cup anemometers, registering 9lb. when the greatest velocity of the wind by the anemometer was 40 miles per hour. I am aware that it can only register a pressure of 25lb. to the square foot. This means a velocity of upwards of 70 miles per hour.—J. F.

[67949.]—**Microscope Definition.**—I have a small microscope which I wish to use for micro-photography, but it does not define very clearly. Can any reader tell me the cause of this and how it may be remedied?—J. S. Mandane.

[67950.]—**Berthon's Equatorial Stand.**—I am about to mount a 15½in. mirror by Mr. Linscott, Ramsgate. Would "F.R.A.S." or some other competent person give me the benefit of his experience with respect to above stand? Can it be adapted to so large an instrument and executed cheaply? Can clockwork be added ultimately if required? Where can I obtain sketches to aid me? Would "F.R.A.S." also kindly say if the corrections by Newcomb's Tables of the R.A. and Dec. of the moon, as given in the *N.A.* for this year, still leave any considerable error with respect to her true place, and if so, what the average error in R.A. and Dec. is likely to be. For instance, what is the degree of dependence to be placed on these two elements, as given on p. 398 of the *Nautical Almanac*?—Luna.

[67951.]—**Electric Signalling.**—I am making a model to warn engine-drivers in foggy weather when signal arm is on—that is, at danger. Also for warning them when starting them out of a station if starting signal is off or on, as I have read of two collisions this last twelve months occurring from the above cause. I want to make a small electric engine to run on about 5ft. of small rails, about 2in. gauge. Having a little knowledge of electricity (but none of steam), I thought of trying to make a small electric engine to work my model signalling apparatus. Perhaps Mr. Bottone or some other electrician will put me on the right track how to make it.—Bamouth.

[67952.]—**Electro-Magnets.**—I am desirous of arranging about 100 small electro-magnets, each to attract and sustain 6lb. from a distance of ¼in. Can these be worked on one circuit, and is the current from a dynamo machine suitable for putting them into action? They will not all be needed at one time, and continually changing; as each particular magnet is required, it will be put into action by a contact maker sending a current of electricity to it from the circuit. If it is practicable to do this on one circuit and with a dynamo, I should be obliged for any information as to sizes of magnets, wire, dynamo, &c.—An Old Reader.

[67953.]—**Battery.**—To "Nedraw."—Should like to know a little more about the battery you recommend (in letter 29629) for small installations. Would cells do if composed of crushed carbon in outer cells of 6 by 4, with carbon plate and porous pot, same size as Leclanché No. 2, as that would come cheaper than the corrugated and give about the same surface, I should think. Also the length of time the light lasts each time of using. If used for an hour or two each evening, would it run for the time said in your letter?—Mechanic.

[67954.]—**Dynamo.**—Will you oblige by giving the following information? I have the castings of a Manchester type dynamo. Size of wrought cores 6 by 3, armature 4½in. diam. and 4in. deep, with 10 cogs (laminated). I intend putting on the F.M. 23lb. No. 20 wire, and about 4½lb. No. 18 on armature. Will you tell me what will be the quantity of current in ampères and E.M.F. in volts from the machine? How many 20c.p. lamps can I light and size of mains to carry the current 50yds. from machine? Also what speed should the machine run and H.P. engine to drive?—Amateur Electrician.

[67955.]—**Book-keeping.**—I am in business and have just finished stock-taking. I follow Pitman's system of "Book-keeping for Retail Traders," and get out a profit and loss account as well as a balance sheet. For several years the net profit shown by profit and loss account has been considerably less than that shown by balance-sheet, and I am unable to discover the cause of this difference. Would one of "ours" kindly help me?—Trader.

[67956.]—**Polishing Machine.**—Can any reader inform me how to construct a polishing machine that will enable me to polish zinc plates, &c., as bright as a mirror? The machine to be worked by treadle and to turn out a number in a short time. The plates to be polished are from 15in. downwards. I have a 20in. diam. iron flywheel and treadle, which is fastened to the floor under table or bench.—Flywheel.

[67957.]—**Voss Machine.**—Three or four years ago I made one of these machines and it used to give about a 2in. spark. I have not had occasion to use it during the last year or so, and, although it appears to be in perfect condition, do what I will I cannot now get any result from it. Would Mr. Bottone or some other experienced reader kindly say where my machine is probably at fault? Also where I can find a full description of this machine?—W. B. C.

[67958.]—**Distancing Shafting.**—Can any practical reader tell me the best distance to place the centres of two shafts, a 12ft. pulley to drive a 6ft. pulley with leather link belt 15in. wide? I want to get the best driving results with least weight on bearings. Please to give formula for obtaining the same. Do not know algebra.—General Jobber.

[67959.]—**Engine Query.**—We are thinking of doing away with a vertical engine turning 200I.H.P. What size cylinders should we require—5ft. stroke, 60 revs. per min., boiler pressure 80lb.? The engine to be tandem; to drive 200I.H.P. compounded, and which would be the best points of cut-off in h.p. cylinder? Also l.p. cylinder, and what would be the best proportion of cylinders 3 or 4 to 1 to give best results? When the steam is cut off at ½ of stroke and cylinders 3 to 1, is it called 9 expansions or 6 expansions? Also what size of belt would it require with rule? The diameter of flywheel will be about 15ft. Cannot get a larger. What weight ought it to be, with rule, if possible, in plain figures.—Young Engineman.

[67960.]—**Starting Compound Condensing Engine.**—Would "T. C." or some other engineer kindly explain the following? 1. At each of l.p. cylinders there is a small pipe and valve that lead from its valve-box to within a few inches of the indicator taps and into cylinder. Now, what are these for? If for blowing through with, how does the steam get into them when the h.p. cylinder or engine is stopped? 2. Should the injection tap be opened before the engine starts, or let condenser get warm first? 3. If the engine lost her water a few minutes after starting, what would be the cause of it, and the best way to start her again?—A Young Fireman.

[67961.]—**Finding Areas.**—Will some reader give me a rule for finding the area of the section? Also a rule for finding the size of an oval equal in area to the section. Also give a rule for finding the area of a triangle, and a rule for finding size of an oval equal to the triangle.—Steel.

[67962.]—**Blueing Solution for Steel.**—I have just come across an alleged recipe for blueing screws, but I suspect it. Such a recipe has been asked for many times without success, and the very form in which this is given is suspicious. Four and two-third ounces of hyposulphite of soda are to be dissolved in one quart of water, and one and one-sixth ounce of acetate of lead in another quart of water. The two solutions are mixed, made to boil, and the screws are immersed, for how long is not stated, but the "result" is stated to be same as blueing them by heat. Is it possible that a thin film of lead may be imparted to the steel by this means, or what would be the result of boiling two such solutions?—W. T. E.

[67963.]—**Watch.**—I have a Geneve calender watch, which goes very unsatisfactorily. The balance does not swing more than half a revolution, while other watches at one-sixth of the price, swing far better with the same driving power. I have been told that it is a very good watch. I have had it for four years, and during that time have spent upwards of £7 for repairs. I heard a noise in my watch-pocket a few days ago and found that the watch was running wild, with the barrel broken. Would it be better to convert into a lever (if possible), and what would be the probable cost? What is the superiority of the lever escapement over the horizontal?—A. G. G. C.

[67964.]—**Dressing Thrashing Machine Cloths.**—Will any reader kindly tell me the proper mode of dressing thrashing machine covers? The material used is best sail canvas. I have tried both linseed and boiled oils; but find it makes them so heavy and stiff, and thereby rotting the cloth so quickly. What I want to obtain is a shiny dress quite pliable.—Young Beginner.

[67965.]—**Aquatic Beetles.**—There are ponds a little distance from me swarming with dytisci and other carnivorous beetles. Wanted advice for catching them. Can any reader suggest some sort of trap? The weeds prevent dragging with a net.—Dytiscus.

[67966.]—**Varnishing Maps.**—I am varnishing a set of maps. I give the maps two strong coats of patent size, applied warm at an interval of twelve hours. When quite dry I give a coat of best copal varnish, with some turpentine mixed in to lighten and thin it. The brushes, materials, and vessels are all perfectly clean; yet the varnish dries all over pitted with innumerable minute holes, which completely spoil it, giving it a dirty, greasy appearance. I have tried paper varnish with just the same disappointing result. Would any reader tell me in what I am wrong, and what is the remedy?—Copal.

[67967.]—**Engine and Boiler.**—To "T. C., Bristol," or Others.—I have a vertical cross-tube boiler, 18in. diam., 36in. high, with firebox, 20in. high by 15in. diam.; uptake 3in. inside diam.; one cross tube 4in. diameter; ⅜in. mild steel plates, ½ crown plates. What pressure would such a boiler be safe to work at? I intend it to work an engine, 3in. bore by 4in. stroke (launch), and what would be the I.H.P. of engine worked by above? Boiler cutting off at ½-stroke.—Congoufaur.

[67968.]—**Back-geared Lathe.**—I wish to make 3in. lathe. Will any reader give dimensions for moulds? Any information respecting above will be thankfully received.—Percy Sykes.

[67969.]—**Oak Polishing.**—Will some friend please tell me how to fill the grain and polish oak, particularly for coffins?—Amateur Carpenter.

[67970.]—**Music from Wood.**—I wish to make a musical instrument I saw, which is made up of pieces of wood of various sizes, which, when struck with a small wooden mallet, emitted musical sounds. Any instructions for making the above will greatly oblige.—An Artisan.

[67971.]—**Rhea Fibre.**—I shall be obliged [illegible] reader who can give information as to this [illegible] (silken) fibre. Also the last and best known mode [illegible] integrating the fibre from the stem—i.e., the [illegible] separating the fibres. In other words, the mo[illegible] solving or rendering non-glutinous the gum [illegible] the fibre together. Also can anyone refer [illegible] patents to effect the above.—The Brae.

[67972.]—**Dynamo.**—To Mr. Botto[illegible] and [illegible] a 20c.p. dynamo, but cannot get it to [illegible] armature is H section, 3½in. by 1½in..

No. 20 s.c.c. wire. The field-magnets are 4in. wide and 6in. high, with 4in. wire space, wound with nearly 7lb. of No. 22 d.c.c. wire. The fault seems to be in the armature, as I cannot get any current from it. But I get a current from field-magnets when coupled as series, even when the brushes have no contact with commutator. In fact, I can get a spark. I get no current when in shunt; but on breaking and making contact with commutator, I get a shock; but this, I think, is owing to the magnetic induction of the armature on the fields. Is it not? The insulation is perfect. The iron is soft as far as the file test goes, and they seem pretty powerful when coupled to four pint bichromate cells in series, but will not work as a motor, as commutator slits are very fine, and will not break contact when on dead points. My bearings are of brass, armature heads are brass, and all screws are brass. I have had slips of commutator and brushes in right position. The armature wire only comes level with the channel in armature. As will be seen, it passes clear of the pole-pieces by ⅛in. Will this be the cause? I have got N.S. poles consecutive. I have also run the dynamo right and left hand.—C. Jones.

[67973.]—**Small Dynamo.**—I should be glad if Mr. Bottone or anyone else could tell me the cause of failure in the following? I have made a small dynamo, and, according to what I have read in the "E. M.," I expected about 12 volts from it. However, I was disappointed. I connected it with a bell to see if it would ring it, and it did faintly when running slowly, and when I made it go faster, or as fast as I could, I do not know what speed—something awful—it would do nothing. Armature 1¼in. diam., 2in. long, H pattern, wrought iron, which I riveted together, expecting it to be better than cast iron. Armature core ⅝, wound with nine layers 25c.c. F.M.'s 4⅜ long. Wrought-iron pole-pieces cast on wire space, 2⅜ long, 1¼ by ⅝, wound with 25 c.c., seven layers. Length of armature core is not 2in., as the wire only comes to that, coupled shunt.—J. Whiteley.

[67974.]—**Soluble Paraffin Wax.**—In the course of some experiments with paraffin wax and mineral oils, I have succeeded in saponifying them, and rendering the paraffin wax soluble in water, the same as gum-arabic (without saponification), as a paste or cream without taste or smell or change of colour. I am informed that this soluble paraffin wax may be found useful in pharmacy, perfumery, and also to manufacturing confectioners. Can any brother reader give me an idea of how it can be utilised to advantage?—A Working Man.

[67975.]—**Bottled and Canistered Fruits.**—I intend shortly to proceed to one of the celebrated fruit-growing states of America and entering upon that business, and shall be exceedingly glad if any reader could give me reliable information on the subject of preparing and bottling such fruits as pine-apples, peaches, pears, plums, strawberries, &c., such as we see in such vast quantities now exposed for sale in the provision stores of this country, and also I should be glad if anyone could instruct me in the process adopted in the crystallisation of fruits, such as are sold in fancy and other boxes and how candied citron is prepared.—Florida.

[67976.]—**Small Vertical Engine.**—I should be very glad if one of "ours" would supply sketches of a good designed vertical engine from ½ to 1H.P., the base-plate large enough for the boiler to stand on and be used as a tank and water heater for supplying the boiler. There would be some good of an engine of this size, as it would take up little room and drive a 5in. lathe. These engines would be much better than spending so much time on toys of ½in. bored cylinders. The engine to be fixed on base-plate with crank shaft low, on the inverted principle like Hindley's make. It might pay some one to design the engines and supply the castings, &c., at a moderate cost. Cylinder bored, and crank and flywheel bored and turned if required.—Ex.

[67977.]—**G.E.R. Locos.**—Can "East Anglian," "Stratford," or any other contributor say whether a new type of express engine has recently come out? According to my information it was to have single driving wheels (7ft. or 7ft. 6in. diam.) and inside cylinders. Dimensions and a sketch would oblige.—Baltimore.

[67978.]—**Fucus.**—Will some one give me a sketch of the life history of fucus, and its mode of reproduction?—H. W.

[67979.]—**Elementary Biology.**—I want to become acquainted with the development of the frog, rabbit, and fowl—more particularly with the chief changes which take place during their embryonic life. Will some one recommend me a book, or books, of not too advanced character, from which I can get the information?—H. W.

[67980.]—**Recovering Sulphate of Copper.**—Please tell me how to recover sulphate of copper from old dipping and pickling solutions? I want it tolerably pure. —William Jackson.

[67981.]—**Accumulators.**—I have a 20c.p. dynamo, shunt-wound. I want to charge accumulators, so as to give 5 or 10c.p. for about three or four hours at night. What size plates should I require, and how long should I have to run dynamo to charge accumulator for time mentioned?—Old Crock.

[67982.]—**Moulding.**—Can some one inform me what is the best kind of sand, or clay, or mixture to use for moulding for small castings in lead, &c.?—O.

[67983.]—**Wood-Carving or Shaping Machine.**—Will some one kindly inform me if a wood-carving machine is to be had? I know several machines of this description have been invented and used, and also that such a machine was used for the carvings in the Houses of Parliament, but I do not know whether they are still used. I have never seen a description of one in "Ours." What I want myself is not really a carving, but a shaping machine—that is, a machine that will reproduce a given pattern (of either convex or concave form) in duplicate any number of times. I suppose such a machine would [illegible]ly be a sort of pantograph with revolving cutters. A [illegible]ription, with sketch, will be of interest to many as [illegible]—Ignoramus.

[illegible]—**Forming Accumulators.**—Will any [illegible]ly say the best way of forming the plates of a [illegible]tors. The plates are 9 by 6 by ¼ thick, cast [illegible]hen filled with red lead made into a paste [illegible]phuric acid. I have tried them with a [illegible] with a heavy one, but they will only take a small charge, say, 1 amp. hour. The voltage is right and they return the small charge. 1. How can I get them to hold more? 2. Should they be charged continuously till they are formed, say, 2 amp. per plate, or should they be stopped when they begin to boil? 3. Should the charge be taken out time after time till they hold more?—One in a Fix.

d = dia

3

4

Then diameter × 1·2 = 81·3in.

[67985.]—**Engine.**—To "T. C., Bristol."—I have a horizontal engine. The cylinder is 1⅝in. bore, and the piston has a stroke of 2¼in. The steam ports measure 6-16in. by ⅜in., and the exhaust ⅜in. by 3-16in. What effective power can be obtained from the above, working at 60lb. per square inch (allowing for friction) and at what speed will it run? What size boiler would suit the above engine? Could it be heated by Bunsen gas-burners?—Horizontal.

[67986.]—**Practical Electric Bell Fitting.**—I am making a detector as described on p. 405, Vol. XLVII. Will some one kindly tell me how I can silver over the brass plate used for the dial, as spoken of by F. C. Allsop?—Detector.

[67987.]—**Horse Balls.**—Could anyone tell me how horse balls are made with round ends? Also how are they coated? I should like to know how they are made in large firms.—Chemist.

[67988.]—**Whalebone Cutter.**—Would some reader kindly give me some information as to the way of cutting or splitting whalebone into thin slips for staymaking purposes? I have a large quantity, but am quite unable to use it, not knowing how to cut it.—A Constant Reader.

[67989.]—**Mandolin.**—Can any reader give dimensions and how to make a mandolin?—Mandolin.

[67990.]—**Counting Speed of Quick-Speed Engines.**—What is the simplest means of counting the revolutions of quick-speed engines?—Ex.

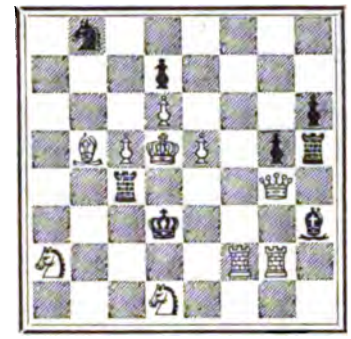
CHESS.

All communications for this department must be addressed "Chess Editor, English Mechanic, 332, Strand."

PROBLEM MCXXXVIII.—By E. J. Winter Wood.

(From "Chess Stars.")

Black.



White. [10 + 8

White compels Black to mate in two moves.

Solution to 1,136.

White.	*Black.*
1. P-Q 4.	1. Anything.
2. Q, B, or Kt. mates.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,136 by F. C. Cook, J. Kistruck, E. Sanders (very neat), Link, Formica, A. Bolus, G. W. Middleton, J. G. Hankin, A. Dean, J. Kilbee, and Fr. Fernando; to 1,135 by J. Kilbee, J. Kistruck, Link, and J. G. Hankin.

Names entered for Tourney:—A Dean (C), J. W. Read (C), and J. Killbee. At present only two have entered for A, one for B, and five for C.

C. J. Lambert.—Thanks for very interesting game.

F. C. Cook.—We shall be very pleased to receive the promised problem.

J. W. Read.—If in 1,136, 1. $\frac{\text{B takes P}}{\text{P takes Kt}}$, and then if 2. Q-K 6 (ch), K escapes at B 4; and *Tri-Weekly Gleaner*, *Sunny South* received with thanks.

The *Leeds Mercury* publishes a remarkable quadruple problem by G. A. Corrias, of Ozieri, Sardinia, which consists of a three-move problem, no matter which way the board is turned, each time giving a new problem.

It has at length been arranged that the match between Lancashire and Yorkshire shall be played on Saturday, 9th March, at the Athenæum, Manchester. A county match between Lancashire minus Liverpool, and Yorkshire minus Leeds sounds rather paradoxical in terms. Though each side may muster some strong players, the teams cannot by any means be considered as fairly representative of the counties.

Mr. Carslake Winter Wood has commenced an interesting Chess Column in the *Western Portfolio*, an entertaining monthly journal, published at Victoria Chambers, St. Andrew's-place, Plymouth, at threepence per number.

In the London *Evening Post*, Mr. Gunsberg describes Mr. Blackburne's blindfold games, played recently at Manchester with Mr. T. B. Wilson, as "worthy of Morphy's best efforts."

In the first round for the Cheshire Challenge Cup, Birkenhead has beaten Egremont, and Northwich has been defeated by Crewe, Macclesfield being a bye.

Captain Mackenzie has won his match with Senor Golmayo by seven games to four.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 27, and unacknowledged elsewhere:—

Pommes de Terre.—Experimenter.—Amateur Optician.—Helix.—Cook.—G. F.—A. R. Timson.—Welsh Horologist.—B.Sc., Plymouth.—D. Roberts.—Whaddon.—Dunelm.—South African.—Young Fitter.—Ignor.—G. B. Luckhöff.—Electric.—Thankful.—Eos.—V. I. A.—Forres, N.B.—A Fellow of the Royal Astronomical Society.

Electro Amateur. (Why send a question which has been answered hundreds of times? It is possible to light an incandescent lamp by a battery, and even by a Leclanché battery; but the Leclanché form will not "do" because it, so to speak, "runs down" after a minute or so. Use a chromic-acid battery. See indices.)—D. Webov. (Why not use a plainer signature? To "construct" an electric lamp of 2 or 3c.p. you will require a glass-blower's plant, a furnace for preparing the carbon filament, and a Sprengel's or mercury air-pump for creating a vacuum. All things considered, it would be cheaper to buy the lamp; but you will find full particulars in back volumes.) — F. Walford. (The method of constructing a Bell telephone has been recently given; but there is no reason why you should not experiment with other forms. Many have been described in back volumes, and so has the method of making permanent magnets.)—Amateur. (By "text-books" is meant any book used by students for learning a given subject. The Westinghouse air-pump is illustrated in back volumes, in the prospectus issued by the company, and in very many books relating to the locomotive, railways, and the steam-engine.)—Stammer. (You have already found the remedy when you say "I find sometimes that if I talk steady and take my time"—well, find that always. It is the secret of curing stammering. See indices for many hints.)—A. J. P. C. (See previous answer. A similar case—"should he forget he stammers he can speak freely." That is it. Practise reading and speaking very slowly, and the speed will follow without the stammer. 2. We agree with you, and we are quite sure our printers do, for they heartily wish advertisers would write plainly—especially names, addresses, dimensions, and prices.)—Summer Fisher. ("Best baits" vary with the season, the state of the water, &c.)—A. Williams. (You will not find it economical to "make" the rubber varnish. You should buy it ready prepared. Boiled linseed oil does not dry so very yellow. See many hints in back volumes.)—Amateur. (See answer to "Reflector" last week. The fullest possible information about making silver-on-glass telescopes has been given in our back volumes.)—Steam. (Was not the construction of such a trough recently described, and will not glass do? See p. 458 of last vol., Feb. 1. Plaster of Paris will set "hard enough" if it is good stuff and is properly treated.)—Edwin G. Pickering. (Sprague's "Electricity," E. and F. N. Spon, 125, Strand—think it is out of print, though—and Tunmer's "Electricity in the Treatment of Disease," E. W. Allen, Ave Maria-lane, E.C.)—One in a Fix. (Steam or boil the wood; pinch it up in a vice, and you will find no difficulty. It is really not a puzzle at all, because it cannot be done unless the wood is softened.)—Y. M. C. A. (A strong solution of tungstate of soda will render most things fireproof, or non-inflammable, at least.)—Enquirer. (The plaster should be sized well before applying the paint, otherwise it will so far "injure" the paint that it will absorb the oil.)—Tamar. (You do not require many practical hints for using the manifold or carbon papers; but if you do they will show you at the stationers where the paper is sold. Use a metallic pencil, and if you want to prepare the paper yourself, make a mixture of washed lard and lampblack, or olive oil and lampblack. See indices.)—Piano. (Answered many times. Oil kills all insects. Therefore force oil into the holes in your furniture, or rub in grease and melt it while in place.)—B. B. (In 1837 Steinheil—at Munich, we think—discovered that the earth could be used as the return conductor. Wheatstone was probably the first to use the earth in this country.)—Berzelius. (What do you mean by the "analyst's point of view"? If the point of view of the analyst who obtains fees for estimating the dyeing value of dyestuffs, it is scarcely likely that any such work is published; but there is Crookes's "Handbook of Dyeing and Calico-printing," Longmans; and Slater's "Manual of Colours and Dye Wares," Crosby Lockwood and Son.)—Macbeth. (The mandoline is a stringed instrument, the strings of which are put into vibration by means of a plectrum. It is different in tone to any stringed instrument.) — S. Walker. (Pattern-maker's varnish is shellac dissolved in wood naphtha or methylated spirit, and coloured with any suitable pigment—vermilion, say, or dragon's blood, gamboge or turmeric. For large patterns paint is generally used.)—E. B. (See the forthcoming index and the back volumes. A good aquarium cement is composed of three parts each of powdered litharge, fine white sand, and plaster of Paris, mixed with one part of powdered rosin, and made into a paste with boiled linseed oil and driers.)—T. E. Spence. (Do you mean the "Home-made Incubator" in No. 1195? There are several designs in back volumes.)—Ancient Greece. ("Tinned meats" and "potted meats" are different; but you will find all particulars of the methods of preparation in back numbers.)—Novice. (Why not take a few lessons, or procure a handbook of the art? There are several articles on bookbinding in back volumes, and a variety of useful hints. If you pull an old book to pieces you will see how the "stringing," as you term it, has been done.)—H. W. (No one can say without seeing a specimen; but probably one of the aniline dyes. 2. Specially prepared colours are used for tinting photographs.)—S. A. B. (Scarcely understand you, but several forms of coil have been illustrated recently. 2. The tires of the wheels are coned; there is a little play in the axle-boxes; and the outer rail is raised slightly. There is also a little slip.)—J. E. P. (Many instruments for describing ovals and ellipses have been illustrated in back numbers, and you can see some of the most useful at Mr. Stanley's in Great Turnstile, W.C. Perhaps his work on "Drawing Instruments" would supply the information you require.)—Puzzled. (Why not procure a manual of the game? We could not spare space.)—R. Brown. (Ginger ale is not brewed with yeast. Here is a recipe: Take 1 gallon of plain syrup at 42° Twad. and add 4fl.oz. of compound tincture of ginger, 4fl.oz. of acetic acid, and ½fl.oz. of sugar colouring. Use an ounce or more to each bottle of aërated water. If you want any similar information, look in our advertisement columns, and apply to Messrs. Barnett and Foster for one of their catalogues.)—Subscriber. (Yes; back numbers. No book.)—F. H. Moore. (We do not know, but no doubt dealers in electrical appliances would procure it. We quoted the description.)—A Learner. (See previous answer. We have no further details. Plenty of telephones in back volumes.)—Horse Power. (Please see indices or the textbooks. The queries have been answered many times.)—Country Boy. (Are you going to manage a steam-engine or what? If so, procure a sixpenny book, "The Safe Use of Steam," published by Crosby Lockwood and Son, and Bourne's "Catechism of the Steam-Engine," published by Longmans.)—Telephone. (See the advertisement pages. All the available telephones are mentioned in them, and descriptions will be found in the back volumes.)—J. McC. W. (You must be articled to a civil or a mechanical engineer; but you can obtain the degree of bachelor of engineering from Dublin and Queen's University, Ireland.) — Musical Nigger. (Ground alum or borax, we suppose.) — Enquirer. (Many recipes for inks in back volumes. Do you want to make the inks on the commercial scale, or merely for private use? The aniline colours make excellent inks.) —Constant Reader, A.T.P. (The directions given on Feb. 8 are sufficiently explicit. The battery wires are connected as described at A A; but Leclanché cells are not of much use for such work, as they "run down" so quickly. Use Fuller cells or the chromic-acid battery. Read again, and trace all the connections.)—J. W. (See the back volumes. The gums must be fused and then dissolved in the turpentine. Varnish-making cannot be carried on economically on the small scale; but if time can be given, pulverise the gums, mix with crushed glass, and put into bottles with the solvents. Then leave in a warm (not hot) place, and give an occasional shake.)—Myth. (You could find an answer in the back volumes. The best medium for mixing with the bronze powders is a pale copal varnish, free from lead, which has been treated to a few bits of quicklime and six times its bulk of turpentine. Mix the filtered varnish and the bronze powder as required. 2. See indices for references about the saws. They require hammering and special tempering, and altogether an amount of skill which can be acquired only by practice.) —H. Wake, W. J. Parker, Viator, Lux. (In type.)

The curative powers of **Harness' Electropathic** BATTERY BELT cannot be too widely known. It is the only bona-fide genuine galvanic belt recommended by thousands (see testimonials) as a simple, natural, and speedy cure for all Rheumatic and Nervous affections, Impaired Vitality, Liver and Kidney Diseases, Ladies' Ailments, &c. Pamphlet and advice may be had (gratis) personally or by letter, on application to Mr. C. B. HARNESS, Consulting Medical Electrician, the MEDICAL BATTERY COMPANY (Limited), 52, Oxford-street, London, W. (corner of Rathbone-place).

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Holloway's Pills and Ointment.—The Pills are one of the most effective remedies ever discovered for cases of obstinate constipation, confirmed indigestion and colic, complaints which are engendered by exposure and irregular feeding. The Ointment will be found of the very greatest service in cases of piles, abscesses, erysipelas, and all kinds of local ulcerations.

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Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good value offered for all kinds of **Instruments** and Collections of Apparatus of Scientific nature.—Caplatzi, Science Exchange, Chenies-street, Tottenham Court-road.

Piano.—What offers for handsome rosewood grand, out of repair. Would suit amateur to learn tuning and repairing on.—C., Finsbury House, Wood-green.

6¼ centre Back-geared **Lathe**, eight feet polished oak bed, iron top, slide-rest partly made, face-plate, drill chuck, T-rests, &c. Want Safety Gas Engine, or offers.—Hoy, Kingsley-street, Sunderland.

Astronomical Telescopes.—Several to be exchanged. —J. Bassett, 48, Leswin-road, Stoke Newington.

Lathe Heads, back-geared, 7in. or 8in. wanted. Will give good English Silver Lever Watch in perfect order, value 50s.—Thos. Crook, 65, Church-street, Preston.

Dr. Nichol's **Fountain Bath and Raising** Douch, most valuable hydropathic appliances, quite new, not used, cost 63s. Offers, Lathe, Drilling Machine, Books, &c.—Below.

Circular Saw Spindle, 2⅜ thick, 4ft. long, with saw, sell at 20s. What offers in exchange?—Webster, Bridge-street, Belton.

Electrical Appliances.—A lot to be disposed of cheap. What offers?—Apply, Goddard, High-street, Dorking.

Portable Fan Forge, hood and iron chimney, powerful Screw Press, lot of Magic Lantern Slides, mahogany case of Microscopic Mountings, second-hand Safety Bicycle.

Lathe Wheel, speeded for gut band, 120lb., crank and treadle not required. Exchange offers.—Thomas, 15, Woodcross, near Bilston, Staffs.

Small Lathe wanted. Would exchange for thorough instructions on the Clarionet, by a Professor.—Address, H. Moon, 19, Mossbury-road, Clapham Junction.

American Organ, handsome £18 instrument, numerous stops, knee-swell, voxhumana, as new, unsoiled. Exchange Piano.—Mechanic, 47, Fernhead-road, Westbourne Park.

Wanted, Screw Plates, Taps, Stocks, Dies (Whitworth preferred), all sizes, in exchange for New Files, American Organ, Magic Lantern.—Mechanic, 47, Fernhead-road, W.

Wanted Rustic Studio Accessories, in exchange for Books by Prof. Tyndall, Fragments of Science, two others.—Rustic, 4, Carlton-terrace, Harrow-road.

Mohr's Burette, other volum. and Chemical Apparatus and Chemicals, Induction Coil, two quart Bunsen Cells, never used. Correspondence invited.—Chemicus, 55, Buxton-road, Macclesfield.

"**History of Rome,**" Ward and Lock's, complete, clean, unbound. What offers Electrical or Microscopical Work? Wanted Bottone's "Electrical Instrument-Making."—Howard, Cemetery-road, Rotherham.

Quarter-Plate Camera, two lenses, two double backs, six dishes, lamp, printing frames, chemicals, and sundries, by Lancaster. Exchange 54in. Bicycle, or Safety.—Below.

Wanted, good six-keyed Piccolo, must be by good maker. Good exchange given.—Address, H. M., 34, Buckingham-road, Stratford, E.

Wanted, English Mechanic vols., for "**Cassell's** Natural History," four vols., in parts.—Saul, Pontefract.

Pair of thorough good **Skates**, worth 12s., will exchange for Electric Apparatus, Metronome, or offers.—C., 16, Elmington-road, Camberwell.

Dynamo—Slide-Rest.—Will exchange splendid 16 guinea Dynamo for Slide-Rest for 5in. Lathe. Other Electrical Goods offered.—12, Barkerend-road, Bradford, Yorks.

Wanted, a Polishing Lathe, to exchange on agreement. —R. I. W., c.o. Longfleet Post Office, Poole.

Compound Launch Engine, 3¼in., and 5in. by 4in., not quite finished, handsome and substantial design; all parts made except links and reversing lever. Exchange offers requested.—Bartram, 42, Hadlow-road, Tonbridge.

Dynamo Castings, 200 candle-power, Manchester Type Machine; also good Induction Coil, by Halse. Offers in exchange.—J. Goodley, 73, Southgate-road, Islington.

Foot Lathe wanted, in good order, with different backs. Exchange Lens and Camera.—H. Spicer, Bridge-street, Sturminster Newton.

Wanted, Furniture, Carpet, Grocery, Drapery, and Provisions. Exchange Bicycle or Tricycle, from a large stock.—Heighton, Vinco Works, Elton, Peterboro.

Sciopticon ¼-plate **Camera**, 4 double backs, long extension, very good condition. Exchange for ½-plate [illegible] Lens, or 5 by 4 Ross Portable Symmetrical, or offers.—[illegible] Weekday-cross, Nottingham.

A quart-size **Bunsen Battery**, square, in good condition. Exchange for Bichromate Battery, or 36 wire.—S. War[illegible], 11, Bromley-street, Blackburn.

Wanted, Set of Castings (or drawings from which to make patterns), of small hydraulic Organ Blower, cylinder [illegible] 2in. Exchange.—Collins, Eaton-place, Tonbridge.

Organ Pipes, open diapason and flute, tenor C to G, 44 pipes. Offers.—M. Jeavons, 33, Market-place, Willenhall.

Organ Pedals, set of birch, in good order, CC to E, 17 keys. Offers in exchange. Apply above.

Street Coil wanted, immaterial if defective, [illegible] Boiler about half horse-power. Good exchange given.—[illegible] Middleton, 65, Southampton-street, Camberwell, S.E.

Powerful 3½ stroke horizontal **Engine**, wants repairing, new Vice, two cramps, large Square. Wanted [illegible] Ship, or Boiler. Offers.—Smart, 36, Queen Anne-road, [illegible]

"**Fleetwood's Life of Christ,**" in 16 parts, [illegible] 32s.; Clarke's Patent Bicycle Rims, 24in. and 30in., new, [illegible] distance Saddle, and several bicycle fittings. What offers?—[illegible] Engineer, Armley, Leeds.

Horizontal Engine, about 2in. bore by 3in. stroke, well made, with pump, &c. Want Locomotive or offers.—P., [illegible] Stirling.

Good Self-feeding Bench Drill wanted. Exchange 24in. Lawn Mower. A genuine offer.—Address, Ironmonger, Brighton House, Redhill.

Locomotive, model of N.L.R., scale 1in. to the foot, cost £10, took prize at exhibition.—Tilbury, White Post-lane, Victoria Park.

Two 10c.p. **Dynamos**, finished for wire, with commutators and brushes, terminals, on oak baseboard. Exchange value. —Below.

100c.p. **Dynamo**, ready for wire, with commutator and brushes, gunmetal trunnions and bearings, fitted with lubricators. Exchange value.—Mitchell, Packington-place, Leamington Spa.

Amateur Rose-Engine Turners.—Valuable M.S. on the Rose-Engine, large Oval Chuck, modern Overhead [illegible] Useful exchange. Offers.—Maclean, Harwood-street, Sheffield.

Pantagraph, for enlarging sketches, photos, &c., cost 5s., complete, with instructions. Exchange anything.—[illegible] Patterson, Carlin How, R.S.O., Yorks.

Gestetner's **Cyclostyle Copying Apparatus** or Graph, cost 21s. Will exchange for works on Surveying, Building, Amateur Work, or offers.—Biggs, 116, York-road, Leeds.

Wanted to exchange genuine **Trade Recipes** and Secrets for others. Send lists to S. A. Field, The Hill, [illegible]

Key to Barnard Smith's School **Arithmetic** wanted. Exchange six-key Concert Flute.—Address, J. Bentham, [illegible] Rotherham.

Inductorium, 1in. spark, fitted with commutator, also switch to condenser, mounted on mahogany pedestal. What offers?—J. Cunningham, 66, Victoria-square, Liverpool.

"**English Mechanic,**" back numbers, from March 25th, 1887, to present date. What offers?—T. Tooley, The [illegible] Lodge, Bushey, Herts.

Small **Coil**, Camera, double back, &c., **Model** Engine, 24 parts "Popular Educator," 2 packets Gold Bronze, [illegible] Lantern Slides, &c.—George, 29, Sydney-road, Sheffield.

50in. **Bicycle**, Booth's Mitring Machine (large), both equal to new. Exchange 5in. single speed Lathe, or smaller one with back gear.—C., 13, Brackley-terrace, Chiswick, W.

One 9½in. and one 7in. **Pistons and Rods**, and two Governors. Exchange for good 4in. or 4½in. Slide-rest or offers.—6, Meyrick-road, London, S.W.

Good Brass-finisher's **Lathe**, complete. Wanted Electric, Pneumatic, and variety of articles offered in exchange.—Address, W. B., 166, Queen's-road, Bayswater.

Camera and three Dark Slides, 1-1 plate, double swing and reversible back, quite new, worth £7 10s. Want [illegible] Working Machinery, or offers.—Batty, 94, Hatchett-street, Birmingham.

"**Science Monthly,**" Vol. III., unbound, for "Cassell's Family Physician," parts 29 to 34 last Edition.—[illegible] Cavendish Buildings, Clerkenwell.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—Harger Bros., Settle, Yorks.

New Illustrated Price List of **Screws, Bolts** and Nuts for Model Work, drawn to actual size, sent on receipt of stamp. —Morris Cohen, 122, Kirkgate, Leeds.

Billiards or Bagatelle, or Requisites for ditto, or Billiard Work.—Hennig Bros., High-street, London, W.C.

Hat Bearer. A great luxury. Fits all hats. [illegible] stamps.—T. Rawson, Heaton-lane, Stockport.

Organ Metal Pipes, voiced or unvoiced. Lowest prices.—G. Shield, Little Green-lane, Small Heath, Birmingham.

Manchester Electrical Stores.—Medical Coils, Magnetos, Bells, Cells, Wires, Fittings, Chemicals. Best terms.—J. Bentley, 7, Newton-street.

Turning Woods.—Box, Ebony, Lignumvitæ, Redwood, &c. Parcels, 5s. and 10s., cut squares.—Harger Bros., Settle.

6d. Pays for three consecutive insertions of 20 word advertisements in *Belfast Morning News*.—Address, Manager.

Microscopy.—Instructive list of really high-class botanical preparations, with sample, 2d.—Walter White, Litcham, Swaffham.

Lathes. Lathes Cheap, good. List 2 stamps.—Robinson, Catherine-street, Sheffield.

Wheel-cutting and Dividing to 12 inches diameter, in brass only.—Clegg, Belinda-street, Hunslet, [illegible]

Breechloaders, single, from 13s. 6d.; [illegible] Air Guns, &c. List of Army Contractor, Granville [illegible]

Gas Engines, best and cheapest.—[illegible] Kerr and Co., Manufacturers, 101, Leadenhall-street, [illegible]

[Continued on page [illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 8, 1889.

MICROSCOPICAL ADVANCES.—XLIV.

By Dr. Royston-Pigott, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; former Fellow of St. Peter's College, Cambridge.

Apochromatic Results.—Refractions in Jet-Black Margins and Attenuated Lines of Light.

THE fine threads alluded to in the last article were produced by Mr. Boys from melted quartz (index of refraction $\mu = 1{\cdot}585$); their high index broadens their intensely black borders.*

When the jaws of the diffraction micrometer are just nearly exactly closed upon the black edges of a cylindrical fibre, two very perfectly sharp lines of light glisten on each side, and the limit of human vision is quickly reached. No diffraction is seen whatever, and the measurements can be taken with singular accuracy, the special object of the invention.

Another fine line of light can be distinguished when two fine spider lines are almost coincident, such as Browning mounts on parallel engine-cut grooves. The thinnest line of light I have been able to discern, allowing for the thickness of the two different spider lines was 1-230000th of an inch.

Fine cylinders of glass or spider-gum, acting optically as a spherical surface, develop cylindrical brilliant linear images of calculable diameters, provided the rays are parallel or originating from a given luminous point.

For condenser of 35° only, a central cone of light can pass through a sphere, leaving the shaded portions black. But as the illuminating cone is contracted, these dark shadows expand until the central rays are delivered by the sphere as a minute point of light, obeying the law of refraction. For parallel rays the distance of the primary focus from the centre for flint glass is half the radius. For—

$$f = -\frac{\mu r}{2(\mu-1)} \text{ (where } \mu \text{ usually } = \tfrac{3}{2}\text{)}$$

r being the radius of the sphere, and μ the refractive index. The primary focus for parallel rays is *outside* the sphere; whilst, as the aperture diminishes, the black margins broaden, and the image of a more distant luminous origin shrinks more and more until at last it vanishes.

It may be now opportune to allude to some of the substances giving variable black margins, either as fibres, bubbles, or islets, such as tabasheer, glass, quartz, English spider-webs, and Indian spider-silk.

When the glasses were haunted with spurious images no exact definition could be attained of the central line of light beyond what then measured about 1-100000th of an inch. The splendid definition of this infinitesimal image by means of Powell and Lealand's newest apochromatic 1-12th objective is a delightful surprise. Under 1,300 diameters the broad margins are displayed: both the inside and outside edges exhibit the most perfect symmetry and precision of breadth. Of the two, collodion fibres are the most interesting, and, in Mr. Boys's opinion, the most delicate. They show the true black margins and central bright line. The Darjeeling silk gives the same effects without any spectrum of intersections (Fig. 2).

The minute islets of iodide of potassium and mercury solution is well represented in figure by 1,260 diameters (Fig. 3).

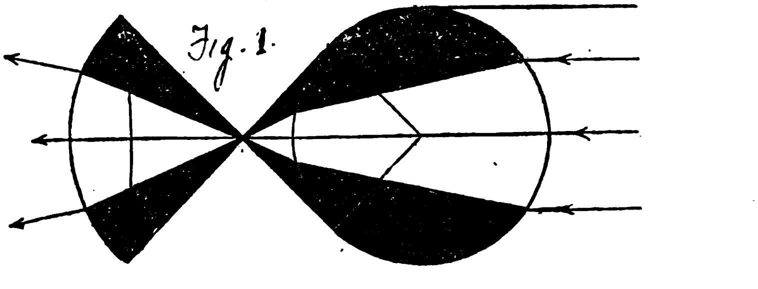


Fig. 1.

FIG. 2

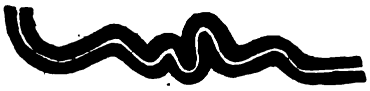
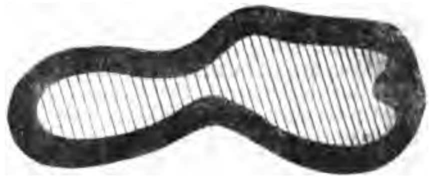


FIG. 3



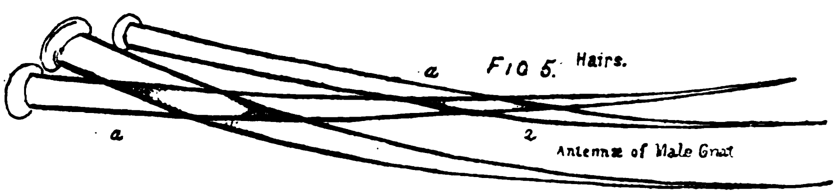


FIG. 5.

Ordinary garden spider's web in England is extremely transparent and refractive, exhibiting with parallel illumination two exquisitely clear and densely black margins. Spiders last year were very scarce; but a very small spider was seen forming most minute threads, which were secured under a glass "cover." One was carefully measured —1-46000th of an inch. Mr. Boys has done me the favour of giving me other threads (remarkable for fineness) of collodion electrically discharged. This substance gives also black margins, very broad and dark; but no central spectra at the points of intersection.

Darjeeling spider silk presents the same optical properties. It is very strong and coarse, and where the fibres cross over each other the thinnest attenuations are produced on their edges it is possible to imagine. It is very pellucid under the microscope, and to the naked eye of a brownish hue.

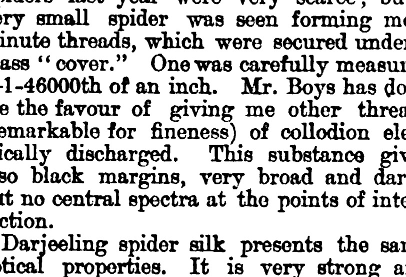


FIG. 4.

Introducing among the quartz fibres solution of iodide of potassium and mercury, very singular little lakelets were developed, which very soon deposited minute drops of metallic mercury—soon, however, to be redissolved. I noticed very broad borders, intensely black, 1-18000th thick, depending on the high refractions.

These lakelets entirely hid the black margins of the quartz fibres, except when they were in contact with the cover-glass, which then gave brilliant black parallel margins; examined apochromatically with Powell's new glass, No. 34, just sent to me.

Under an extremely fine glass, these black margins appear perfectly true and even in breadth. When the condenser is depressed, *the central line of brilliant light thins thinner and thinner, the jetty black margins becoming broader and broader:* they are broadest when seen by parallel rays transmitted from below. The breadth of this perfect line of light is calculable, supposing the condenser removed and a circular aperture of half an inch permitted.

The aberration is a minimum, and this accounts for the supreme accuracy of the central line of light.

These results are entirely dependent on those two variables—the refractive index and the diameter of the round fibre. The kind of definition attained is, therefore, frequently an unknown function of these variables. And whether the object is a bubble—i.e., a hollow sphere—or an islet puddle, the marginal black line is equally regulated. The very high indices of sulphide of carbon and oil of cassia will elicit fine, broad, dark margins, either in microscopic islets or bubbles. Solutions of phosphorus or arsenic also give interesting data; whilst in tabasheer (bamboo silica) the margins are very faint with 12° of aperture.

The delicate English spider threads display intensely black margins inclosing a bright cylindrical image of great beauty and accuracy.* Similar margins and spectra are seen in glass crossing fibres (Fig. 4), on a larger scale, as also in the crossing hairs of the antennæ of the male gnat mounted in Canada balsam (Fig. 5).

(*To be continued.*)

REVIEWS.

Star Atlas. By Dr. Hermann J. Klein, translated and adapted for English readers by Edmund McClure, M.A., M.R.I.A. London: Society for Promoting Christian Knowledge.

THIS is a nicely-printed atlas of the stars from magnitudes 1 to 6·5 between the North Pole and S. Dec. 33°, with prints of the star clusters and nebulæ in the same region which are visible in telescopes of moderate powers. The stars are printed black on white ground, with name, numbers, &c., in red, on the system of Bayer. Double stars catalogued by Struve, if they have not been noted by Bayer, bear the number they have in Struve's catalogue, with Σ attached, and all other numbers are those of Flam-

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* An article on the "Errors of Microscopical Vision," the writer in *Quarterly Journal of Microscopical Science*, uary 1, 1871, investigates the effects of variations of actions in producing black margins.

* 'Browning's ; micrometer spider webs are about 1-10000th of an inch thick.

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steed's catalogue. Clusters and nebulæ have the numbers assigned in Herschel's general catalogue. A variety of plates are included in the volume, including a reproduction of the photograph of the star clusters of the Pleiades by MM. Henry, and some others, the utility of which in an "atlas" is not easily comprehended.

The Telephone. By William Henry Preece, F.R.S., and Julius Maier, Ph.D. London: Whittaker and Co.

This is a practical work on the telephone, and will, we imagine, be eminently useful to those who will have the improvement of telephony in their care during a near future. The rudimentary principles of sound, induction, &c., are set forth briefly, but sufficiently, and the history of the subject has been lightly touched on, the object of the authors being to cover as wide a field as possible. The work is intended for the technical telephonists, but at the same time the tiro can find in it all he wants to know, if he brings to its perusal a slight knowledge of the subject. There is little to criticise in the volume: it is really descriptive of the appliances used in telephony nowadays, and as such is fully illustrated and replete with technical details. So far as we know, it covers the whole field, even to the application of the apparatus to what the authors term medical science. A photograph of the Western Electric Company's Multiple Switch-board at the Manchester Telephone Exchange forms an appropriate frontispiece to a work which does really supply a want. The phonograph finds a place in its pages, and those who wish to know what has been done in telephony, or are in want of information to help them to devise something better, will find, we think, all that is available in this work.

Practical Surveying. By George Wm. Usill, A.M.I.C.E. London: Crosby Lockwood and Son.

This is a work which may be said to be really "practical," the author being a teacher and knowing exactly what is required. Nothing but practice can make a competent surveyor; but those who cannot obtain the services of an expert will find all the information needed in this work. The various instruments are fully described, their use and manipulation in the field are explained, and the student who reads carefully will readily understand the principles of theodolite surveying, traversing, town surveying, levelling, contouring, setting-out curves, the computing of land quantities, and routine work of the surveyor's office. The volume is freely illustrated, all the usual instruments employed being depicted by diagrams, while those of a special character are well represented. It is a work that can be recommended to the student.

An Encyclopædia of Architecture. By Joseph Gwilt, F.S.A., F.R.S.A.; new edition by Wyatt Papworth, F.R.I.B.A., London: Longmans.

This encyclopædia is well known to all who have had occasion to study architecture, as it is a work of reference for the antiquarian, the historian, and the student; it is, in fact, practical, theoretical, and historical, and represents an enormous amount of carefully-applied labour. It contains over 1,400 pages of text, and nearly 1,700 illustrations and diagrams, and in this new edition, which has been revised, partly rewritten, and added to by Mr. Papworth, we have a work which easily retains its position as the standard reference book on everything connected with architecture.

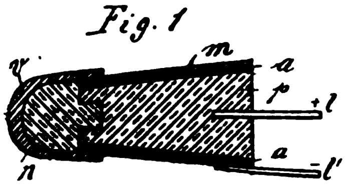
The Life of Sir William Siemens, F.R.S., D.C.L., LL.D. By William Pole, F.R.S. London: John Murray.

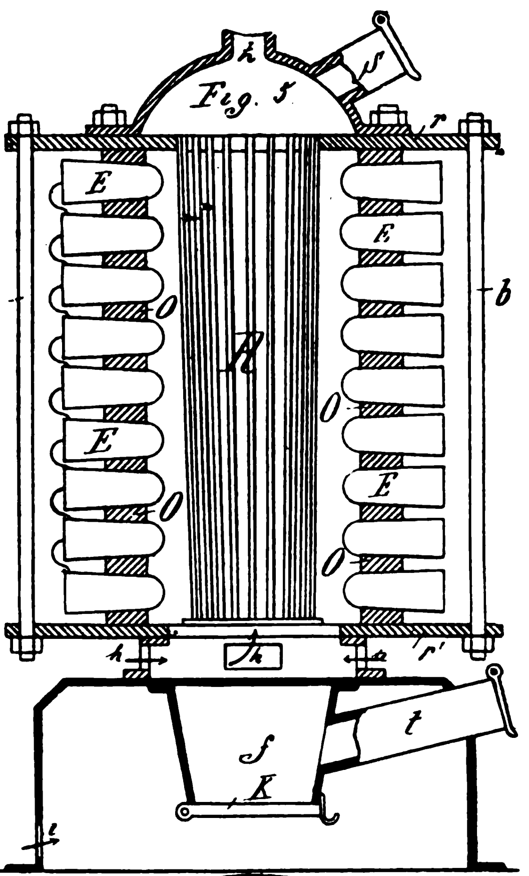
The life of Carl Wilhelm Siemens, better known as Sir William Siemens, or familiarly as the London Siemens, to distinguish him from his brothers, is a story of a self-made man who by his own exertions obtained fame and fortune, and made the world his debtor at the same time. Dr. Pole tells us that there is no record of his having made any pigmy windmills or model boats, but he early displayed an attentive and careful observation of things passing around him. At the age of seventeen he lost both mother and father, but in Werner Siemens he had a brother who apparently had gauged the abilities of the youth, and took care that so far as training could develop them they should be developed. The result is known; but we have not space to follow Dr. Pole through the interesting volume he has provided for those who wish to learn the details of the early life of his friend, whose great achievements are fresh in the minds of all who are acquainted with the progress made in the arts and sciences during the middle of the present century. Dr. Pole has done his work well, and as he has been assisted by all who could help to supply information, letters, &c., we have a biography of the late Sir Wm. Siemens as authentic as it is interesting.

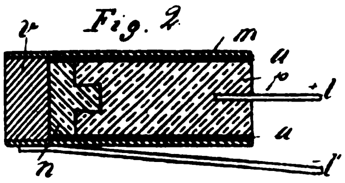
We have also received *Supplement to Carpmael's Patent Laws of the World* (London: W. Clowes and Sons), which has been prepared by a committee of Fellows of the Institute of Patent Agents, and which gives precise information of the various patent laws down to the latest date.——*What's in a Name?* (London: Swan Sonnenschein and Co.) is an interesting little work on "surnames and their significance," the author assuring his readers that the names he refers to are all bonâ-fide surnames collected from numerous sources.——*My Life and Balloon Experiences*, by Henry Coxwell (London: W. H. Allen and Co.), is the second series of the author's professional "life," and is an interesting review of the work done by the famous aëronaut and his companions, together with illustrations of historical and other balloons, and many useful notes. Mr. Coxwell says, "Ballooning is still an infant, but it will lead to aërial navigation."——*Elementary Building Construction and Drawing*, by Edward J. Burrell (London: Longmans), is one of the Elementary Science Manuals issued by the Messrs. Longmans, prepared from the notes of lectures delivered by the author to the day students at the People's Palace Technical Schools. The diagrams have been carefully dimensioned, a feature which imparts especial value to them, so far as students are concerned.——*Building Construction and Drawing*, by Charles F. Mitchell (London: B. T. Batsford), is the "first stage or elementary course" compiled primarily for the use of students at the Polytechnic Institute, where Mr. Mitchell is the lecturer on Building Construction. Each branch has been thoroughly revised by specialists who are also the author's fellow-teachers. The diagrams in this work are also fully dimensioned.——*The Playtime Naturalist*, by Dr. J. E. Taylor, F.L.S. (London: Chatto and Windus), is a work written expressly to interest "intelligent English lads" in the "same loves and the same pleasures" which provided the author with so much pleasant and innocent amusement, not to speak of instruction, when he was a lad. The work is nicely printed, and is freely illustrated, and forms an excellent gift-book or school prize for boys who exhibit a liking for natural history.——*A Textbook of Elementary Metallurgy*, by Arthur H. Hiorns (London: Macmillan and Co.), is a useful textbook for students, by the principal of the school of Metallurgy, Birmingham and Midland Institute, with an appendix containing the whole of the questions set in the three stages of the Science and Art Examinations during the past twenty years.——*The Blowpipe in Chemistry, Mineralogy, and Geology*, by Lieut.-Col. W. A. Ross, R.A. (London: Crosby Lockwood and Son), is the second edition, revised and enlarged, of a manual well known to our readers who work with the blowpipe. Col. Ross has added a series of useful exercises in the blowpipe analysis of minerals on his system.——*Modern Workshop Practice*, by John J. Winton (London: Crosby Lockwood and Son), is the fourth edition, enlarged and revised, of a well-known standard work.——*Plumbing*, by William Paton Buchan, R.P. (London: Crosby Lockwood and Son), is the fifth edition, revised and enlarged, of a work which, in substance, first appeared in the pages of the *Building News*. About fifty pages have been added to this edition, and there are nearly 400 illustrations.——*Workshop Notes and Sketches*, by Thomas A. Clark (Edinburgh: James Thin), is intended for use by "handicraft classes" in wood-working, the author being superintendent of workshops in George Heriot's Hospital School, Edinburgh. It is well adapted to its purpose.——*Practical Elements of Construction*, by Percy L. Addison (London: Elliot Stock), is a reference book for engineers and builders, containing many notes and hints that will be useful to beginners.——*A First Course in Mechanical Drawing*, by Geo. Halliday, Wh.Sch. (London: E. and F. N. Spon), is by the instructor of mechanical drawing and lecturer on mechanism at the Finsbury Technical College. It consists of tracing copies, and is admirably adapted to teach instead of to cram. We can heartily commend it to the attention of all teachers of technical classes, and especially to those students who wish to write "Wh.Sch." after their names.

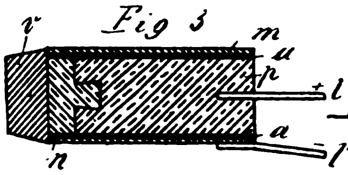
MESTERN'S THERMO-ELECTRIC BATTERY.

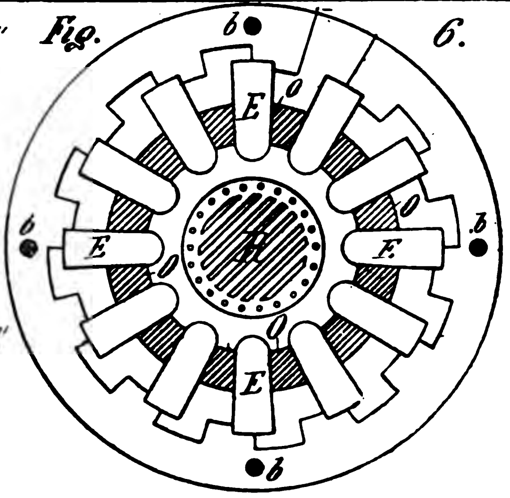
At present thermo-electric batteries are rather more of curiosities than economical appliances for the production of current; but inventors continue to devise new plans, and as they are always of interest we illustrate the thermo-electric, or furnace, battery recently patented by Herr Hugo Mestern, of Munich. The extensive application of thermo-electric batteries is principally prejudiced by the fragility of the elements, by the danger of an interruption of current, the commonly employed alloys being of a very fusible nature, and by the noxious effect of the fire vapours on the elements with direct heating, unless the less effectual indirect heating of the elements by means of particular heating bodies is applied. Experiments have demonstrated, that, if in direct contact with coal and fire vapours, the cements are very rapidly reduced, and the alloys are changed in their composition by the alternately occurring oxidation and reduction flame. Moreover the flame having electric conductivity produces a by-current, thus decreasing the effect of the battery. These inconveniences are intended to be obviated by the present invention, the elements being given a more durable shape and so constructed as to prevent an interruption of current even in case of highly fusible alloys being employed, while the heating is so effected as to protect the electrodes from the detrimental influence of the heating vapours and also to avoid a direct contact of the fire-vapours with the thermo-electric elements, thereby precluding a conductive connection of the elements through the flames. Figs. 1 to 4 represent four modifications of the improved thermo-electric elements, *p* indicating the positive easily-fusible electro, consisting of antimony, zinc, and other suitable metals, and connected as shown in the drawing, dove-tail fashion with the negative electrode, *n*, composed of copper and nickel, thereby increasing surface of contact and cohesion. *a* is an insulating layer of asbestos which separates the protective mantle *m* of iron, nickel, or other resisting metal from the electro-positive alloy and serves simultaneously with the strengthening cap *r*, made of the same metal, as a deflecting conductor for the negative electrode. It is obvious that by the above arrangement, a greater durability of the elements as well as the avoidance of an interruption of the current in case of fusion of the electrode *p* is attained. l and l^1 are deflection-slices made from an alloy of

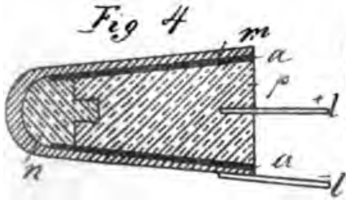












nickel and copper. In Fig. 1 the strengthening cap *v* is so shaped as to completely embrace the electro-negative metal and at the same time secure the protective mantle *m*. In Fig. 2 the cap forms a thermal conductor surrounded and held fast by the mantle *m*, while in Fig. 3 the thermal conductor *v* is not surrounded by the mantle *m*. Fig. 4 represents a modification in which the strengthening ring or cap and the protective mantle are made in one piece *m*. Figs. 5 and 6 show the improved furnace-battery in vertical and horizontal section. The elements E are united to a thermo-electric battery. The furnace O, constructed in an annular shape, is made, according to its application and size, from asbestos, china clay, or other material having no electric or thermal conductivity, and is so arranged as to allow of an easy exchange of the single elements E. Within the furnace-battery a basket grating R consisting of iron bars is provided. This grating is adapted to be filled with burning coke through the funnel S to effect the heating. The ash box *f* is arranged to serve simultaneously for heating, and is to this end closed by a tilting grate *k*, the fuel being supplied through the funnel *t*. The requisite air of combustion enters at *i* and *h*, the smoke escaping through the pipe *z*. The whole furnace is held together and stiffened by means of rings *r* r^1 and bolts *b*. The element-groups superposed to one another may be joined consecutively or in parallel.

MIX AND GENEST'S INTERCALATING APPARATUS.

In the annexed engravings we illustrate an improved switch or "intercalating apparatus" patented by Messrs. Mix and Genest, of Berlin, and intended especially for portable incandescent lamps. The arrangements in use for double wires, serving to connect portable lamps with fixed wires, have the disadvantage that the switches must either be turned (screws or bayonets), or they cannot be turned at all, because the contact pieces are not centrally arranged. The "intercalating apparatus" of Mix and Genest is believed to be an improvement upon its predecessors. The idea of arranging the two contact pieces of the switch in the form of concentric tubes in and around the switch contributes to give the apparatus a solid construction. The contact pieces are connected by soldered copper wire with the segment-like binding screw in the handle. Fig. 1 shows the apparatus complete, while Fig. 2 shows it taken apart, thus showing the construction. The contact pieces of the connecting box are suitably arranged, and the two spring-plates and the joint are stamped out of one piece and fastened by one binding screw. The spring pin being split with a conical top, when pressed into the interior contact tube, completes the electric circuit with the ground plate fixed by the second binding screw. Besides its suitable and solid form this apparatus has the advantage that the intercalation of portable glow lamps can be easily effected in the dark. No turning being necessary, the possibility of injuring the wire at the joining points is very remote. The apparatus can either be fixed on the wall or on a gas tube hanging from the ceiling. In the latter case the fixing is done by means of a box with flange, secured by a wood rosace, which gives the whole apparatus a ball-like appearance.

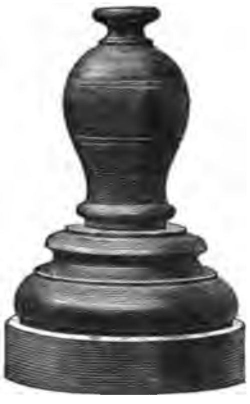


Fig. 1.

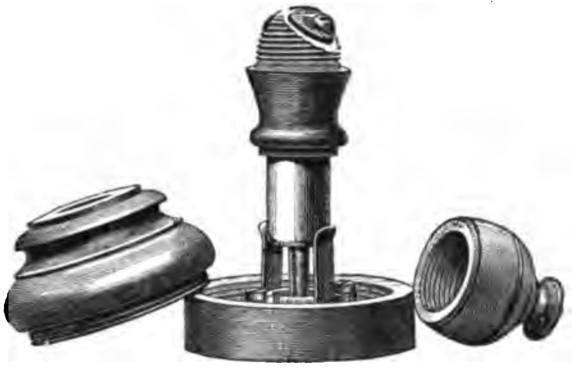
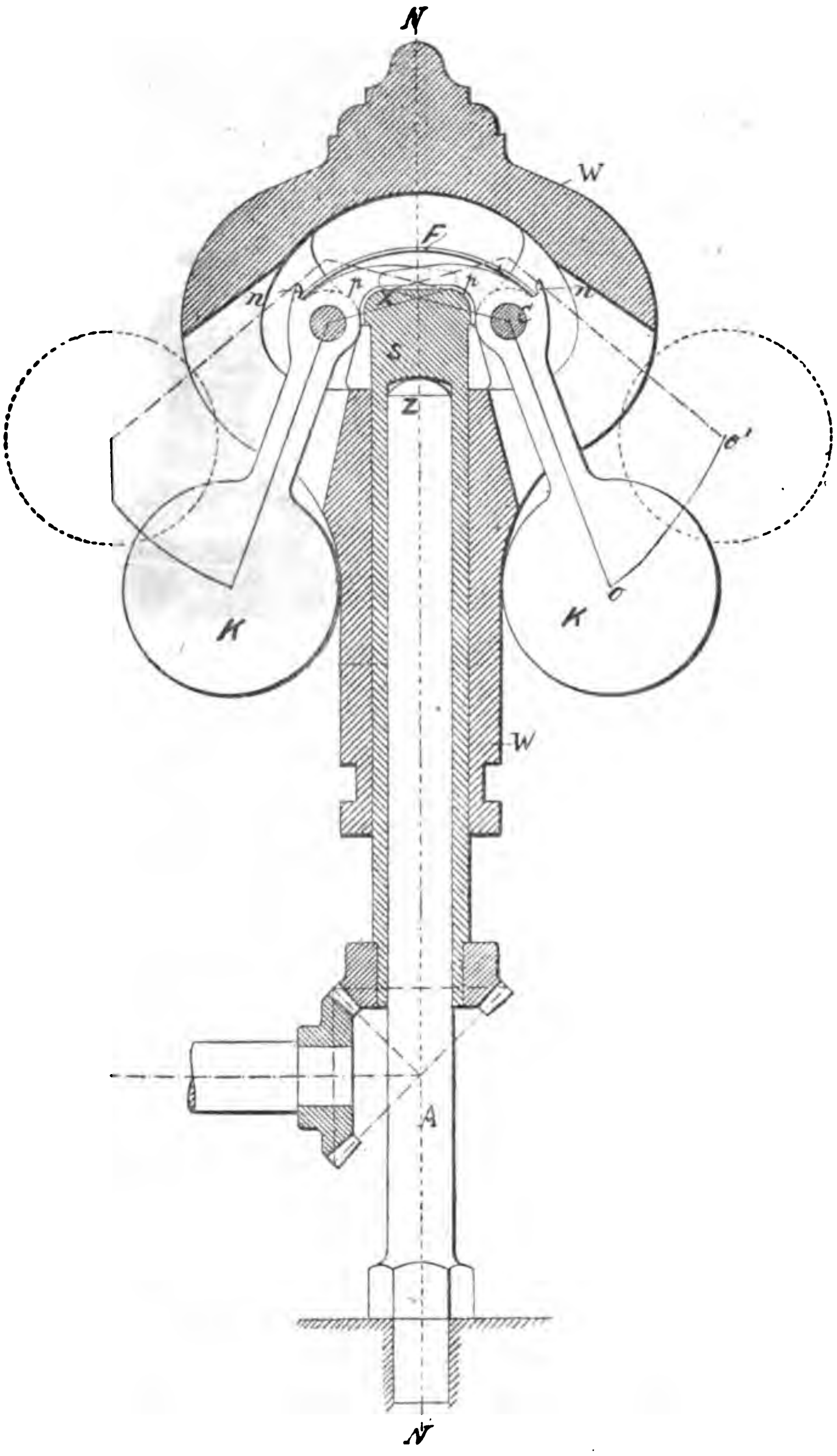


Fig. 2.

BUDENBERG'S CENTRIFUGAL GOVERNOR.

The importance of prompt and accurate governing of motors has come to the fore in a very pronounced manner since the introduction of electric lighting, and although there are many sensitive governors in the market, there is still "room at the top." Mr. Arnold Budenberg, of St. Mary's-street, Manchester, has taken out letters patent for an invention relating to that class of centrifugal governors in which the curves described by the centres of the governor balls in rising and falling, are approximately parts of a parabola, and in which the fulcra of the pendulous levers are situated on the sliding weight, while a short arm or cam of each lever, extending from the fulcrum towards the axis of the governor, rests on a vertically immovable



shaft or sleeve which serves as point of support. The illustration represents the principal parts of a centrifugal governor, according to this invention, in vertical section. S is the revolving tubular shaft supported by the fixed vertical spindle A. W is the sliding weight carrying the fulcra C C of the pendulous arms K. Each of these pendulous levers has a rear extension or short arm $p\ p$ extending beyond the central axis N N, and resting with its extremity x on the top of the shaft S. In parabolic governors as usually constructed, the actual path $O\ O^1$ of the governor-ball centres coincides with the parabola only when the balls are in their lowest position O, and forms a tangent to the parabola in that position. In the new governor, on the contrary, the ratio between the length of the pendulous lever O C and of the arm O—x which rests on the shaft or sleeve S is such that the actual path of the governor balls forms a tangent to the parabola at the points where the balls are in their middle position—that is, midway between O and O^1. As the distance of the pendulous fulcrum C from the axis N N of the governor is constant, the end x of the short arm C—x will slide a little on the top of the central shaft S. A straight line drawn from x perpendicularly to the path $O\ O^1$ intersects this path at $O\ O^1$ in the middle, so that x may be considered the centre of curvature for the parabola, which touches the path between O and O^1. A governor constructed as described will rise from the lowest to the middle position immediately after its normal velocity of equilibrium has been attained, and will in the higher positions of the pendulum form a close approach to a perfectly isochronous governor. In the lower half of its lift it would, however, be useless, from want of stability, while in the upper half of its path it would be too sensitive for practical use. In order to obtain the required stability and sensitiveness in all positions of the governor, the patentee interposes between the two pendulous levers a spring, F, in such a manner that the ends of the spring press symmetrically on a pair of projections or noses $n\ n$ formed on the levers near their fulcra, while the lifting of the balls tends to compress the spring. The spring is preferably a leaf spring forming over the top governor spindle (and in the hollow interior of the sliding weight) an arch between the upper ends of the two pendulous levers, the arch being flattened or bulged more or less according to the position of the pendulous levers. As the sliding weight W is suspended by the bolts C, so that its total weight, together with that of the pendulous levers, must be lifted, the governor acts with considerable energy. As mentioned above, the revolving shaft S, on which rest the ends x of the short arms of the pendulous levers, and which therefore support the pendulous levers together with the sliding weight, is made hollow, so as to fit like a cap and sleeve over a fixed post A forming the centre of the governor spindle. The top of this central post is situated approximately in the centre of gravity of the governor, and forms a step-bearing for the bottom of the revolving sleeve-cap.

THE CULTIVATION AND PREPARATION OF PRUNES IN FRANCE.

THE introduction of prunes into France is attributed to the Crusaders, says the United States Consul at Bordeaux, and if tradition is exact, this valuable fruit was first cultivated in the south-west of France by the inmates of a convent near Clairac. In travelling from Avignon to Fumel, through the valley of the Lot, fertile plains are seen covered with plum-trees, which furnish the famous *prunes d'Ente* and *Robe-Sergent*, these being exported to the remotest corner of the commercial world. The plum-tree does not confine itself to this particular district of France, but it is profitably cultivated in the valley of the Loire, the departments of the Garonne, Dordogne, Tarn, and Aveyron. The well-known brand called Tours prunes comes from the orchards of the Loire. Lorraine produces a variety called Quetsche, one of the best for ordinary preserves. The prune-tree thrives best in clayey, calcareous soil, and does not exact for its roots a loam of profound depth. Land adapted to the culture of the vine is also partial to this tree. In many localities these two valuable products are cultivated together, as the broad leaf of the vine is especially useful in protecting the roots of the tree from the intense heat of summer. When the prune is ripe, it is covered with a sort of glaucous powder called flower, which greatly adds to its value as a table fruit. The fruit is usually gathered after the heat of the day has dissipated the humidity of the night, and when possible, straw is spread beneath the trees to prevent the fruit coming in contact with the earth. Only such fruit as readily falls when the tree is slightly shaken is gathered. As soon as harvested, the fruit is taken to a building, where it remains for a few days to complete maturity. Prunes are subjected to not less than three, and frequently to four, distinct cookings before being pronounced ready for market. The first two preliminary cookings have for their object the evaporation of water contained in the fruit, and preparation for the final cooking, which dries the fruit and imparts a certain brilliancy much sought after by buyers. In several districts of France most primitive means are practised in curing the fruit for market. In Provence freshly-gathered fruit is plunged into pots of boiling water, where it remains until the water again arrives at boiling point. It is then removed from the boilers, placed in baskets, and gently shaken until cool, when it is placed on long trays and exposed to the heat of the sun to complete desiccation. At Digne the prunes are not gathered until completely matured. Women peel the fruit with their nails to avoid injury to the soft pulp. The fruit is strung upon small twigs and in such fashion as not to touch; these sticks of prunes are stuck into straw frames, which are suspended in the sun until the prunes easily detach themselves from the stick; the pit is then removed, the fruit placed upon trays exposed to the sun, and, when thoroughly desiccated, packed for market. In the departments of Indre-et-Loire and Lot-et-Garonne, immense ovens, specially constructed for prune-cooking, are used. Most prunes are subjected to a preliminary washing to free them from dust or sand. After washing, the fruit is exposed to the sun or air on beds of straw, or on the trays on which it is cooked, to rid it of all humidity. When dry it is spread in a single layer on the tray and at once submitted to the oven. The trays used are made during the winter months by peasants; they are clumsy and cumbersome, and very primitive in their construction, only consisting of a frame, to which is fastened a wicker-like bottom fashioned from rushes or willow twigs. They hold from twelve to eighteen pounds of green fruit, representing about four to six pounds of prunes. Care is taken in preparing the oven for the first cooking that the degrees of heat shall not exceed 50° C. (122° Fahr.), and in the second 70° (158° Fahr.). After each cooking, which occupies about six hours, the fruit is removed from the oven and exposed to the air. When the prunes are cold they are carefully turned by women specially charged with this duty. They avoid disturbing the fruit while it is warm, as the touch renders it glutinous and prevents the fruit from congealing. The third cooking is performed at a temperature of 80° to 90°, and occasionally at 100° (212° Fahr.) After the third cooking the prunes are sorted, and such as are found imperfectly cooked are again submitted to the oven. The degree of perfection in cooking is obtained when the fruit presents a dark purple colour, solid and brilliant surface, malleable and elastic to the touch, and when the kernel is well done and intact in the shell. When these conditions are not obtained, the kernel ferments, and alters the entire prune, which very soon becomes mouldy and worthless. Prunes are divided into nine categories, and are classified as follows:—No. 1 represents 90 to 92 to the pound; No. 2 represents 80 to 82 to the pound; No. 3 represents 70 to 72 to the pound; No. 4, 60 to 62: No. 5, 55 to 56; No. 6, 44 to 45; No. 7, 40 to 41: No. 8, 34 to 35; and No. 9 represents 30 to 31 to the pound. When ready for exportation, the fruit is pressed flat between two cylinders covered with indiarubber, and then packed into cases by a special machine called a packer. Many dealers still perform this operation in the primitive manner of foot pressure. Bordeaux is the principal centre of this industry, which is yearly increasing. Besides the large amount of prunes exported to European countries by rail, there are, says Consul Roosevelt, about 100 vessels annually leaving the port of Bordeaux loaded with this produce. In the beginning of the prune industry many devices were employed for their proper conservation. The first ovens were very primitive, and the work of preparing the fruit for market laborious. At present there are many different kinds of ovens in use, possessing more or less distinct features, but almost the same in general principles, the most generally used are the Bournel and the Marletean ovens. The only ovens in use are of French manufacture.

SHAPING SHEET METAL BY FLUID PRESSURE.

THE following description of a method of shaping zinc, copper, and other ductile metals by fluid pressure was contributed by Mr. D. W. Kemp, of Leith, to the Royal Scottish Society of Arts, and we extract it from the recently issued *Transactions* of the Society. The following improvements in shaping ductile metals by surface tension and diffusion, to form concave, indented, or hollow articles, are the subject of letters patent, and have been provisionally protected. The initial idea is largely due to Mr. James Kirkwood. Mr. John Kirkwood, zinc-bath maker, Leith, assisted by Mr. James Kirkwood, put the idea to a practical test, and independently I carried out several experiments; since then we have been developing the process together. The invention consists in taking advantage to the full of the well-known properties in all ductile metals to flow or stretch under gradual pressure. The methods ordinarily followed in the manufacture of hollow metal articles are by hammering, cressing, or spinning. Two copper pans, extraordinary specimens of hammered work, were exhibited in the Edinburgh International Exhibition of 1886. The larger pan was 9ft. 6in. internal diameter by 3ft. 3in. deep, and weighed 13cwt. 2qr. 20lb.; the smaller one was 6ft. internal diameter by 3ft. 6in. deep, and weighed 7cwt. 2qr. 3lb. An ordinary tinned-iron basin is a good specimen of cressed, struck, or stamped work. The tinned copper hemispheres, for making balls for the end of levers of cistern stop-cocks, are beautiful specimens of metal spinning.

The improvement we claim over those methods may be called blowing, and consists in employing fluid pressure and heat, in combination with suitable moulds. The pressure must be applied in such a manner on the sheet metal as will force it gradually and steadily into the concave or hollow part of a mould shaped internally to fit the external shape intended to be given. Thus, if a sheet of zinc is to be shaped into a basin-form or into a dome—a cast-iron mould is made consisting of two parts, one of which is of the required form, and has a flat flange round its edge, whilst the other is a cover of a nearly flat form, and has a flange which can be bolted or otherwise tightly fastened to the flange of the other part. The sheet zinc is fixed between the two parts of the mould, and steam or other fluid under pressure is admitted between the zinc sheet and the cover of the mould, and produces the desired effect. Glass-blowing and the boys' soap-bubble may be cited in illustration of small flat surfaces being stretched by pressure into a curved form.

The large dome now exhibited was made by this process by Mr. Kirkwood. It is of sheet zinc about $\frac{1}{16}$in. thick, internal diameter 2ft. 4in. by 1 foot deep. To accomplish such a piece of work by any other process would require costly machinery. This dome was made in about half an hour with the simplest appliances—only a pipe from a high-pressure boiler and a mould. The numerous small specimens exhibited I have made by direct pressure, similar to the experiment now proceeding on the table. It will be seen that the mould is also the boiler, and steam pressure is obtained by means of a Bunsen gas lamp. The internal diameter of the dome-shaped zinc vessel is 12in., and a depth (or, as it appears, height) of 4½in. may be easily reached before the zinc will rupture. The pressure should be applied gradually and steadily; if too great, or applied suddenly, the metal will break.

With metals of good and uniform quality the fluid pressure will impart a spheroidal or similar form without a mould surface, and when worked in this way heat may be applied directly to the outside of the sheet that is being operated on.

The pressure and heat required will vary with the kind of metal and the thickness. In some cases heated and compressed air may be used with advantage, or any suitable gas or vapour, or a heated liquid, water, oil, &c., under pressure; and if found desirable in any cases, heat may be applied to the exterior of the mould either in addition to, or instead of heat being applied to the pressing fluid, prior to such fluid being introduced into the mould.

Zinc expands the most, and platinum the least under the influence of heat. The following figures show the expansion between the freezing and boiling points of water of a rod 100,000in. long:—Zinc, 298in.; lead, 282in.; tin, 196in.; silver, 192in.; copper, 171in.; gold, 144in.; iron (soft), 120in.; iron (cast), 109in.; platinum, 87in.

Apart from the utility of the invention in the industrial arts, the simplicity of the process to illustrate the elongation, expansibility, and flowing of certain metals, makes it a beautiful lecture-table experiment.

FIG 1

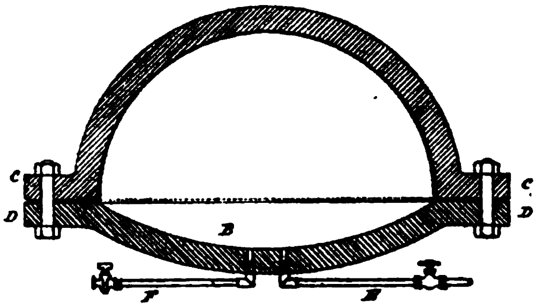


FIG. 2.

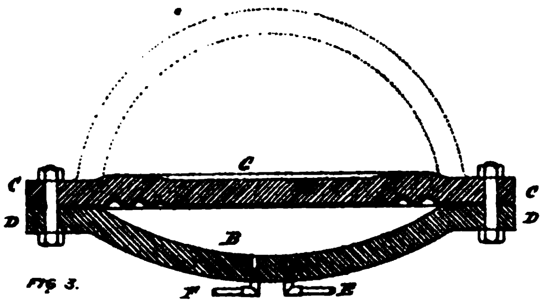


FIG 3.

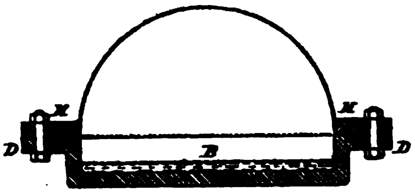


FIG 4.

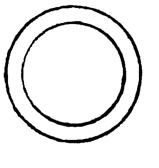


FIG 7

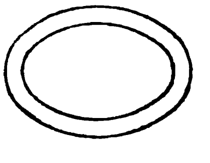


FIG. 10

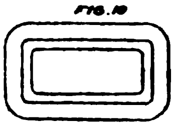


FIG. 11.

FIG 5.

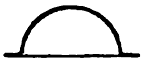


FIG. 8

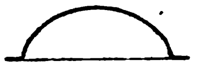


FIG. 6.

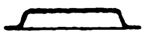
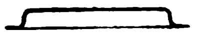


FIG. 9.



Explanation of Diagrams.

Fig. 1 is a cast-iron mould, consisting of two parts A, B. A has a flat flange C round its edge, whilst the other B (of a nearly flat form) has a flange D, which must be tightly fastened to the flange C. The zinc, or other metal sheet, is shown by a thick black line (its original flat form being indicated partly by the dotted line), is fixed in the mould between the flanges C, D, and steam or other fluid under pressure is admitted by the pipe E, so as to enter between the zinc sheet and the bottom part of the mould B. F is a pipe for carrying off the water of condensation.

Fig. 2 may be used for the partial preliminary drawing or blowing operation; this piece being formed with annular corrugations at and near the outer parts, whilst the middle part is flat. On the pressure being admitted, the sheet metal is pressed and held against the flat part of the mould top G, whilst it is stretched at the outer parts so as to fill the corrugations. The mould G is then removed, and a mould shaped like A fixed on as indicated by dotted lines, and on the steam pressure being again admitted the shaping is completed. This prevents the sheet metal being drawn thinner at or near the top, thus securing greater uniformity in thickness.

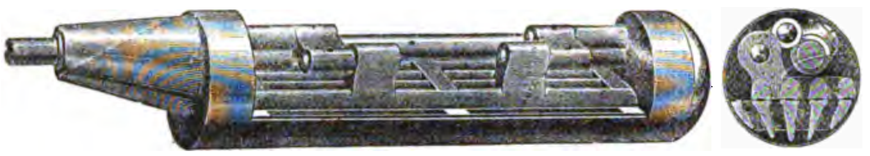
Fig. 3 is a ring H to fix the sheet metal to a dish-shaped casting B, between which and the sheet the fluid pressure is applied.

Figs. 4 to 11 are diagrams on a reduced scale showing some of the forms which may be shaped according to this process. Irregular forms may also be produced, and the inner surface of the mould A may be shaped to form ornamental surfaces.

THE WHEELOCK ENGINE VALVE.

VISITORS to the Inventions Exhibition will remember the Wheelock steam-engine with its suspended rotary valves, a design which the Company now representing Jerome Wheelock have improved by the arrangement shown in the annexed engravings. The valve now used is a multi-ported slide, working on a flat seat, formed within a skeleton plug or shell, through which passages are cored, forming ports into and out of the cylinder. The valve and operating parts being mounted upon or within this shell, they together form a complete and self-contained piece of mechanism entirely independent of the cylinder. The shell is turned slightly

Fig. 1.



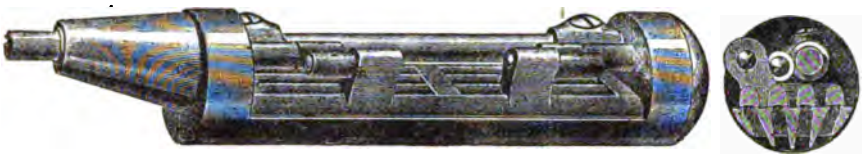


Fig. 2.

tapering, to fill corresponding holes in the walls of the steam chest, and being ground to a steam-tight fit therein, it, with the contained valve, seat, and operating parts, is lightly driven into place, and is retained secure without the need of other means of fastening than results from the tapered driven fit. The valve is operated from a rocking spindle having bearings in the ends of shell. Motion is communicated from the spindle through crank arms and a pair of short links connecting the latter with the valve, and forming a toggle joint which converts the rotary motion of spindle into reciprocatory motion of valve. The spindle works in hardened steel bushings, and is itself of steel, hardened and ground, as are also all the running parts of the valve gear. The spindles are self-packing, by the action of steam-pressure forcing the accurately ground face of a collar against a corresponding face of the end of the bushing. Upon the outer end of spindles are keyed cranks, driven direct from the eccentric in case or the exhaust valves, those of the admission valves being operated from the others by latch links which alternately hook on and let go through the action of a curved finger engaging with trip cams adjusted by the governor, thus accomplishing cut-off in an obvious manner. The detail and arrangement of valves and valve gear is clearly illustrated by the illustrations, Fig. 1 showing the valve open, while in Fig. 2 it is closed.

The original tightness of valves can be retained in its perfection by a periodical use of the scraper, the valve and seat being taken to a convenient place during the noon hour or at evening. For inspection and repair, this accessibility is all important. A duplicate set of valves on hand may be put in place in a few minutes, in case of a breakdown. Valves are usually more or less accessible by removing nuts, bonnets, &c., and breaking packed joints, but the seats are not so, and consequently are rarely surfaced, the result being years of running with leaky valves. Tightness of valve and piston is one of the greatest steam-saving qualities.

Small clearance is an all-important element of steam economy, and one of the results of this construction. There is but one port at each end, and that a small one; whereas all other four-valve engines have two at each end. The improved connecting-rod used does not vary in length as the boxes are keyed up, consequently clearance between piston and heads is safely made less than in any other engine. Inspection of the cuts will show clearly the possibility of very small clearance. Large port areas, with correspondingly large pipes and directness of steam passages, are a feature of the Wheelock system. With usual constructions the advantage of increasing port areas is soon offset by disadvantages of increasing clearance, valve travel, and valve friction. The Wheelock system admits of port area twenty per cent. of piston area, and yet less clearance, less valve travel and friction, and an easy running valve system.

METHOD OF PREPARING NUTRITIVE GELATINE.*

THE following method is one of the best:—

Tubes to be used for the storing and subsequent inoculation of the gelatine must be thoroughly cleansed, dried, plugged with cotton-wool or fine cotton, and sterilised. This is done by heating them for one hour in a hot-air steriliser or oven at a temperature of 150° C. (300° F.) Care should be taken that the plugs fit firmly, but not too tight. When the tubes are ready the following method is recommended:—

Take, for example, 250 grams (about ½lb.) of good beef after all fat has been removed. Chop or grind this to a fine pulpy mass. Transfer it to a beaker, and add 500c.cm. of distilled water—i.e., 2c.cm. of water for every gram of chopped beef. Thoroughly stir up the beef in the water, and then place it in an ice-box, or, if in winter, in a cold room until the next day.

On the following morning the meat infusion should be thoroughly stirred, and the liquid portion separated by filtering and squeezing through a linen cloth. The red liquid thus obtained must be brought up to the amount of water taken on the previous day by adding distilled water. To this is now added 1 per cent. of peptone, ½ per cent. sodium chloride, and 10 per cent. of the best gelatine. This would be in the case taken, 5 grams of peptone, 2·5 grams of salt, and 50 grams of gelatine. The beaker containing this mixture is now placed in a water-bath, and heated to 45° C. and allowed to stand for some minutes, until the gelatine is completely dissolved.

The next process requires the greatest care and attention. Most micro-organisms grow best in a slightly alkaline medium. This is obtained by adding, drop by drop, a nearly saturated solution of sodium carbonate to the beef-infusion-peptone gelatine mass until the reaction is slightly alkaline, which is determined by its turning red litmus paper to a faint blue. If by accident it should be made too alkaline, it can be neutralised by the addition of lactic acid. In order to clarify it, the white of two eggs is now added and thoroughly stirred into the gelatine mixture.

It is now boiled for one halt- our by placing the beaker or flask containing it in a large water bath or covered kettle. After boiling, it is allowed to cool and set, after which it is again heated to the boiling point, and filtered while hot. A hot filtering apparatus is necessary for this. It may, however, be filtered with the ordinary filter in a hot-air chamber at a temperature of 60°C. The funnel should be kept covered while filtering, to avoid evaporation.

The process of filtration must be repeated if necessary until the filtrate is perfectly clear. It is of a pale amber colour generally, varying in tint according to the amount of blood in the meat used. It is desirable to filter it into a sterilised narrow-necked flask to avoid evaporation. It is now ready to be distributed in tubes. The sterilised test-tubes are filled for about one-third of their depth (7 to 8c.cm. in each) by pouring in the gelatine carefully and steadily to prevent the mixture from touching the pert of the tube with which the plug comes in contact; otherwise, when the gelatine sets the cotton-wool adheres to the tube and becomes a source of embarrassment in subsequent procedures. Care also should be taken not to contaminate by touching or otherwise that part of the plug that belongs within the tube during the process of pouring the gelatine into them.

After the tubes are filled they should be placed in a wire basket and suspended in a steam steriliser for ten minutes after the thermometer indicates a temperature of 100° C. This is repeated each day for three successive days. This has been found sufficient to sterilise the gelatine. If one has not a steriliser, the tubes may be placed in a water-bath and be boiled for five minutes each day for three successive days. If the gelatine is boiled too much, it will not set upon cooling, and is therefore worthless. After the gelatine is sterilised it should be kept in a cool place until used.

THE PAISTE SWITCH FOR INCANDESCENT LIGHTING.

A NOVEL switch for incandescent work, has been designed by Mr. H. T. Paiste, of Philadelphia, Pa. Practical workers in incandescent wiring will appreciate the efforts of the designer in attempting to avoid the use of spring brass for electrical contact, experience having demonstrated that the contact, unless soldered, will, in time, through corrosion or dust, be heated, removing the temper from the brass, and thereby destroying electrical contact. As shown in the illustrations, the entire switch is stamped from sheet (not spring) brass by standard dies, making all parts interchangeable.

The parts of the switch, Fig. 1, consist of seven pieces—viz., the U-shaped main shell, side plate, two arms, spindle, spring, and hard rubber handle. The spring is attached to the ends of two arms and is extended when the switch is being operated to make or break circuit. As soon as this is accomplished, the spring is no longer under tension. The circuit wires are attached to binding screws on the U-shaped main shell and side plate. The arm, as shown in Fig. 1, completes the circuit, between the side plate at the main shell, at its point and through the spindle, upon which it is centred, making ample electrical contact. In breaking the circuit, the handle which is attached to the spindle turns to the right, moving the arm up the side plate, preserving sufficient electrical contact at its point until the position shown in Fig. 2 is reached; then the spring which joins the ends of the arms, being lengthened as the arm climbs the side plate, throws the same rapidly to the position shown in Fig. 3, instantly breaking the circuit. Whatever arcing might result would be on the back of the arm, and not on the face, where electrical contact is made.

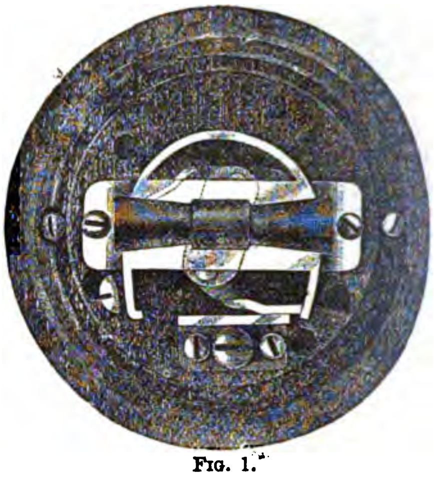


Fig. 1.

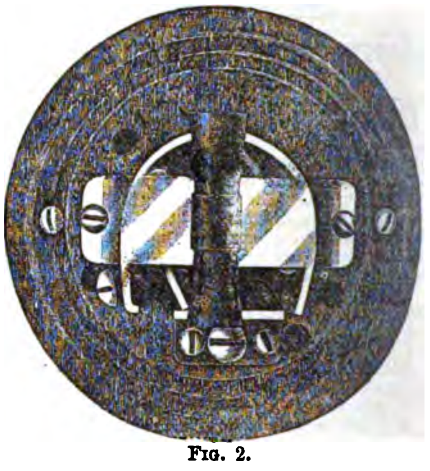


Fig. 2.

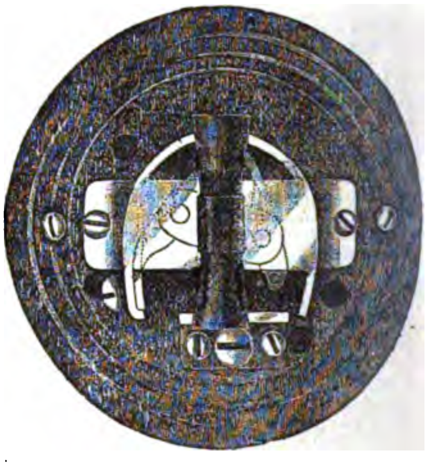


Fig. 3.

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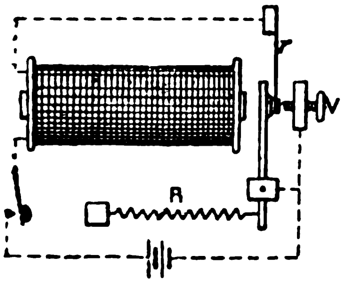
* From the *American Monthly Microscopical Journal.*

The making of the circuit is accomplished in like manner by the second arm. An improved handle has been added to switch, which obviates injury to it, for if turned backwards it will unscrew instead of straining the working parts. Mr. Paiste has given this switch a thorough test of twelve months at the sea-shore and at sulphur springs, where corrosion destroys many switches. The reports from these places have been most satisfactory, not a switch having been destroyed. The switch has been adopted by a number of central stations.—*Electrical Review* (N.Y.).

A DOUBLE CONTACT VIBRATOR.

THE accompanying illustration shows an arrangement for vibrating bells and similar apparatus, which was recently described in the *Annales Telegraphiques*, and which is claimed to possess the advantage of suppressing the sparks at the contact, so-called, at the moment of rupturing the circuit, and in transferring the spark to a pair of auxiliary contacts whose good and bad condition is of no importance in the operation of the apparatus. As will be seen, the spring R follows the armature during an instant when the former is attracted. Thus the breaking spark takes place for the most part between the spring *r* and the armature, so that the contact between the other face of *r* and the screw V remains in good condition. This apparatus has been employed in particular for the telephone service in Paris, in connection with the Ruhmkorff coils used for calling generators on long lines, and has given very good results. It would seem to possess some advantages over the employment of the shunt, condenser, or voltameter placed in shunt around vibrating contacts.



FLASK BARS AND GAGGERS.*

IN the accompanying sketch is shown a method of making cast-iron bars of any description for special castings. Of course, in regular jobbing shops a set of these bars may not be required more than once; still something must be made to do the work, and on the plan shown it does not take as much or any more time than to make the bars of wood. They are easier fastened in, and are better than wooden bars, and can be made to fit across a cope of any width and depth, and conform to any shape that may be in the pattern, and can be used horizontal or perpendicular to support the sand in the cheek of a mould.

Wooden strips are got out in four lengths, 8in., 12in., 18in., and 24in. long, 2½in. wide, and about ¾in. thick. Two of each of these sizes must be made to be used for patterns for the flanges of the cross or side bars, to bolt to the side of the flask. One of them is shown in back and side view, Figs. 1 and 2. Two core prints, A A, are fastened on each pattern; the concave B in the pattern is only to lighten the strip. A set of strips as described once made are ready for any occasion. If a cross bar of any particular shape is required, two side strips of the required length are bedded in a level sand bed, as at Fig. 1, and good strong bars cut with a gate cutter from one strip to another. These can be strengthened by cutting from bar to bar, and projections can be cut on the lower bar to suit the work.

For instance, if a frame is required to go round the bottom of a cheek to support a great amount of sand, the strip is bedded in as at Fig. 1, and good strong fingers cut to suit a circle as at Fig. 3, or to form a square as at Fig. 4. After drawing the pattern, Fig. 1, a stop-off core or plain ¾in. core can be put in the core prints A A, and filled over with green sand to form the bolt holes. Heavy iron flasks have (or ought to have) a number of holes in the sides, and the core prints A A can be moved to suit them, and in wooden flasks holes can be bored to suit the bars. It is a poor policy to cast flanges on the inside of heavy iron flasks, as they are sometimes made to rest lifting grates or bars of this kind on. It is better for jobbing shops to have the sides of heavy iron flasks plain on the inside, and with a number of holes cast through them to bolt in any kind of a bar that may be desired, for when flanges are cast fast on the inside of the flask, it is often found to be just too small to admit the pattern on account of the flange.

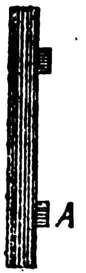


Fig 1

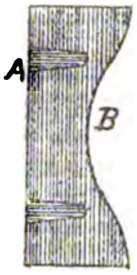


Fig 2.

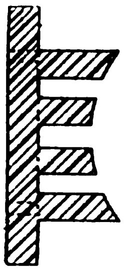


Fig 3

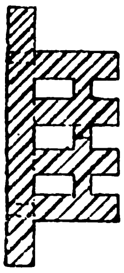


Fig 4

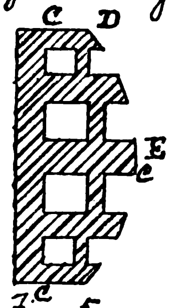


Fig 5

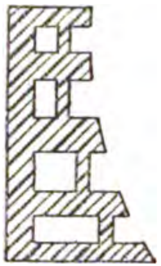


Fig 6

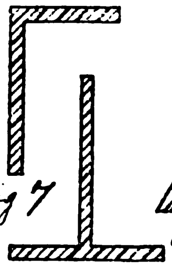


Fig 7

Fig 8

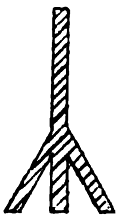


Fig 9

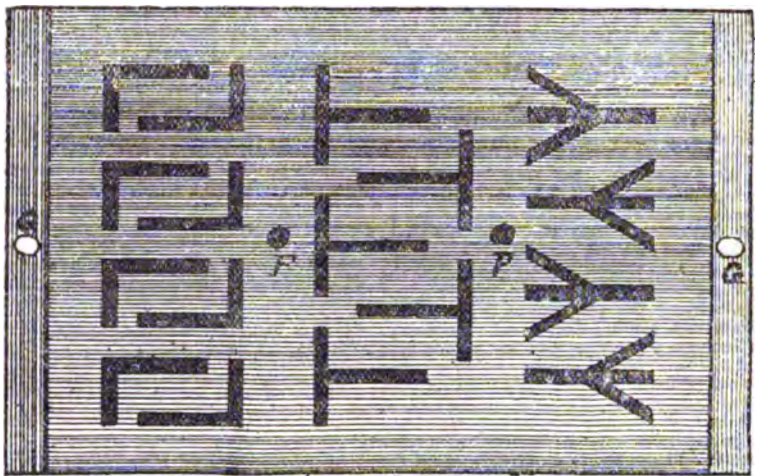


Fig 10

For perpendicular bars in cheeks the fingers can be cut in a variety of forms to suit the work, as at Figs. 5 and 6. The advantage of these bars over wooden bars is they do not burn out, and they save the flask from being split and broken up by driving large spikes or long rods around the cheek to support the sand, and if the pattern is of such a shape as to fit around the bar (Fig. 5), in the cheek from C to C, with a parting in the pattern (for the convenience of drawing it) at D or E, the bars can be unbolted from the outside of the flask and shook out with the casting, and can be used again if two or more of the same style of casting are required; whereas if wooden side bars are nailed in they have to be broken or prised out to get the casting out of the flask.

Figs. 7 and 8 are familiar forms of gaggers to all moulders. Fig. 9 will be new to many. Why it is that gaggers are such a scarce article in so many foundries, when they are just as necessary and as useful to the equipment as any other tool in it, is something I have never been able to understand. It is true, they are often used when there is no necessitty for it, yet there are times when a foreman might as well ask a man to ram up a mould without a flask as to do it without gaggers, or something to answer their place (or absence, I imagine, would be a more proper term).

It is a very simple thing to keep a good supply of T, L, and Y cast-iron gaggers on hand. The patterns can be fastened on a board, as shown in plan and section Figs. 10 and 11, and a boy can run up a lot of them in a short time. Each kind can be put on separate boards if desirable, and the runners made on the boards to save the time of cutting them in each mould.

F F are holes to set the gates, and G G are holes for the flask pins, or they can be rapped down on a level sand bed, and poured open one at a time with a hand-ladle. I know a number of moulders who do this every now and then on the back end of their floor after they have got up their work, and keep themselves supplied with gaggers for their own convenience.

Fig. 9 is better for a deep lift or a pocket in a pattern than either Fig. 7 or 8. For lifting deep places out of a pattern I have found long, slim pieces of coke rammed up with the cope a good thing for the sand to hang to, and again, I have used old shingles to advantage, putting the thick end down in the sand, and tacking the thin end to the side of the bars.

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* By Robert E. Masters, in the *Manufacturers' Gazette*.

ADULTERATION OF OLIVE OIL.

THE United States Consul at Marseilles, in a recent report, says that the olive oil industry of Southern France is suffering heavily from adulteration, or the artificial fabrication of oils called by that name. The olive is of slow growth, the area on which it can be grown is limited, and it is beset by insects and diseases which render the yearly crop uncertain. Hence any serious reduction in the consumption is sufficient to reduce the market value below the point of profitable culture. This has now been done by the almost universal practice of adulterating the native oils of Nice and Provence with various seed-oils, such as sesame, peanut, poppy-seed, and especially cotton-seed, which last, by reason of its cheapness, palatable flavour, and difficulty of detection, has of recent years supplanted all the others as an adulterant. The rank, low-priced olive oils of Southern Italy, Algeria, and Tunis are imported into France in vast quantities, diluted with cotton-seed oil, and exported wholesale as the fine, delicate, high grade oils of Var and Bouches du Rhone. This has so reduced the value of olive oil in Southern France that the Government has set itself seriously to provide a remedy, and the first step was to discover some method of detecting adulterations which should be not only exact, but sufficiently simple for ordinary consumers to use. In May last a distinguished chemist of Marseilles reviewed all the known processes, and admitted that not one of them was sufficiently delicate and exact to detect an adulteration of less than 10 per cent., while the process generally in use, which consisted in treating the oil with a mixture of sulphuric and nitric acids, was useless unless the adulteration exceeded 20 per cent. The Bechi process used by the Italian Government will detect an admixture of 15 per cent. of cotton-seed oil, provided the sample analysed contains no glycerine, formic acid, or free fatty acids, any one of which will mask the chemical reaction on which the process depends. It would seem, however, that at last the process required has been discovered by M. Brullé, of the agronomic station at Nice, and has been endorsed by a committee of the Agricultural Society of the Alpes-Maritimes. It depends upon the principle that vegetable oils when oxidised by the application of certain acids assume different shades of colour. By repeated experiments the tints of olive oil in its pure state and with its usual adulterants in various proportions have been established. Thus pure olive oil, when treated by the Brullé process, yields a precipitate tinted like five units of Naples yellow dissolved in 100 units of water; if it has 5 per cent. of cotton-seed oil its tint is that of five units of Naples yellow and five units of dark chrome yellow in 100 units of water; and so on for other degrees of adulteration. The consul mentions that over two million gallons of cotton-seed oil are exported from the United States to Marseilles every year, and that more than half of this is used for adulterating olive oils, a large part of which is exported to the United States with a 30 per cent. import duty.

Linoleum, and How it is Made.—Linoleum is, as its name is intended to denote, a peculiar preparation of linseed oil. In 1849 Nicles and Rochelder independently discovered that chloride of sulphur would solidify oil and render it of use in many new ways. "In 1859 M. Perra communicated to the Academie des Sciences the details of the mode of effecting this by mixing and milling the ingredients and pouring the mixture out in a thin layer. By varying the proportions the resulting substance assumes varying degrees of consistency. The term linoleum properly applies to the hardened or oxidised oil itself, but is chiefly used as a designation for one of the substances made from or with it—a kind of floor-cloth. When the oxidised oil is rolled into sheets it becomes a substitute for india-rubber or guttapercha. When dissolved as a varnish or mastic and applied to cloth, it is useful for waterproof textiles, felt carpets, carriage aprons, waggon and cart sheets, nursing aprons, water-beds, tank linings, table covers, &c., according to the mode of treatment. When vulcanised or rendered quite hard by heat, it may be filed, planed, turned, carved, and polished like wood, and used for knife and fork handles, mouldings, &c. When used as a paint it is useful for iron, for wood, and for ships' bottoms. When used as a cement it possesses some of the useful properties of marine glue. When brought by certain treatment to the consistency of dough or putty, it may be pressed into embossed moulds for ornamental articles. When used with a grinding wheel, touched with emery it becomes a good cutter. Lastly, when mixed with ground cork, pressed on canvas by rollers, the canvas coated at the back with a layer of the same oil in the state of paint, and the upper or principal surface painted and printed, it becomes the linoleum floor-cloth."

The Jablochkoff Distribution Patent.—It will not be a surprise to those who are familiar with the chronology of publications bearing on electrical distribution by means of transformers, and the terms of the judgment in favour of Messrs. Ferranti at the recent trial, that Jablochkoff's patent of 1877 is now recognised as covering the system. The holders of this important interest are the United Electrical Engineering Company, Limited, of 68, Victoria-street, Westminster, who have concluded arrangements involving both the recognition and support of the patent with the leading electric lighting companies. The name of Paul Jablochkoff has been long and honourably known in connection with the development of the electrical industry. At an early period he was identified with what was then termed the "division of the electric light," and his name became familiar with the first public lighting of any extent which was carried out. The lighting of the Thames Embankment, London, and the Avenue de l'Opera, Paris—undertaken for a contract term for the purposes of demonstration—marked an era in the evolution of the industry. To the prescience of the same inventor credit is due for the "distribution" system referred to, which solves the problem of house-to-house supply over extensive districts, and presents a field of operation of enormous and far-reaching importance.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

ANNUAL meeting held at King's College, Strand, W.C., on the 13th February, 1889, Dr. C. T. Hudson, M.A., LL.D., president, in the chair.

The president having appointed Mr. W. W. Reeves and Mr. H. Epps to act as scrutineers, the ballot for the election of officers and council for the ensuing year was proceeded with.

The secretary read the Annual Report of the Council as follows:

Fellows.—During the year forty Fellows have been elected whilst twenty-eight have died or resigned, a somewhat larger average than usual. Four Honorary Fellows have died: Mr. Waterlowe, Prof. A. de Bary, and Dr. Asa Gray, whose deaths were noticed in the last report, and Mr. P. H. Gosse, an obituary notice of which appears in the current volume of the "Proceedings" of the Royal Society. In their place were elected: Prof. Virchow, Prof. Lovén, Prof. Gore, and Prof. Allman. One *ex-officio* Fellow has also been elected the president of the Nottingham Naturalists' Society; this leaves the list of Fellows, 641 ordinary Fellows, 50 Honorary Fellows, and 88 *ex-officio* Fellows, or 779 in all.

Finances.—Notwithstanding that the deaths and resignations have exceeded the average of previous years, yet as these have been to a large extent amongst the compounders and Fellows paying the old rate of subscription; the increase in the revenue of the society is larger than previously, namely £41 9s. 6d., as against £34 2s. 6d. in 1887, and £24 3s. in 1886. The invested funds of the society remain at the amount mentioned in the previous report — namely, freehold mortgages, £1,200, and Indian Three per Cents, £875 10s. 8d., including the Quekett Memorial fund £100. The total revenue of the society from Fellows' subscriptions only is £920.

Library.—The Council regret to have to announce that they have received notice from the authorities at King's College that, after the present year, the society can no longer be accommodated at the College. As this notice has only been very recently received, the Council have not had an opportunity of considering future arrangements; but this will form the subject of discussion at the first meeting of the new Council. It will probably be found convenient to arrange to share a meeting-room with some other societies. The catalogue of the library is now ready for distribution, and can be obtained by any Fellow on application to the librarian. The Council have fixed its price at the moderate sum of 1s.

Cabinet.—An important addition has been made to the cabinet by Mr. A. D. Michael's donation of 130 type-slides, illustrating his work on the Oribatidæ, another set of which has been deposited with the British Museum. Mr. Suffolk has continued during the year his valuable revision of the slide cabinet, which is now completed. The thanks of the society are due to Mr. Michael and to Mr. Suffolk for their contributions.

By-Laws.—As mentioned in the last report, the by-laws of the society have been remodelled, and the Council have thought it desirable that they should be issued as part of the prefatory matter to the *Journal*, so that they may be preserved for future reference, great difficulty having been experienced in obtaining copies of the former by-laws.

Upon the motion of Mr. Bettany, seconded by Mr. J. J. Vesey, it was unanimously resolved that the report be received and adopted, and that it be printed and circulated in the usual way.

The Treasurer presented his annual statement of accounts, and read the balance-sheet, duly audited by Messrs. Guimaraens and Parsons, who were elected auditors at the preceding meeting. From this it appeared that nearly £1,100 had been received during the past year.

Upon the motion of Mr. A. D. Michael, seconded by Mr. Ingpen, the adoption of this report, together with a vote of thanks to the treasurer for his services during the past year, was passed.

The President then read his annual address, which was upon "Foreign Rotifers and their Distribution." Dr. Hudson having completed, in conjunction with the late Mr. P. H. Gosse, the monograph on the rotifers of Great Britain, has now turned his attention to the foreign species. This country stands far ahead of other countries in the species hitherto discovered; but the result of study of foreign species is that a considerable number are found to be widely distributed over the world. This is somewhat surprising, considering that most of them live in fresh-water pools and ponds. It appears, however, that the eggs of many are capable of being carried to great distances with the dust of dried-up ponds, this dust being also carried by packages, &c., on shipboard. The winter eggs of the Rotifera are extremely light, and can rest undeveloped for months. Rotifers may also be dispersed by aquatic birds or even by dogs. The eggs of some species bear either freezing or roasting, their powers of endurance and adaptation being practically unlimited. They can be dried in an air pump, and can swallow many poisons with impunity. Nearly half the marine species are also capable of living in fresh water; thus their distribution is readily accounted for. Dr. Hudson believes that all rotifers are related by descent, and that the great variations in their forms and structure have been produced by causes that have been at work a very long time. The address was listened to with great attention, and warmly applauded. At its conclusion, he proceeded to exhibit a number of large transparencies of foreign rotifers and other objects, which were greatly admired by the Fellows present.

Mr. Jas. Glaisher said he rose to propose that a very hearty vote of thanks be given to the President for the most interesting and valuable address to which they had just had the pleasure of listening, and also for the exhibition of drawings by which they had all been so much interested. With regard to the address, he could only say that it contained matter which would afford them much profitable thought in their studies at home. He had also put them under a further obligation when he said that their *Journal* was so full of matters relating to the progress of microscopical science that it was no longer possible to find materials for a president's address by a detail of what had been done during the year, and that therefore they were to have in the future addresses which would contain a large increase of knowledge upon special subjects, instead of a repetition of facts with which the *Journal* had already made them acquainted. He felt that the Society was deeply indebted to the president for his address, and he had the greatest pleasure in moving that their hearty thanks be given him for it.

Prof. Bell said he should be very glad to second the vote of thanks for the most instructive, and, he might also add, entertaining, presidential address to which they had just been listening. It was full of matter for reflection, and he had been especially struck by the concluding paragraph, which breathed so entirely the spirit in which they ought to attack the subjects of biology. It had also raised questions of great interest as showing how Nature often did the same things in different ways under different circumstances. The Rotifera were not the only creatures common to various parts of the world, or to this country and to Australia; the protozoa of both showed similarities of type and structure; but in their case the cause was doubtless altogether different from the causes which had been assigned to account for the wide distribution of many forms of the Rotifera. If he might make one criticism, it would be to point out one serious omission from it, and that was that the President had not mentioned the work on the Rotifera which he had lately published, in which they had the results of researches which laid all students of the subject under the deepest obligations to him.

Mr. Glaisher having put the motion, it was carried by acclamation.

The President said he had to thank them very heartily for the way in which they had received his address, and for the cordial manner in which they had responded to the vote of thanks by Mr. Glaisher and Prof. Bell. He was glad on his part that he had been able to please them in that respect, and as he found that they had done him the honour to re-elect him as their President for another year, he hoped to have the pleasure of again addressing them on a future occasion. He also hoped that during his second year he should be more successful than in the past in the matter of regular attendance at the meetings. He had not yet entirely recovered from the effects of his accident, but was much better than he had been for some time past, and he ventured to hope that he should be able to occupy his place as often as occasion required.

The scrutineers having handed in the result of their examination of the balloting-papers,

The President declared that the whole of the gentlemen whose names had been printed upon the lists were unanimously elected to the offices and council for the ensuing year as follows:—

President: Charles T. Hudson, Esq., M.A., LL.D. (Cantab.). Vice-Presidents: Rev. W. H. Dallinger, LL.D., F.R.S.; *James Glaisher, Esq., F.R.S., F.R.A.S.; *Prof. Urban Pritchard, M.D.; Prof. Charles Stewart, F.L.S. Treasurer: Lionel S. Beale, Esq., M.B., F.R.C.P., F.R.S. Secretaries: Frank Crisp, Esq., LL.B., B.A., V.P., and Treas. L.S.; Prof. F. Jeffrey Bell, M.A., F.Z.S. Ordinary Members of Council: Alfred W. Bennett, Esq., M.A., B.S.C., F.L.S.; *Robert Braithwaite, Esq., M.D., M.R.C.S., F.L.S.; Rev. Edmund Carr, M.A.; Prof. Edgar M. Crookshank, M.B.; Prof. J. William Groves, F.L.S.; George C. Karop, Esq., M.R.C.S.; John Mayall, Esq., jun.; Albert D. Michael, Esq., F.L.S.; *Thomas H. Powell, Esq.; *William Thomas Suffolk, Esq.; Charles Tyler, Esq., F.L.S.; *Frederic H. Ward, Esq., M.R.C.S. (The names with an asterisk have not held during the preceding year the office for which they are nominated.)

The President then proposed that the thanks of the Society be given to the auditors and scrutineers for their services.

The motion having been seconded by the Rev. Edmund Carr, was put to the meeting, and carried unanimously.

Mr. A. D. Michael said they should not separate that evening without passing a hearty vote of thanks to their secretaries, who had done the work of the Society so admirably during the past year. How well they had performed their duties was so perfectly well known to the Fellows that it was impossible for him to say anything new about it; he would, therefore, simply move the best thanks of the Society be given to the secretaries for their valuable and efficient services during the past year.

The motion was seconded by the Rev. T. S. King, and on being put to the meeting by the president, was carried unanimously.

Prof. Bell said that his feelings, when any allusion was made to the secretarial work, might be compared to those of one of two men who had agreed to share a bottle of wine together; the other man was such an efficient drinker that the amount which he got himself was only a very small glass now and then. He thought that in the matter of thanks for work done in connection with the office, he deserved one-hundredth part, and Mr. Crisp the other ninety-nine hundredths. It was probably due to the fact that Mr. Crisp thought he had usually so little to do that he put upon his shoulders the difficult task of responding to-night to the vote. He thanked the Fellows, on behalf of his colleague and himself, for the way in which they had passed it.

USEFUL AND SCIENTIFIC NOTES.

New Tin Oxide.—A new acid of tin has been obtained by Prof. W. Spring, consisting of two molecules of a higher oxide, SnO_3, combined with one of water. The new acid, $H_2Sn_2O_7$, or $2SnO_3 . H_2O$, is consequently analogous to disulphuric acid, $H_2S_2O_7$, and dichromic acid, $H_2Cr_2O_7$. The method by which Dr. Spring has prepared it is of peculiar interest. A saturated solution of about 10 grammes of stannous chloride, in water containing sufficient hydrochloric acid to prevent decomposition into the oxychloride, was treated at the ordinary temperature with excess of peroxide of barium. The latter substance was obtained pure in the form of the hydrate, $BaO_2 . 6H_2O$, by precipitating clear baryta-water with oxygenated water. Upon subjecting it to dialysis, chloride of barium diffused through the membrane, and was eventually entirely removed by changing the water in which the dialyser floated every day during a period approaching three months. The contents of the dialyser were now evaporated as low as possible upon a water-bath; when the evaporation was sufficiently advanced the contents of the dish became converted into a white opalescent jelly, and this eventually dried up into a white solid mass of the new acid. Analyses prove beyond doubt that the tin is present in the form of trioxide, and that at 100° C. one molecule of water remains combined with it. From certain secondary phenomena, Dr. Spring is of opinion that the reaction really takes place in two stages; an oxychloride of tin being first formed by direct addition of oxygen to stannous chloride, $SnCl_2 + BaO_2 = SnOCl_2 + BaO$. This stannic oxychloride appears, then, to react with a further molecule of peroxide of barium chloride and trioxide of tin, or hyperstannic anhydride, as Dr. Spring terms the new oxide.

Train Telegraphy for Ranches.—Another application of train telegraphy, says an exchange, adapted to any use, or for branch or hacienda service in Mexico or other lands, suggests itself. It is this: A horseman desiring telegraphic communication, and separated from his command or detachment, or otherwise isolated near an ordinary telegraph line, but distant from the station, equipped with a telephone receiver—a coil or two of wire and a magneto battery, such as is used for testing telephone circuits—would possess all the essentials of a successful "hopper" telegraph, which, in this case, would become a "horse" telegraph. He rides up to a telegraph pole, throws one end of a coil over the line, makes his ground by throwing another coil on to the earth, applies the magneto, send his message, collects his apparatus, mounts, and is away. All in a few moments, and with no cutting of the wire to insert a "relay," as by the old way.

A Scandinavian method of quarrying is to drill a row of holes, close together, in the rock at right angles to the plane of stratifiation, fill the holes with water, and allow the expansion due to the water freezing to disrupt the mass. A correspondent thinks this gives a suggetion for the safe getting of coal in fiery mines, if the Poetsch system of artificially freezing the water in quicksands, while sinking a shaft, be applied to the underground workings of a colliery; but he forgets that the range through which the pressure acts, while sufficient in the case of stone, would be insufficient in coal even if time did not enter into the problem.

SCIENTIFIC NEWS.

MINOR planet No. 281, discovered by Dr. Palisa, of Vienna, on Oct. 31 last, has been named Lucretia, in honour of Lucretia Caroline Herschel.

The total solar eclipse of December 21, 1889, will be visible for observation purposes at Cayenne, and at a point on the West Coast of Africa some miles south of Loanda. As it is proposed to send observers to those spots, it is to be hoped that those who have had experience of the climate will be chosen.

The death is announced of the Rev. John George Wood, M.A., F.L.S., the well-known writer and lecturer on natural history subjects. Mr. Wood was the son of a surgeon, and was born in London in 1827; in due course he passed from school to Merton Coll., Oxford, in which he was elected Jackson scholar. He was attached for some time to the anatomical museum at Christ Church, Oxford, but subsequently taking Orders, he filled some minor offices in the Church, being well remembered by many as assistant chaplain of St. Bartholomew's Hospital for several years. Mr. Wood was a prolific writer on his favourite subjects, as a long list of works bearing his name testify, and he was an indefatigable contributor to magazines and similar periodicals. His magnum opus is the "Natural History," in three volumes, but many readers will prefer the series of works bearing titles beginning with "Common Objects," and such books as "Homes Without Hands," "Our Garden Friends and Foes," and "Insects at Home." Mr. Wood died suddenly at Coventry on Sunday last.

The head of the famous firm of Beyer, Peacock, and Co. died on Wednesday last. Richard Peacock was born in Swalesdale in 1820, and served his apprenticeship to Messrs. Fenton, Murray, and Jackson, subsequently becoming locomotive superintendent to the Leeds and Selby Railway, and afterwards to the Manchester, Sheffield, and Lincolnshire Co., whose works at Gorton were planned by him. The firm Beyer and Peacock started in a small way; but owing to the quality of the productions it prospered amazingly until it employed nearly 3,000 hands, and turned out 200 locomotives per annum.

The death is announced of Mr. Edward King Fordham, a well-known scientific agriculturist of Hertfordshire, farming upwards of 1,000 acres on his own estate. He was in his 79th year.

A well-known American engineer and mechanic, Mr. Cornelius H. Delameter, died last month in his 68th year. He went to New York as a boy to earn his living, and in 1850, in conjunction with his cousin, Peter Hogg, founded the famous Delameter Iron Works, where the turreted ironclad *Dictator* was built.

The anniversary meeting of the Institute of Chemistry was held last week, when Dr. James Bell, F.R.S., was re-elected president. Dr. Bell, in his presidential address, stated that during the year there had been an increase of 38 Associates and 141 Fellows; and the income had exceeded the expenditure by £737. At the first annual meeting in 1878, the number of Fellows on the register was 225; now it is 768. Dr. Bell indicated several directions in which the efficiency of the institute has been much improved, and among other improvements suggested was an annual meeting of the Fellows, to last two or three days, at which papers might be read and discussions held on subjects in practical chemistry.

The following arrangements have been made for science lectures at the Royal Victoria Hall, Tuesday, March 12, "A Tramp among the Mountains at Home and Abroad," by Prof. Kennedy, F.R.S.; Tuesday, March 19 and 26, two lectures, by Prof. H. E. Armstrong, on the "History of a Crime Unravelled by a Piece of Rusting iron, a Horse-shoe, and a Match."

At a recent meeting of the Anthropological Institute, Mr. B. Hollander read a paper on "Centres of Ideation in the Brain," the object of which is to furnish a basis for a really scientific phrenology.

At a recent meeting of the Paris Academy of Sciences, a note by M. Minary on "Shooting Stars" was presented. The author argues that the incandescence of such bodies cannot be explained by the transformation of motion into heat. The gases being perfectly elastic bodies, and in the upper atmospheric regions in an extremely rarefied state, heat cannot be produced by the shock of bodies endowed with great velocity and impinging on perfectly elastic molecules capable of receiving the motion and acquiring the velocity of those bodies; in this case the movement is communicated, not dissipated or transformed to heat. Had such transformation taken place, the velocity of the bodies on their trajectory would be progressively retarded, while the incandescence would be proportionately increased. But observation shows only luminous flashes, and more or less uniform velocities of translation at least for all the bodies that are not combustible. The reading of the paper was followed by some observations by M. Cornu, who remarked that the illumination of the trajectory of the shooting stars might be attributed to a development or a discharge of static electricity without any considerable rise of temperature, as implied by the incandescence of detached particles of meteorites. That would agree with the spectral observations made on the shooting-stars, and would lend support to the view that certain cosmic phenomena, such as auroræ, the zodiacal light, comets, solar protuberances, &c., are electric manifestations analogous to those so easily generated in rarefied gases.

At the same *séance* of the Academy, a paper referring to the possible transformation of pathogenic into harmless microbes was presented by M. A. Chauveau. It appears, however, that the charbon microbe and that of anthrax are not as yet proved to undergo specific transformation. How deadly is the anthrax which produces "woolsorter's disease" has unfortunately been shown again in the case of a horse-hair dresser who died recently at Sudbury, Suffolk. The deceased complained of a pimple on the back of the neck, but persisted in going to work, and the pimple developed into malignant pustule, which was excised too late to avert death. At the inquest it was stated that this was the fourth case of the kind in two years for the district, which is not a large one.

At a recent meeting of the Société de Biologie, Prof Brown-Séquard referred again to the use of carbonic-acid either as an inhalation or as spray in relieving pain. He obtained complete success with it recently in a case of lumbago. Expired air, as Brown-Séquard, in conjunction with D'Arsonval, has shown, contains at least one toxic property, and by experiments it has been proved that it is the exhalation of toxic matter from the lungs, and not mere carbonic acid, which kills—a powerful argument for free ventilation in crowded buildings, railway carriages, &c.

Mr. George Westinghouse, jun., is having an instruction car built at Altoona for the purpose of showing American railroad men the practical working of all the Westinghouse railway appliances. The car will be fitted with working models of the improved air brake, steam heating apparatus, and other specialities. A 15H.P. boiler and a Westinghouse engine and dynamo will be included in the fittings.

"Motorneer" is the new American word to designate the man who controls the electro-motor, or handles the trolley on the overhead wires of the electric railways.

The electric cars on the Omaha—Council Bluffs line are said to run faster than on any other street road in America. A speed of 15 and often 20 miles an hour is attained. The power plant consists of two 80 and one 40H.P. generators.

Prof. Ayrton exhibited his low-reading voltmeter for general use in electric installations at a recent meeting of the Physical Society. The dial of an instrument reading up to 2·5 volts is about 6in. in diameter.

The method of lighting the channels of harbours by means of electric buoys, which has been tried in New York Harbour, is likely to be adopted in this country, as it has been favourably reported on by officers appointed to examine the system.

A curious instance of the utility of the electric light is found in its introduction by Mr. Hartness, manager of the test works of the River Wear Commission. Hitherto the testing and examining of chain cables could be carried on only by daylight; but lately the examiners have been provided with 16 candle-power incandescent lamps attached to their caps, the current being supplied through a flexible cable from the main, which allows the men to work within a certain radius. This arrangement has, it is stated, enabled the Commissioners to nearly double the "output" of their testing department.

According to *Die Natur*, Dr. Otto Zacharias, of Hirschberg, Silesia, intends to establish a zoological station for the observation of freshwater fauna. It is considered that the banks of the Plöner Lake in Holstein would be suitable for the purpose, and funds for maintaining the station for four years are being collected.

Arrangements are being made by the Berlin Academy of Sciences for an interesting scientific undertaking. During the summer of this year a ship is to be despatched for the investigation of the pelagic fauna of the Atlantic, especially along the coast from Greenland to Brazil. Prof. Hensen, of Kiel, will be at the head of the party, which is expected to start in July.

Some statements have been made recently that the method of preparing the famous cæruleum or Egyptian blue has been discovered by a French chemist. The fact is that M. Fouqué has been investigating the pigment in a fresh series of experiments, and has announced its formula to be $CaO,CuO,4SiO_2$, consisting of 63·7 parts of silica, 14·3 of lime, 21·3 of copper oxide, with a trace of iron; specific gravity 3·04. The Egyptian blue is said to have been discovered by Vestorius, but it was not made after the fall of the Western Empire. The above analysis may be more accurate than that of Vauquelin.

USEFUL AND SCIENTIFIC NOTES.

The Eggs of an Eel.—According to Mr. Fred. Mather, of Cold Spring Harbour, N.Y., scientists have known that the eel is an egg-producing fish for a dozen years or more, the Russian naturalist, Syrski, having first figured the ovaries of the female and the spermaries of the male, but how and where these minute eggs are laid is still unknown. In October the eels run down to salt water to breed, and in the spring the young eels ascend the brooks and rivers in swarms. As they are then some 2in. long and of the size of a darning needle, it is evident that they must have been hatched several weeks before, perhaps in February, to have grown so much from so small an egg. The number of eggs in a 6lb. eel in November (in what is known to fishermen as "eel fat," but which are really the ovaries) is fully 9,000,000. Under the microscope they measure 80 to the linear inch, and taking one ovary and dividing it by means of the most delicate scales known to science; I halved, quartered, and further divided the mass seventeen times, until I had a section small enough to count the eggs in it. This section represented 1 = 131,072 of the total number, and three sections were laboriously counted under the microscope. One of the sections contained 68 eggs, making the total 8,912,896 eggs. The second held 77 eggs, or 10,092,544 in the whole. The third section consisted of 71, from which it would appear that there were 9,306,112 eggs in the eel. There have been many theories about the reproduction of the eel, some of them being wildly absurd, such as their being hatched by fresh-water mussels, or that the lamprey was the female and the so-called silver eel the male, &c. The fact is that the lamprey, miscalled "lamper eel," is a form of life lower than that of the true fishes, to which the eel belongs, and is a vertebrate with a cartilaginous skeleton instead of a bony one, has its skull imperfectly developed, and has no lower jaw. Superficially it appears like an eel, but is not nearly related to it.

The Thomson Effect.—M. A. Battelli has recently been pursuing some investigations with regard to the Thomson effect. The method employed was similar to that of Le Roux, but more accurate. These investigations show that, so far as the metals experimented on are concerned, the quantity of heat carried by the current is proportional to the strength of the current, and that, except for iron, it is proportional to the absolute temperature. If in the formula $\varepsilon = a T i$, i is expressed in C.G.S. units, T in absolute temperature, and ε in calories, the value of the constant a for the different metals experimented upon will be as follows: Cadmium, $a = 3{\cdot}678 \times 10^{-8}$; antimony, $a = 7{\cdot}081 \times 10^{-8}$; bismuth, $a = -3{\cdot}909 \times 10^{-8}$; German silver, $a = -2{\cdot}560 \times 10^{-8}$.

A new alloy has been made by Herr Reith, of Bockenheim, Germany, which is said to practically resist the attack of most acid and alkaline solutions. Its composition is as follows:—Copper, 15 parts; tin, 2·34 parts; lead, 1·82 parts; antimony, 1 part. This alloy is, therefore, a bronze with the addition of lead and antimony. The inventor claims that it can be very advantageously used in the laboratory to replace vessels or fittings of ebonite, vulcanite, or porcelain; but the "novelty" can be only in the proportions of the constituents employed.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

ERRATUM—THE "SCIENCE AND ART" OF COSMOGONY—CATS AND MUSIC—BERTHON EQUATOREAL—ERRORS IN THE MOON'S PLACE.

[29682.]—Your compositor has certainly done his best to make me talk nonsense in the penultimate paragraph of letter 29653, Vol. XLVIII. p. 520, by converting the word *enlisting* into "whistling"!

Of all the examples of "Verba non res; vox et præterea nihil" that I have ever come across, the lecture by Mr. Lockyer which you report on pp. 517 and 518 of Vol. XLVIII. seems to me to be about the most glaring. What is sound in it is the mere rechauffé of other men's work. The novel part is the veriest empty verbiage. Everything for which there is any scientific warrant is no more Mr. Lockyer's than it is mine. The lecturer begins by talking about certain "possibilities." Were he a mathematician, I would invite him to test, by the doctrine of probabilities, the odds against his perperfectly gratuitous assumptions. For example, the void space in which hydrogen (from some other part of space—the other side of the wall, so to speak) "curdles"!—which "curdling" apparently results in dust!—and so on and so forth. He speaks of the identity of the spectrum of the dust of a crushed meteorite with that of certain nebulæ as remarkable: the fact being that, if we admit, as all physicists now do, the common origin of the visible universe, the wonder would be if they were *not* identical. We do not need "the auspices and direction of a Government Committee called the Solar Physics Committee" to make such a discovery as this. I will not, however, waste your valuable space by further commenting on this part of a too-well-advertised hypothesis; but in connection with that part of the "work" alleged to have been "done in the science schools," which really has some physical warrant, will content myself by referring my brother-readers to pp. 210 to 219 inclusive, of the first edition of "Other Worlds than Ours," by the late lamented Proctor, published in 1870. The considerations at which I have hinted above will show how much of the "science school" hypothesis is true; the perusal of Proctor's essay will enable everyone to see for himself how much of it is new. Dr. Mayer was the originator, in 1848, of the theory of meteoric collisions as the active agent to which the heat of our own (and, of course, implicitly, every other) sun is due; just as Professor Clarke, of Cincinnati, was the originator of the hypothesis of the non-elementary character of the elements, which has been so blatantly puffed as a Brompton theory, though not always (as at the Royal Society, for example) with unqualified success. But this is emphatically the age of quackery. Puff yourself, advertise yourself *proprio nomine* as well as anonymously, and hundreds of thousands of more or less ignorant people will readily accept you at a very small reduction on your own valuation.

As an illustration that the whistling of a plaintive air practically affects all cats alike. I would refer "J. K. P." letter 29663 (Vol. XLVIII. p. 521), to p. 282 of the volume of Hardwicke's *Science Gossip* for 1869.

I am sorry that I am unable to give any reply to "Luna's" query (67950) on p. 18, as my acquaintance with the Berthon mounting is confined to having seen it once in my lifetime. It *looked* top-heavy; but this may have been an optical illusion.

The second part of "Luna's" query cannot be answered categorically; as he will find out for himself by consulting any volume of the "Greenwich Astronomical Results." But, speaking roughly, I should say that in the data given on p. 398 of the *Nautical Almanac* for the current year, no error approaching 0·2 second is to be expected in the R.A. given; while 3″ would probably be in excess of any to be feared in the Moon's Declination.

A Fellow of the Royal Astronomical Society.

SATELLITES OF SATURN, &c.

[29683.]—It may interest Mr. P. F. Duke if I give him some of my experiences in the observation of Enceladus. My equatoreal, by Cooke and Son, is 8½in. diameter of object-glass, or four times the light-giving power of Mr. Ward's 4·3in. aperture. It is not often that I can see Enceladus *shining steadily*; I question whether I can see it by glimpses even in *six* observations of the planet out of *ten*. Mimas I have never seen decidedly; I have fancied that once or twice, on exceptional nights, I have just glimpsed it. This being so, I think Mr. Duke will waste his time by trying to see Enceladus with his 3¾in. aperture. I am quite of the opinion expressed by "F.R.A.S.," and I further think that any assertion of its having been seen with a 4·3in. aperture is also a statement to be received with caution. My old telescope, by Mertz, of Munich, 6½in. aperture, used to show it occasionally. I think very few persons have ever seen the *stepping* of the shading on Saturn's ring, save myself and the late well-known observer, Rev. W. J. Dawes, who drew my attention to it.

Amateur, F.R.A.S.

THE MOON'S ALBEDO.

[29684.]—I am very much obliged to "F.R.A.S.," not only for his note on my letter 29496, page 332, last Vol., but for his not having taken advantage of the clerical error I made in hurriedly copying out the figures quoted from Proctor's "Moon."

I wrote 0·783 as the number reflected out of 1,000 rays—which, of course, should have been 783, or 0·783 for *unity*.

Regarding the darkness of Grimaldi, I urge that we have two valuable terms in the albedo series in a true *black* in all lunar shadows, and a white equal to new-fallen snow in Aristarchus at 0·783 for unity (or 783 per thousand rays of white). Tested by these extremes, Grimaldi would seem a medium grey and not "nearly black."

If there is no snow on the moon, what are we to consider Aristarchus as composed of?

I do not think that meteoric dust would fall in "patches," but equally all over the surface. It would tend to accumulate on the levels whence gravitation could not remove it, and hence their relative darkness. But on the mountains and all inclines and cliffs, that, I assume, are *composed of snow*, I see no reason why avalanches should not remove it occasionally, and hence give us the whiteness, or even brilliancy, at all such places.

There are no dark ranges on the entire surface, the *inclines* are all *bright*, and the *dark* parts are *levels*; in the former we should expect to see effects due to gravitation, and not so on the levels.

The long bright rays seem to me the tracks of electrical surface discharge that has removed the coating of meteoric dust. Their peculiarities seem to be—(1) Radiality, (2) brilliancy, (3) superficiality. They are not irregularly hatched all over the surface as if due to meteorites grazing it, but indicate the passage of some force outwardly from centres. Occasionally they end suddenly at another centre, and seem to be thus *guided*, as it were, from start to finish by some form of induction.

Possibly snow would be a bad conductor, and the coating of meteoric dust enable an electrical discharge to pass from one active centre to another, or simply out on to the surface generally. Our own auroral streamers are pretty long at times, and are in semi-vacuo. The latest rays would presumably be brightest. Enormous quantities of meteoric dust fall on our earth yearly—thousands of tons. It has been detected on our Polar snows, but on our earth it cannot accumulate as it could on our moon for tens of thousands of years so as to produce a dark stain.

Regarding "colour" on the lunar detail, it is almost exclusively confined to the maria or seas, and hence anomalous. The lunar mountains and land surfaces, so to speak, are not only colourless, but, as before stated, bright; there are no dark ranges at all. Surely if the moon were surfaced generally by volcanic agencies, we should see traces of colour on these land surfaces easier than on the maria, and if like our earth, large areas of red clays, red sandstone, yellow clay, blue clay, or granites, brown peat, &c., would be visible in streaks or patches. I can see clearly the red landslips on the outer Himalaya through 134 miles of *dense air*; we can see planetary colour, so that neither our telescopes nor dense atmosphere are at fault, and the moon, beautifully lit up, is not so far off.

I urge that this brilliancy of the mountains and absence there of colour is an argument on my side.

Again, lunar snow would be almost inconceivably light, our terrestrial *ice* would there be lighter than cork to us, and presumably lunar snow would pack down much less than ours in accumulating, possibly not half the mass in the same vol. The snow peaks and ridges would rise into a vacuum, nothing to disturb them or shake them down but the "tremors" due to faulting. The "clefts" show us that subsidence of large areas occasionally takes place (see *Journal L. A. S.*, May, page 243). So that it would take but a slight shake to bring down the steeper snow surfaces, and the meteoric dust so brought down be buried at once.

I value very highly the criticisms of "F.R.A.S.," and I crave his patience in laying this before him. I have cut my remarks down to the lowest limit, on account of space in the "E. M.," but I hope that as far as the albedo, meteoric dust, the rays, and colour, I have made my view a little more intelligible.

I am only a student trying to decipher the writing on the wall, and by "Darwin's Life," I see that he considered observation without speculation was barren.

Asam, Jan. 23, 1889. **S. E. Peal.**

P.S.—Why has the moon no polar caps?

MOUNTING MIRRORS, AND ASTRONOMICAL.

[29685.]—WE are often told that a mirror which is of good figure when free from pressure upon the edge, becomes distorted when tilted up and resting partially on one diameter, so that definition is impaired. Resort is had to a variety of contrivances: cloth round cell, straps and strips of metal in which to suspend the mirror in order to, not remove, but distribute, this pressure round the circumference. Surely it would be better to remove it altogether, and I will now show how this may be completely and safely done. Some mirrors have a hole drilled partially through in centre from back. If the mount at the back has a peg put into it firmly for this hole in mirror to drop on to, the mirror will be held steadily without strain or pressure. If there be no hole, then have a 2in. hole cut in back board, or bored out, if metal, and cement a disc of wood barely 2in. in diameter on centre of mirror back, to fit this hole. Of course this must not touch the bottom of hole. In this way there can be no pressure on edge of mirror, nor any strain, since the wood disc would take it all upon its own edge. If afraid that the wood will affect temperature in case of a metal support, a metal or glass disc may be cemented to back of mirror instead.

I should like to direct attention to the remarkable field of O Σ 118. This is a close double with a wider *comes*. In the field of an eyepiece of 100 there are eight or ten pairs, not wider than the wide pair of 118. It is one of a cross of stars resembling Cygnus on a small scale, without the central star. O Σ 118 forms the right extremity of the transverse arm of cross. The star at opposite arm has *comes* nearly in same direction, which points to a faint triple not more than twice as far away. This pair is very delicate. Continuing the arm of cross slightly, following the nearest star is a small 4" pair. Both the stars at the longitudinal extremities of the cross have faint companions, and, altogether, I counted 40 stars in the group on a rather poor night.

ζ Gemini is mentioned in Webb as a triple star, with a *comes* 20" from the 8th mag. This is visible with 6½in. I found it without knowing it was there.

The pair mentioned in Webb *f.* 16 Aurigæ has a faint 2" or 3" pair 1' S. **Edwin Holmes.**

NEWTON AND NOAH'S FLOOD.

[29686.]—IN Halley's explanation of the last diluvial catastrophe, made to the Royal Society in 1694, but not printed till 1724, he quoted: "A person whose judgment I have great reason to respect." Though I always knew this could allude to nobody but Newton, I have always, in referring to this discovery, called it only "Halley's theory." I have but just met with documentary proof that we ought to call it equally Newton's. In a book by Whiston (who maintained, as is well known, the same cometic theory, but was the main agent in causing it to be neglected for a century and a half by his extravagant and untenable riders), in the 1728 edition of his "Authentic Records," Vol. II. p. 1069, he says, parenthetically "(which account of the cause of that Deluge by a comet, in general, was view'd and approved of by Sir Isaac Newton himself, before it was published in my 'New Theory')." You see, he honestly says it was the notion of a comet fall "in general" (not Whistonian details) of which Sir Isaac approved.

March 4. **E. L. G.**

GLAZING GELATINE PRINTS.

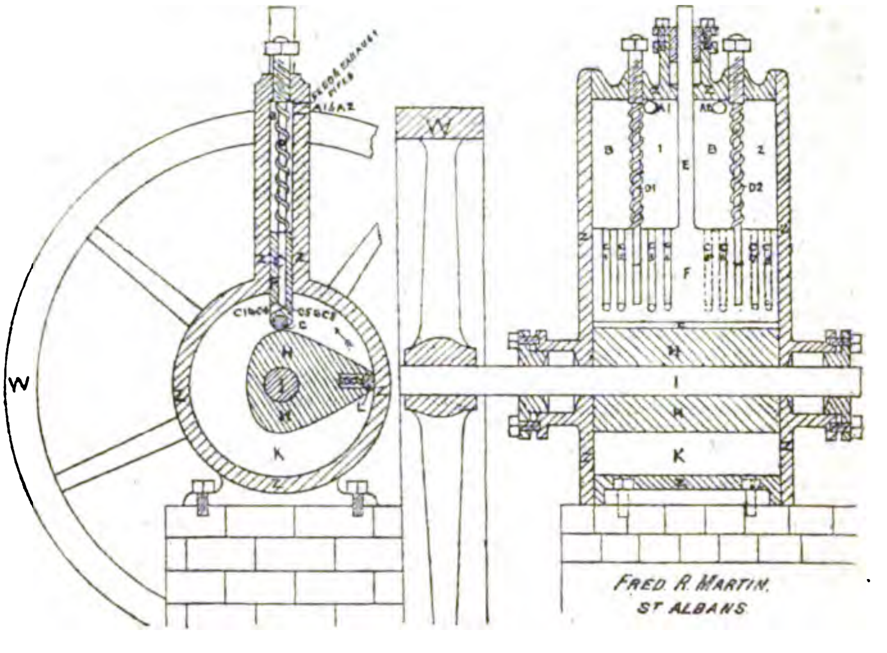
[29687.]—A VERY good surface may be produced on gelatino-bromide prints by squeezing them when wet on to a piece of tinplate in lieu of a piece of polished ebonite. When the prints are dry, they can be very easily removed. It is hardly necessary to mention that the better the polish of the plate, the better will be the surface of the prints.

J. G. Bartel.

Collingwood-street, Nelson, N.Z., Jan. 24.

REVERSIBLE ROTARY ENGINE.

[29688.]—I INCLOSE drawing and description of a reversible rotary engine, which I have recently provisionally protected, and I think you will see the superiority over the ordinary rotaries of to-day. It has been always a difficulty to obtain a good reversible rotary. The simplicity of the engine considerably reduces the friction and enables it to be constructed much cheaper. I don't know, but engineers tell me that my engine will consume ⅓ less steam than other rotaries of the same power. There is only one dead point, and a very even pressure is maintained nearly all round the cylinder.



It is extremely compact, and requires very little room, an engine of 1½I.H.P., weighing about 4cwt., can be screwed on a bedplate 12in. by 15in.

The advantages are: First, Compactness and simplicity, and less friction; second, more economical in the use of steam; third, most perfectly reversible; fourth, can be constructed far cheaper, and is as durable as any engine extant.

Steam enters at A 1 and passing into B 1, thence down four passages C 1 to C 4, drilled in the slide F, from C 1 to C 4 the steam passes into steam chamber K and blows the eccentric axle H and I in the direction of the arrow; the ecentric when revolving presses the slide F up into B 1 and B 2, when the roller (steel) G passes over the brass slot L, the engine is at a dead point, no steam being admitted or emitted. The steam on the "arrow" side of eccentric H passes up C 5 to C 8 into B 2, and passes out A 2 to the steam box (not shown), whence it is exhausted; the springs D 1 and D 2 keep F and the roller G continually pressing against H. By reversing the steam and admitting it into A 2 the wheel is driven in the opposite direction.

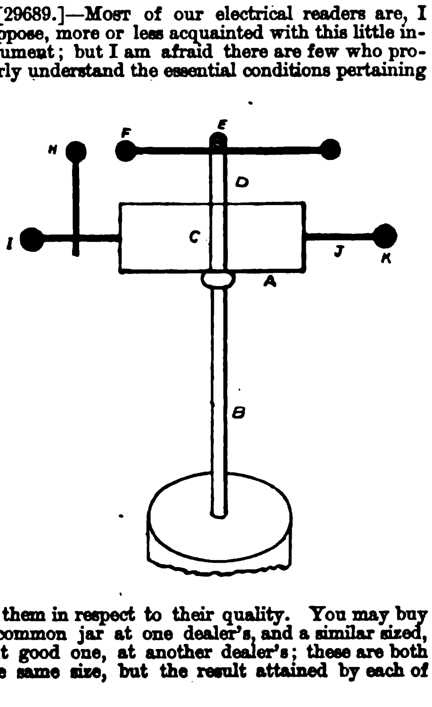
This engine is capable of driving at far above average rate of rotaries of the same power.

Fred. R. Martin.

Southwold Villa, Marlboro'-road, St. Alban's.

THE LEYDEN JAR.

[29689.]—MOST of our electrical readers are, I suppose, more or less acquainted with this little instrument; but I am afraid there are few who properly understand the essential conditions pertaining to them in respect to their quality. You may buy a common jar at one dealer's, and a similar sized, but good one, at another dealer's; these are both the same size, but the result attained by each of them (in form of the spark) will be much different. It will be found that the length and brightness of spark obtained by the thin jar far exceed that obtained by the thick glass one. Then comes the query, "Whence the cause of this?" The answer to this is, The quality of a Leyden jar depends upon the thinness of the glass, and also upon the specific conductive capacity of the glass, and it is needless to add, upon the capacity or size of jar. A pint jar will of course give double the result to that of half a pint jar. The thinness of the glass depends also upon the quality of the glass—the better the glass, the thinner it can be used. In fact, I had in use till lately a battery composed of six thin ordinary tumblers (water); these were half-filled with water and lids put on the top of them, through each of which passed a brass screw, dipping about an inch below the water; the tumblers stood upon a sheet of zinc (this of course represented the outer coating, with the water for the inner one); on discharging this I obtained a splendid result, equal to that of four or five half-pint ordinary jars—in fact, the result was so splendid as to cause the death of a pet kitten of mine, which somehow or other happened to get itself between the discharging points. I myself received a charge from one of the jars; but I must decline to have that honour again. This is, of course, only an illustration to show that the quality of the jar depends upon its thinness. About the best method to discover when a jar is fully charged is to attach a pith ball quadrant electrometer to the prime conductor of the machine, and watch for the pith ball flying out, which then indicates that the jar is charged to its maximum capacity. The best method also for measuring the quantity of electricity imparted to a jar is by means of a little instrument called Harris's unit jar. This consists as per sketch.



A is a small Leyden phial about 3½ by 1¾, mounted upon an insulated glass rod B; in connection with the outer coating C, by means of a brass band D, is the rod E, which terminates in the knob F. In connection with the inner coating is the brass rod G, upon which another vertical brass rod terminating in a brass ball H is mounted—the extremity of rod G also is provided with a knob I. Also, in connection with the outer coating is another brass rod, J, provided also at its extremity with a similar brass ball, K. It may be stated that the rod E has a sliding motion, so that it can be regulated to any distance from the knob H. Between the rods H and F is what is called the striking distance. To use this instrument, the knob is presented to the prime conductor of an electrical machine. When the jar is fully charged a spark passes between H and F, so these knobs are adjusted so as to obtain the maximum spark. When this is done, the Leyden jar to be charged is presented to the knob K, and then the electrical machine turned. The result is, that as soon as the jar receives its maximum quantity of electricity, it discharges itself by means of the knobs H and F, and for every discharge (or spark) a unit of electricity enters the Leyden jar, which is presented to K, and so the quantity of electricity can be regulated, for if we obtained four discharges (in shape of sparks) it would mean that we had obtained in our Leyden jar double the amount of electricity to that which we obtained with two sparks. This is the use of Harris's unit jar. I would also just in conclusion like to give a few words of advice to amateurs regarding their Leyden jars—(1) Always keep the jars as far as possible in a warm place, and never on any account in a damp one; (2) always warm them before a good fire for a few minutes before using them; and (3) always see that they are fully discharged before putting them away. The author had a narrow shave once through this. Fetching a battery of jars out of a cupboard, by some means or other I obtained such a shock as to lay me up for two or three days; if the jars had been fully charged it might have meant death. They were 12 pint jars; and so I would strongly advise my readers to see that their jars are fully discharged before putting them away.

F. W. Mason, Consulting Electrician.

WEIR'S NEW BATTERY.

[29690.]—In reply to the letter of Mr. F. W. Mason (29660, p. 521), I am glad to find that he has tested my battery practically, though I consider the results set down in his letter as scarcely fair to the battery. The E.M.F. of 2·03 volts and resistance $\frac{3}{8}$ ohm for 4sq.in. zinc surface were obtained as the results of experiments made, both with chromic acid and bichromate solutions, in the physical laboratory of Glasgow University, the measuring instruments used being Sir Wm. Thomson's graded galvanometers.

Perhaps "$\frac{3}{4}$ ohm" at the end of Mr. Mason's letter is a mistake for "$\frac{1}{8}$ ohm."

I may mention that the battery is shortly to be brought into the market by a well-known firm of instrument makers. **Geo. J. Weir.**

Hillcrest, Partickhill, Glasgow, March 1.

A NEW BATTERY.

[29691.]—With regard to the short-circuiting across the indiarubber band spoken of by Mr. Mason in letter 29660, I believe the Silvertown people found the same thing, after standing a long time, with their agglomerate Leclanché cells, and attribute it to the deposit of a conducting salt upon the rubber band holding the zinc rod. I think *anything* connecting the plates under the surface of the solution is a mistake.

I designed a similar cell to that spoken of in the above letter some five years ago, and have tried many forms since. I should like to know how Mr. Mason prepares his permanganate of potash solution to give such good results, as I shall certainly try it. **Farad.**

ERRATUM—GAS BATTERIES.

[29692.]—In letter 29681 on "Gas Batteries," read "I *then* transferred," instead of "have transferred." Otherwise, it appears as if I had written the letter before depositing the platinum, whereas I did the particular experiment described some months ago. **A. T.**

CLOCK TRAINS.

[29693.]—"J. K. P.'s" photo. and description of wheel-cutting gear in last week's issue of "E.M." is very interesting, but doubly so is the fact that there is a "hospital for diseased lathes." There are plenty of quacks about, but I should like to know of a "hospital" where "skilled operations" are performed at moderate fees. Will "J. K. P." kindly communicate the information? If he prefers to do so privately, I have given my address in the Address Column. **H. P. W.**

"J. K. P.'S" WHEEL-CUTTING ATTACHMENT.

[29694.]—I must write a line to thank "J. K. P." for his valuable contribution. In copying the photograph several lines seem in different parts to have been omitted, and in my copy the letter E nowhere appears, and as this is the most important letter in the figure it is the more disappointing. These omissions must be my excuse for asking a little more information on the positions of the parts and their operation. Am I right in thinking the cutting frame D is carried on the ordinary sliderest?

What is the object of the *two* wheels or discs on what I take to be the "head"? The broad one, to the front, against which the carrier is shown, and which performs the part of a face-plate, I take to be the worm wheel: the worm being hidden. What is the use of the other one shown at C? There appear to be two wheels on the horizontal bracket, separated over the head, the larger one with a winch handle—is this E? And if so, why does it not gear with what appears to be a wheel on shank of the worm? Two studs are shown on the bracket. Lastly, why is the driving-band taken such a roundabout course? I have always thought the more directly a band can be led to its work the better, and that wherever possible guide pulleys should be avoided, as absorbing a lot of power. I know "J. K. P." pulleys are steel and finished in the very best way; but even so, must there not be an unnecessary loss of power in leading the band as shown? Where everything is perfect this loss may be trifling, but if it is a loss and can be avoided, ought it not to be so? It is often the badly constructed tool which shows the error in principle, which is quite, or nearly, covered in a well-fitted tool.

Last year I asked for an opinion as to the efficiency of the Haydon cutter-bar as compared with a solid tool. Several friends came forward with advice and instruction in its use, and the proper method of sharpening, without which its powers are greatly reduced.

Under this teaching I came to think better of the tool than I had at first; but my old doubts have revived again, and I do not think it can be compared at all with a properly formed solid tool in the amount or character of work it will turn out, and this is how I have arrived at this conclusion. I have a very wretched lathe, with a slide-rest badly designed for solidity, and not over well fitted in some parts. With the Haydon cutter-bar I can only take a very light cut without chattering, owing to the great overhang of the tool straining the rest so much.

With a solid tool this overhang can be, and is, reduced one-half, and the fact is, I can take off with this tool a cut which comes off with that pleasant and sweet hiss in a long, unbroken coil, which tells you that all things are going well. Now the moral of this I take to be, those, or at least some of those, who have written to me in favour of the bar have had practically perfect lathes, in which a little loss of rigidity is unnoticed; their sliderests are so firm and well fitted that they could bear the extra strain brought on them by the increased overhand without suffering; and, judged by such a lathe, the bar and the solid tool might seem equally good, but all the time it is not so. The bar is trying the lathe in all its parts in a way the solid tool is not; and though, like a young man who unfairly tries his health and strength, the mischief done is not perceived by him, it is done all the same.

By some interested parties I have been sought to be persuaded that my bar is not the correct make. It has not the mark, without which, in the true quack self-advertiser style, it is nothing more than "a worthless imitation." But I know my bar is all right, as far as a bar can be; but that it is the principle, or, rather, I mean the overhang, which is wrong, and let anyone try it for himself on a weak lathe.

Further proof I have too. I have now a planer which for solidity and fitting no one could wish anything better. I have tried the bar in this, and as against a solid tool the comparison is decidedly to its disadvantage.

I will not be misunderstood as wanting to run down the Haydon bar. It is an exceedingly handy tool to have; those with much greater experience than I have say it is the best out, take it all round. But this was not my original query. It was how it stood with regard to solid tools, and to a properly-shaped and sharpened solid tool? My experience is that it cannot stand up to it at all. Unless the explanation is that my cutters are only made of $\frac{3}{16}$in. steel, which I think is too slight for a 5in. lathe, and for such work as I expect mine to do, though I have been told it is not so.

But to return to that from which I diverged—the use of more guide-pulleys than is absolutely necessary. If they are well made, perhaps you can afford to disregard them; but the first ones, and, indeed, the only ones, I ever made were hurriedly fitted up, and though the angle to which the band was bent was not even a right angle, the amount of power absorbed was enough to impress the fact on my memory so deeply that nothing since has been able to blot it out.

March 2. **Fredk. Carre.**

A MODEL LOCOMOTIVE.

[29695.]—The series of articles bearing the above title promise at the outset to prove both interesting and instructive, and it has occurred to the writer that some of our "model engineers" should get up sets of castings the exact size which "J. H." is now describing, and at a moderate cost. I have no doubt that "J. H." would gladly furnish (at once) any of our regular advertisers the information necessary to prepare sets of castings for sale. This would prove a great boon to some of us amateurs, who would be glad to follow his instructions, but are at a loss for castings, the regular trade asking something like £7 or more (!) for castings suitable for making a somewhat similar engine to the one now being described in "Ours." I would further suggest, in order to offer them as low as possible, that no material such as copper sheet, tubes, or sheet iron be included—*castings only*. Perhaps it would be as well to give the option of these at an extra rate, as well as the boring of the cylinder. It appears monstrous to have to give £7 for, at most, a very few stones weight of castings.

If the above could be carried out, with the additional prospect of a prize of, say, first £5; second, set of castings, free, for the best loco. made from them, on the condition that one or two hundred sets were sold, surely it would answer well its purpose, and pay too. Say, 150 sets were sold at £2 = to £300. This must surely be better than three or four sets at £7. Possibly a much lower figure might be made to pay. The engine might be well made in 12 months, and each competitor would, of course, have to pay carriage to and from London, or wherever the competition took place.

Will not one, at least, of our many makers of castings take this up, and give us poor amateurs the chance of getting for once a good article at a low price. **J. G.**

RAILWAY SIGNALLING.

[29696.]—A few years ago it will be remembered that a lengthy correspondence took place in your columns with regard to the positions in which railway signals should be placed, and the necessity for a uniform code of signals and signal lights. It unfortunately cannot be said that those very desirable objects have been attained; but, at any rate, one important step has been taken. To secure uniformity in the arrangements of outdoor signals, the London and North-Western Company has issued a series of instructions to its inspectors with regard to the fixing of signals, and it is to be hoped that other railways will follow in the same direction. The most important clause in the instructions is that "All signals should be fixed on the left-hand side of, and as near as possible to, the road to which they apply."

For many years past it has been part of my duty to examine all signals which drivers have run past or mistaken, and in every one of those cases I have found that the signal was either badly situated or placed upon the wrong side of the line.

Whenever a fog occurs the public always hear of several fatal accidents to fogmen. As a matter of fact, I find that fogmen are not generally killed when either putting signals on the rails or taking them off. The greatest cause of accident to these men is where the signal-post is placed upon the *wrong side* of the railway. In a dense fog the men have then constantly to cross and recross over both, and in many instances four, lines of rails, in order to find out the position of the signal, and then returning to put on the fog-signals. It is this crossing of the rails which leads to the fatal accidents. On the other hand, when the signal-posts are in their proper position upon the left-hand side of the line, the fogmen have simply to put on or remove the fog-signals without any risk of going over or even upon the rails.

Clement E. Stretton,
Consulting Engineer, Associated Society of Enginemen and Firemen.

Leicester, March 4th.

ORGAN MATTERS—TONE COLOUR.

[29697.]—In his letter on tone colour, Mr. Robinson ignores the organs at St. Paul's Cathedral and at St. George's Hall, Liverpool, the latter being acknowledged by organists and musical people generally to be the finest toned instrument in England.

When you listen to these organs being played you might fancy yourself in a gallery filled with pictures painted by the old masters. You see before you a quiet, cool, grey Wilson, soon the tones begin to brighten and glow, till, with imperceptible change, it blends into a brilliant Turner, then the colours grow solid and massive, combining themselves into a bold and vigorous Constable, which in its turn blends into a stormy Linnell with pearly grey distance, and as you gaze into the picture the horizon seems to recede further and further away, and the music ceases.

In these organs the principal is not a mere repetition of the diapason tone, but is quite distinct. This can easily be tested by playing the middle C on the diapason, and then the octave below on the principal, the latter will be found to possess a peculiar living quality of tone.

In both of these instruments the reeds are beating reeds, and their smooth rich tones blend harmoniously with the rest of the organ, and do not assert themselves with the uncontrollable blare of the free reed. **Chopin.**

PROPULSION OF SHIPS, &c.

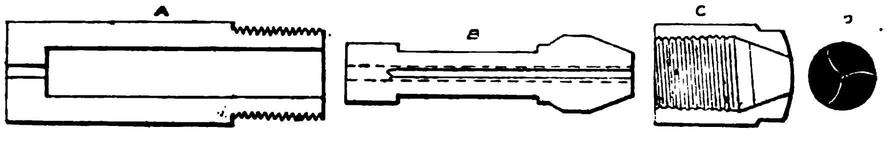
[29698.] — If "Griffiths" (letter 29278) would look through the steam trials of H.M.S.'s *Iris* and *Mercury*, he would find some interesting statistics on speed and slip.

The *Iris* on several trials made a little over 19 knots; slip, about 1 per cent. negative. I presume the slip 34·55, H.M.S. *Fairy* is in error stated to be negative.

There is no relation, or but little traceable, between speed and slip—in fact, so little is known of the laws governing propulsion that no method has been arrived at of controlling either with any certainty. **Cima.**

FLEMING'S GAS-TESTER.

[29699.]—This apparatus, which you illustrated last week, will doubtless answer the purpose desired, but "cui bono"? What can be simpler than to collect the gas over water in a small tin cylinder, in the usual way, and apply a light or red-hot taper? **Sm.**



SPLIT WIRE CHUCK.

[29700.]—A is a tube with one end closed, save small hole; B, three-jawed spring with conical exterior point; C, cap to screw on to A with conical interior; D, end view of conical point at largest part. The tube A can be turned conical to fit the sacred orifice, or can be left as purchased, and a chuck made to receive it similar to a drill chuck with set screw. **Dynamite.**

PATHOGENETIC EFFECTS OF VASELINE.

[29701.]—May I be permitted to record a mild protest against such replies as No. 29675, p. 12, of No. for 1st March, 1889, by the "Lydney Dispenser," whose zeal as a homœopath seems to me rather to outrun his discretion.

My query was for any publication giving the pathogenetic effects of vaseline, and the "Lydney Dispenser," in his airy manner, refers me to the library of the Homœopathic Hospital, Great Ormond-street, which, he says, "no doubt abounds with such data." To adopt his own style, I may say, "Well, I have my doubts!"

I have had vaseline in use for some few years now —pretty constantly, in fact, since its first appearance in the market, and find it an excellent lubricant and unguent; but I am not satisfied with Mr. Sohn's dictum that it is "all petroleum." It certainly differs physically, and in some of its properties, from ordinary petroleum. Does Mr. Sohn mean to assert that it is petroleum in an allotropic condition? I have been informed that it is a preparation derived from petroleum, and I believe that to be a fact; but then, so is stearine a preparation derived from tallow, without its being possible to maintain that stearine is all tallow. What I seek to learn is—1. What chemical difference is there between vaseline and petroleum, if any? and if not, in what the essential difference really consists? 2. Are the pathogenetic effects of vaseline, as a medicament, known and published? 3. If so, where?

I did not ask about the pathogenetic effects of sulphur. I am pretty familiar with them, they being recorded in Laurie's translation of Jahr's "Homœopathic Materia Medica," which I obtained when it was first published—I should imagine at or before the time of the "Lydney Dispenser's" occupation of his first cradle, if I may judge from his still youthful and impulsive style of expression—not that I do not value these qualities; on the contrary, I do very much; only they are better when kept discreetly under control. **Gamma Sigma.**

[29702.]—It is apparently hopeless to expect accuracy from the "L. D." (letter 29675); but he need not have accused me of asserting that vaseline contains no paraffin. If the "L. D." does not know the difference between paraffin and paraffin-oil (syn. petroleum) I shall be happy to afford him the necessary information.

In the mean time, what I did say was that it did not follow that vaseline contained petroleum because petroleum contained vaseline, any more than because coal-gas contains ethylene, therefore the latter contains coal-gas. **Sm.**

CATS AND MUSIC.

[29703.]—With reference to "J. K. P's" letter in your last issue, I was somewhat amused with the idea that cats had a particular liking for the air "Ah Che La Morte" when whistled. It is not a matter of uncommon knowledge that cats are affected by whistling. I have had more than one cat in the house which, when I have been whistling and the cat has been sufficiently near, has been affected in such a manner as to cause it to climb on to my knee and purr about my face, and if left alone give me a severe bite or nip, evidently not viciously, but under some sense of excitement and pleasure. I think if "J. K. P." had whistled any other air of a similar striking nature, he would have found his cat affected just the same.

R. W. E. W.

OTHER FISH-POISONS FATAL TO CATS.

[29704.]—A box of the unusually large prawns caught at Bombay was sent to me with other sea-fish by rail a distance of some hundred miles, packed in ice as usual. Through neglect in prompt delivery, the contents arrived in a putrescent state, only fit for manure; accordingly the prawns were buried in the garden—the other fish sent to the dungheap. Next day I found a large cat which used to frequent my premises in the dreadful condition described by "Jack of All Trades," dying in the same manner. The cat had scratched up the ground and eaten most of the prawns. **Eos.**

PLATINUM-PLATING.

[29705.]—This is generally done by means of a solution of bichloride of platinum ($PtCl_2$). Perchloride is the same as bichloride. This bichloride is prepared by dissolving the metallic platinum in aqua-regia (equal mixture of nitric and hydrochloric acids). I myself prefer to use two parts of hydrochloric to one part of nitric acids. When the platinum is dissolved the reddish solution is evaporated down to a syrup, then redissolved in hydrochloric acid, and evaporated down to a syrup again. This is then cooled; it then solidifies to a solid mass. Care should be taken that the solution is not overheated in evaporating it down; as, if this is done, it will be found that the plating solution will be almost worthless. I myself also prefer (in the making of the bichloride) to use old platinum crucible lids in preference to new, or platinum wire. This old platinum, before being dissolved, should be boiled for about ten minutes in nitric acid, and afterwards dipped in a strong hot solution of caustic potash, washed, dipped again in nitric acid, and afterwards rewashed in distilled water; the platinum is then dissolved. If the platinum does not dissolve pretty quickly the application of a little heat will soon hasten it; I generally find myself that the solution requires a little heat. For the plating process I prefer to use a solution of the double salt of chloride of sodium and platinum, prepared by dissolving 268·4 parts of bichloride of platinum in distilled water containing 58·5 parts of chloride of sodium (common salt), to this add 55·96 parts of caustic potash. The solution should be made up so that it contains 400 grains of platinum in 2 quarts of water. Throughout these experiments distilled water was used: failing to obtain this my readers should use water that has been boiled for a while and then filtered.

The following are the figures I employ for my bath:—Bichloride of platinum, 400 grains; chloride of sodium (common salt), 87·183 grains; caustic potash, 83·420 grains; distilled water, 2 quarts. The decimals can be rejected and the whole numbers taken without any serious inconvenience. With this strength of solution I prefer to use a small anode and a weak current—about two Bunsens are the best; this current will, I think, be a little too strong; if so it should be regulated to the proper intensity by means of the ordinary plater's resistance board; the current I employ is 2·22 volts. This gives a very fair reguline deposit, far better than with any other strength of battery-current employed; the article does not require much moving about in the bath, nor does it require (except in some cases) a very high temperature, between 65° and 70° F. is very good. But a few words regarding the treatment of the articles themselves that are to be platinised. I cannot lay too much stress on having them scrupulously clean; in fact, experience proves to me that the cleaner they are the better the deposit takes place. For my method I use the ordinary acid dips, and then boil them in a strong solution of caustic potash, and then well wash them in distilled water, and then immerse them immediately in the bath. There is no need for me to discourse upon the usefulness, &c., of platinum-plating: the rapid growth of the process itself, proceeding as it is at the present day, will explain for itself; the only drawback to platinum-plating is its troublesome working, which can be overcome by using the proportions named. If there are any platers of any kind who have any trouble with their solutions, if they will advertise their address through the usual column, I will endeavour to help them. Any questions on platinum-plating I shall be very pleased to answer.

F. W. Mason, Consulting Electrician.

SOME LITTLE KNOWN PLANTS OF THE FLORA MEDICA.

[29706.]—Euphorbiaceæ: Ricinus communis (castor-oil plant) is certainly the most generally useful of the whole of this large order. The quick-growing, densely-leaved, little trees supply shade to the weary travellers halting on the highway, and yield a cool refuge to the herdsman's cattle; the long line of plantation saves the sugar-cane fields from high winds and trespassers; the leaves furnish food to that valuable silkworm, the domesticated Phalæna cynthia; the seeds valued by the dyer for fixing his colours; last, not least, the expressed oil, applied to illuminating purposes, the arts, and domestic medicine.

In the early days of my Indian sojourn, I have seen castor-oil in the lamps of British residents—as the kind least stolen by their black servants; nevertheless, I have witnessed a peasant enjoying a dish of boiled rice saturated with the said oil. The native sugar purifiers used it so largely in some districts that I learned to abstain from sugar entirely, the odour and flavour of the product being very nauseous to an Englishman.

There are three modes of extracting oil from the seeds: First, boiling in water; second, expression by machinery. These two operations yield oils quite unfit for civilised stomachs; though good enough as lubricants and household illuminants; they are so prepared in Jamaica and Bengal. Third, extraction by alcohol: the formula is too lengthy for insertion here; it is much practised by manufacturing druggists. M. Feé describes it as the best and easiest of all.

It was long believed that the embryo was the source of acridity in the oil; Messrs. Henry Charland and Guibourt, French analytical chemists, disproved this statement by conclusive experiments. Boiling, however, is universally believed to increase acridity. Should the seeds become rancid, their oil is rendered acrid and irritating, and should the oil turn bad it may be considered dangerous. In India imported castor-oil is a favourite aperient—the only one which can be administered with safety during the prevalence of cholera, one or two drops of laudanum or oil of peppermint being added to the dose.

The French prepare gelatine capsules containing castor-oil as a tasteless vehicle; but I find two or three drops of tincture of orange peel or lemon peel an odorous addition, only requiring a gulp of hot coffee to clear the palate.

In hot countries castor-oil is one of the best dog medicines—especially in puppyhood—a weekly dose relieving the stomach when green grass is unprocurable. **Eos.**

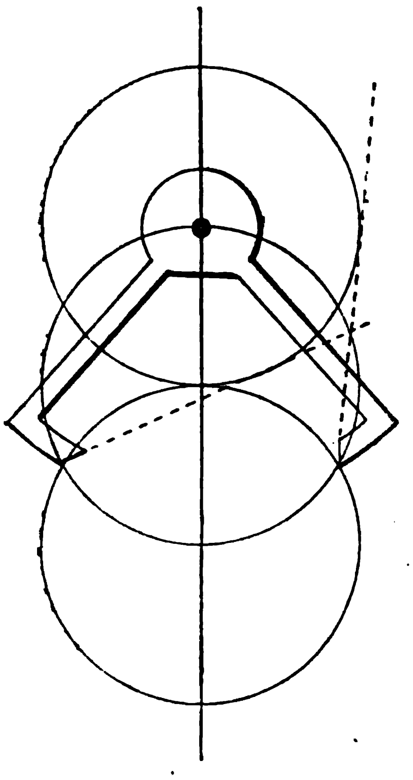
Toxic Action of Edible Mushrooms.—It is generally supposed that edible mushrooms are under all circumstances a safe article of diet, but some recent observations made in Switzerland appear to show that there may be danger in at least one species if preserved in the dry state. Some persons in Berne who had eaten a quantity of the mushroom known as Helvella (or Morchella) esculenta, which had been purchased in the dry state, were seized with abdominal pain and vomiting a few hours afterwards. It was at first thought that some poisonous species must have got mixed with the Morchella esculenta, but upon examination this was found not to be the case. A decoction of the dried plant was then examined by Prof. Demme, with the result that it evidently contained a powerful poison, the behaviour of which, when tested on cold-blooded animals, produced the impression that it was more nearly allied to curare than to muscarin: the residue, when examined, was found to be inert. The toxic substance, whatever it was, appeared to have no connection with the Helvellic acid discovered by Boehm and Külz in Helvella. Trimethylamine was prepared from a watery distillate of the dried mushroom, and the watery and alcoholic infusions contained a base which presented all the chemical and poisonous characters of neurin; the presence of other basic bodies also belonging to the group of ptomaines was suspected. The theory suggested by Prof. Demme and Dr. Berlinerblau, who was associated with him in the investigation, is that the highly nitrogenous mushroom substance is capable, under special circumstances, of undergoing certain putrefactive changes which lead to the formation of products of a poisonous character bearing a close analogy to those formed during the putrefaction of animal bodies. Consequently, there is a double source of danger in eating mushrooms—viz., the chance of admixture of poisonous species and the possibility of the existence of ptomaine-like bodies arising from partial decomposition having set in.—*Lancet.*

Treatment of Ingrowing Toe-Nail.—Dr. Theodore Clemens, of Frankfort, strongly recommends the employment of tinfoil in the treatment of ingrowing toe-nail. He first has the toe thoroughly washed with soap and carefully dried. He then envelops the whole nail with tinfoil, putting a strip between the portion that grows in and the raw surface caused by it. The tinfoil is fixed by means of a very thin layer of common wax, and the patient told not to wash the part, but to use dry bran for rubbing off the dirt. Of course the toe has to be repeatedly dressed with tinfoil; but, if the operation is carefully performed, it is surprising how long the tinfoil will remain intact, even when the patient is, as was usually the case in Dr. Clemens' hospital practice, very poor and very badly shod. The results are stated to have been most satisfactory, and are ascribed by Dr. Clemens not merely to the mechanical action of the tinfoil, but to the effect of the permanent contact of a combination of metals comprising iron, copper, arsenic, molybdenum, wolfram, and bismuth, with a moist and growing portion of flesh. This, he says, brings about in a few weeks the complete healing of the sore, and causes the nail to grow more slowly and in a more healthy manner.—*Lancet.*

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67472.] — **Dead - Beat Escapement.** — "G. T. C.'s" remarks anent the above are rather difficult of application practically. I have sent sketch of the usual method of making such pallets, both correct and simple, adopted by those who regularly make them. The drawing will explain itself. Three circles are drawn the size of 'scape-wheel; centre of first circle, A, represents 'scape-wheel; centre of third circle represents centre of pallet's axis. The angles of impulse faces are obtained from the circumference of third circle, as shown by dotted lines. All that remains to obtain success is careful workmanship, and filing off little by little until you obtain the required angles, &c. Note thickness of impulse-face is slightly less than half the space between two teeth.



Forres, N.B.

[67492.]—**Tangent Galvanometer.**—Make two distinct instruments, instead of one with two circuits. For tangent ammeter, make a wooden ring 14¼in. diameter (outside); cut a U groove in it, for holding the wire, ⅛in. deep, $\frac{7}{16}$in. wide; wind with ten separate wires, No. 16 B.W.G. Connect the twenty ends to a suitable mercury or other commutator, so that the wires may be arranged in "series" or "parallel." When all are in "series," 45° will represent ·5 ampère for 1889, and with all in "parallel," 45° = 5 ampères. This instrument will measure any current from ·01 to 12 or 15 ampères with fair accuracy. Remember that the resistance in the second case is $\frac{1}{10}$. Care must be taken to place the commutator so that it will not act on the suspended needle. I use a special form of commutator which may be used near the most delicate instruments. For "tangent voltmeter," a ring 6in. diameter wound with about 9oz. No. 36 B.W.G. copper wire, silk-covered and paraffined, in a groove ⅜in. deep and ¼in. wide, answers well. A set of platinoid resistances are used in "series" with the instrument—500, 1,000, 2,000, 2,000, and 5,000 ohms will do.

Gal. resistance.	Platinoid *r*.	Total R.	No. of volts. to about 45°.
500 ohms	500 ohms	1,000	1
,,	1,500 ,,	2,000	2
,,	2,500 ,,	3,000	3

It must be remembered that these measurements are approximate. The error increases with the internal resistance *b* of the generator. If V stands for volts indicated, and E for the true E.M.F.

$$E = \frac{R + b}{R} V.$$

The number of degrees or divisions to the volt you can find by aid of your standard instrument. If you wish for further particulars, write again, and I will help you. Gilbert B. Luckhoff.

[67558.]—**Speeds (U.Q.)**—The speed for running 6in. lathe, when turning wrought ironwork 3in. diameter, is 28 revs. per minute; cast iron 17 revs., and in both cases varies as diameter of work turned. For boring 1in. holes the revolutions should be 35 for wrought iron, and 26 for cast iron, and vary as diameter of hole. McGill.

[67559.]—**Bisulphate of Potash in Leclanche Cells.**—Will Mr. Mason kindly give further particulars of the action of this salt in the battery? Does it throw the undissolved chloride of zinc down as a powder, or thoroughly dissolve it in the solution, leaving it perfectly clear? Unfortunately, all my cells have outer stoneware jars, so that I cannot observe the reaction that takes place. After all, do you think there is really any great advantage in using it? Do the cells work any longer, or ring the bells louder? F.R.Met.Soc.

[67578.]—**Planing Machine.**—Should be glad to know how to chuck a thin strip of iron so as to insure each side being planed perfectly parallel? Also how an angle plate is chucked? With regard to attachments, I should think a very efficient drilling machine might be fastened to the cross-slide; also an apparatus for milling. Can this be done? W. J. G.

[67584.]—**Gun Caps.**—The composition employed in percussion caps is a fulminate of mercury made by dissolving 100 parts of mercury in 1,000 parts of nitric acid (1·4), which is then slowly poured through a funnel tube into alcohol (·830) 830 parts. When effervescence ceases it is filtered through double bibulous paper, washed with cold water, and dried by hot water not exceeding 212° Fahr. The fulminate thus prepared is mixed as follows:—12 parts of fulminate, 26 parts chlorate of potassium, 30 parts of nitre, 17 of sulphur, 14 of ground glass, and 1 of gum. T. M.

[67585.] — **Bicycle Saddle.** — Scarcely worth while trying to restore the colour, as a dull brown looks as well as anything. To soften, soak well with lukewarm water, and when thoroughly soft give a good dressing of castor-oil.

Nun. Dor.

[67588.]—**Raising Deformed Apple-Tree.**—The best way to raise the tree is to dig all round it, cutting the roots cleanly, and then fasten it upright to a strong stake until the roots have taken hold of the fresh soil which you will put round them. That will take some little time. Root-pruning rarely injures trees. Nun. Dor.

[67593.]—**More Light.**—Why not try whether it can be done? The temperature of a paraffin oil flame is much too low to render platinum gauze incandescent. J. T.

[67599.]—**Compound Engines.**—In compound engines the object is to so place the cranks that the strain on the shaft is equalised, and that obviously requires thinking over and working out for suitable angles to the cranks. S. M.

[67601.] — **Sharpening Twist Drills.**—See indices, as several methods of sharpening these drills have been given. Everything depends on the way they are ground. T. J.

[67606.]—**Bells to Organ.**—Quite practicable to add a couple of octaves of bells or tuning forks; but whether it is worth while is quite another matter. See the specifications of the patents.

J. C.

[67620.]—**Equation of Time.**—Would "Tria" kindly favour me with the fourth term in his expression for the equation of the centre? Also the mass of the moon used by the *Nautical Almanac* computators in calculating the perturbation in longitude? If "Tria" would give an expression for the equation of the centre in terms of the greatest equation of the centre for 1890 and the mean anomaly, I should feel obliged. Viator.

[67621.] — **Engine Wheel.**—Why does not "J. H. R." consult the catalogues of makers of agricultural locomotives, or does he want some one to invent a better wheel than experts have been able to devise? S. T.

[67623.]—**Cycle Repairs.**—"Jobbing Smith" will find what he wants in back numbers.

C. C.

[67624.]—**Organ-Blowing Motor.**—What sort of a motor does the querist require—steam, gas, or hydraulic? All have been described in back volumes.

L. J. S.

[67628.]—**Double Voss.**—See page 335, Vol. XXXIII., and the indices. Nobody cares to make Voss machines nowadays, when the Wimshurst has been fully described in all details. T. M.

[67649.]—**Chemicals for Mimic Sea-Fight Effects.**—To "Principia."—As the amount of Cl_2O_4 generated depends on the quantity of H_2SO_4 used, and that (see letter) was to be one drop, if it did explode it would be immaterial. "Principia" should know that a test-tubeful (and, I have no doubt, a great deal more) may be safely detonated by heating the tube. Lux.

[67796.] — **Telescope.** — The information Mr. Linscott asks for is as follows:—Object-glass is achromatic, 4in. clear aperture, and the solar focus is 52in. Amateur Optician.

[67804.]—**Thermo-Electric.**—Has not F. W. Mason, replying to above, made en error in the E.M.F. of his 36 thermo-electric pairs, which he gives at 35 volts? The following is, according to Dr. Matthiessen, the thermo-electric power of three metals relatively to lead, expressed in micro-volts, per degree cent.:—Bismuth + 97, iron − 17, antimony − 26. Alloys of antimony are often negative to the pure metal, but not to a great extent; and even supposing that the addition of zinc brought it as low as − 100, then, with a difference of 100° cent., the voltage of the 36 pairs would only be—

$$\frac{(100 - 17) \times 100 \times 36}{10^6} = \cdot 33 \text{ volt.}$$

F. M.

[67813.]—**Engineer's Accounts.**—Find the cost per year of the machines, including interest on capital, depreciation, repairs, cost of power, and divide by 52; then divide result by the number of hours worked by men and boys using these machines, and add result to the different jobs they have worked on, just as if it were a time-sheet of so many hours at so much per hour, &c. This should be sufficient. If, however, greater accuracy is needed, correct above result by deducting the whole or part of such charge to any job which has not required that proportion of machine's time, and add to cost of those which have exceeded it. Some firms add a percentage to p.c. of labour and material to cover use of machinery, rent, taxes, &c. I consider that rent, taxes, and office expenses should not show in p.c., but come out of the gross profits.

Cost of machine	£50 0 0				
5 per cent. interest		£2	10	0	
10 ,, ,, depreciation		5	0	0	
10 ,, ,, repairs		5	0	0	
Cost of power (say)............		20	0	0	
Total cost per annum......		£32	10	0	
,, ,, ,, week		0	6	6	
,, ,, ,, hour (50 per week)		0	0	1½	

If the machine is only used for half the time the charge must be 3d. per hour. You can add 5 per cent. to the p.c. found in this way to cover office and general expenses. Renewals and repairs to drills I always distribute over the jobs worked on during the week these repairs were done. At present I am dividing the ascertained cost per week of machinery over the jobs in hand during the week in what I consider a fair proportion. My experience is that a perfect p.c. is next to impossible. Are you quite sure the result you crave for justifies the necessary trouble? If so, I should suggest attaching a board and pencil to the machine, and making it a rule for anyone using machine to state his name, the job, and time the machine was used, the leading man in shop being responsible for the correct keeping of same. Prime Cost.

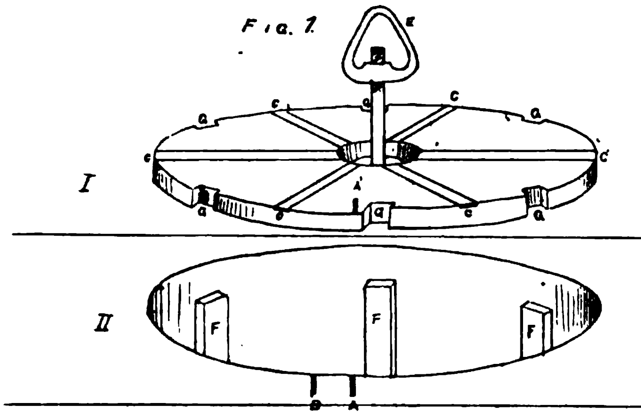
[67823.]—**Crank and Lever.**—I simply mean two levers and rods, either applied at right angles to one crank, or to two cranks at right angles.

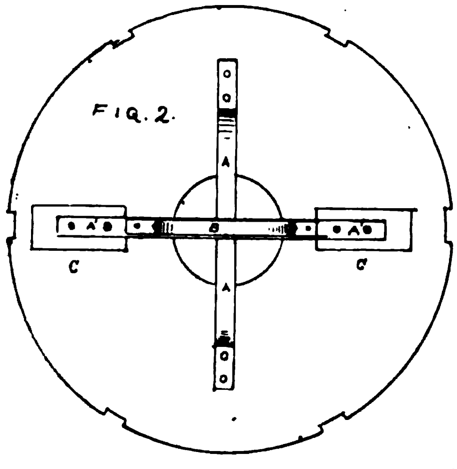
Bristol. T. C.

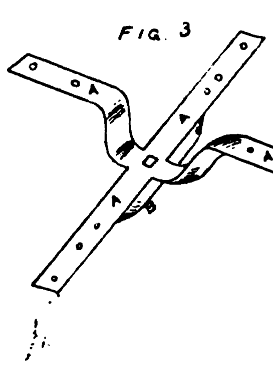
[67874.]—**Tracing Fluid — Sepia.**—Probably glycerine, or glycerine thinned with spirits of wine, would suit for making Indian-ink work well on tracing-cloth. Indian-ink is somewhat misnamed, it being the dried juice or secretion of the mollusc or cuttle-fish called sepia, the use of which fluid appears to be rather for poisoning the smaller fry upon which the sepia feeds than for clouding the water surrounding it so as to preserve it from its foes. Strange as it may seem in the eyes of artists and of others using sepia in drawings, &c., sepia is one of the most valuable medicines of homœopathy, for out of the 700 pages devoted to the description of 70 of the leading medicines of the science in Farrington's "Materia Medica," twenty-four pages are devoted to that of sepia, the discovery of its medicinal properties having happened through Hahnemann's observation of one of his patients—an artist, frequently moistening his sepia brush in his mouth. This artist's illness having long been a puzzle, Hahnemann conjectured that the pigment was the real and actual cause thereof; and, as health followed Hahnemann's caution, the illustrious physician instituted a series of experiments with sepia, resulting in the discovery of a powerful therapeutic agent, venous congestion being its most prominent feature. It has proved itself very reliable therein in the hands of

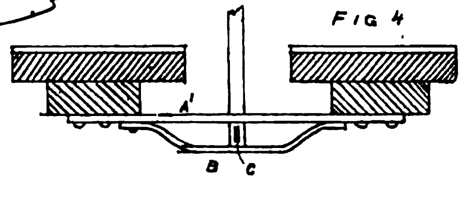
The Lydney Dispenser.

[67831.]—**Cartwheels.**—In answer to "Young Spud," I send a rough sketch of platform for shoeing cartwheels or, in fact, any wheels, on. It can be made of wood, with cross-pieces of iron, shown at C, Fig. 1. D is an iron pin (which passes through box of wheel) square at lower end, which has a hole through to admit of a key, the end of the pin D









passes through a square hole in the irons A' and A (Fig. 2), the iron B is to stop D from falling through. On the upper end of D there is a thread, on which screws the link E. The platform I rests on struts of stout iron (F II). When the platform is required to be used, it is slightly raised and (supposing the marks A' and B to be together) turned round until A' and A are together. If the platform is then lowered into the holes II, the irons F will pass through the slots G. Fig. 2 shows the under side of platform, the iron A' is straight, and is bolted to two blocks of wood, C. Fastened to A' is another iron, B, the use of which is explained above, but more fully in Fig. 4; the hole for the key is shown at C. Fig. 3 explains itself. I do not know of any method of contracting tires without cutting them.

WALTER J. PARKER.

[67880.]—**Lantern Pinions.**—The reason that lantern pinions are extensively used is because they are easier to make. You will never see them in well-finished clocks, but they are to be seen in almost all American and German clocks. The lantern pinion is not a preferable one except in the above sense. The reason for the teeth, more properly called the pins, of the pinion being made to revolve is because the pinion will last longer, for if they are fixed they have only one point of contact, and, therefore, that part of the pinion is soon worn; but when the pin revolves it presents many points of contact to the wheel, and, therefore, lasts longer. A solid English pinion always gives best results.

WELSH HOROLOGIST.

[67881.]—**Slanting Wheel-Teeth.**—I have used mandrels with straight teeth; but I prefer the one with slanting teeth, as they are much easier to spin, and do not make much noise. I cannot say why it is, but experience has taught me so.

WELSH HOROLOGIST.

[67902.]—**Watch Cleaning.**—The manner of cleaning a Geneve watch is pretty much the same as with a lever, so I need not go over this again; but the construction being different, a few hints as to taking down and putting together again may be acceptable to Maud H. Glase. There are two common types of Geneve watch—those with bars to all the wheels, and those with a plate covering all but the 'scape and balance wheels. I will take the former as being the commoner in ladies' watches. Having got all ready, as before described (66947, page 337), open the back and the inside case, called the dome. You will then notice at the edge of the main plate, probably near the balance, a screw with nearly half of the head cut away. Turn this till it frees the edge of the plate. There may be two screws, when both need freeing, and it is generally best to open the front, and firmly press the forefinger of the left hand on the dial whilst turning them. The movement will now readily come out at the front. Now take off the hands, and if the watch is wound up and firmly stopped with dirt, it will be necessary to let the mainspring down. To do this, take the key and release the pressure of the spring from the click, and with the point of a fine screw-driver hold the click just free of the ratchet teeth, and let down half a turn at a time. This is rather a three-handed job, but it may be managed by one person with a little dexterity. But probably the watch may be induced to start by touching the 4th wheel with a peg point, when the best way is to take a hair out of the brush and put it through one of the arms of the 'scape wheel to stop it; the balance may then be taken off with its bar without any fear of damaging the 'scape wheel. The hairspring is pinned to the bar, so the balance comes off with it, and it may be that the cylinder catches one of the 'scape teeth a little, when it is almost best to lay the watch face down on the table, take the bar in the tweezers in the left hand, and raise it nearly an inch, stretching the hairspring, which will do it no harm unless stretched too much; then with a peg point move the 'scape wheel a little, when the balance will be freed and spring out. Now take out the hair, and the watch will run down. Take off the dial. It may be held either by two screws like those that hold the watch in the case, by two pins, or if a gold or silver one by being simply sprung on; if the last, raise it with a knife point. Now knock out the centre that carries the hands, taking care of the small pinion and the cup that catches the dirt at the back. You may now take off the bars and all the wheels. Great care is needed in cleaning the 'scape wheel and pinion, as the teeth are apt to catch the brush, especially a new brush, and the dirt in the pinion is usually the cause of the watch stopping, so special care should be taken to get it out. The hairspring need not be unpinned; turn the little cover that is over the curb pins, and then either pull out the stud that hairspring is pinned to with fine pliers, or raise it carefully with a knife; peg the cylinder-hollow out clean. It will scarcely be worth while to take the cover off tho mainspring barrel, but a little oil may be put on the bottom pivot if no stop is on; other parts are cleaned the same as in a lever. Not much needs to be said about putting together, but great care should be taken in putting the stud back in the balance bar. The hairspring should vibrate evenly between the curb pins, not rest against either of them when at rest, and when put in its place in the watch, it should be nicely flat. If the watch has a gold or silver dial sprung on, don't put it on till the movement is in the case, as not till then will you know the right position. The hour hand you can press on with the tweezers, but the minute hand will need to be driven with a hollow punch and a hammer, though it can generally be fairly fixed with a pair of pliers carefully and firmly applied. If the watch is a ¾-plate, the only difference is that it is a little more difficult to get the plates together with all the wheels between, and generally an amateur would not be able to let the spring down with a key so easily.

H. WAKE.

[67906.]—**Dynamo and Storage Cell for Bicycle.**—I am much obliged to Mr. Bottone for his reply. Will he kindly tell me how to place the switch to disconnect storage cells when charged, and cannot it be an automatic switch? If so, how is it made?

FAUTEIL.

[67906.]—**Dynamo and Storage Cell for Bicycle.**—Would Mr. Bottone, who replies to this query on p. 17, kindly say how the dynamo should be fixed to the bicycle, so as to take power from the tire, and also where the two storage cells would be best carried. Would the dynamo absorb any large amount of power, or would the friction be inappreciable.

A CYCLING MECHANIC.

[67907.]—**Fading Prints.**—If "R. P. S." really does what he says, and fixes his prints for 24 hours, it is not surprising that his prints lose tone considerably. Ten minutes is ample, provided the fixing-bath is freshly made, of the usual strength, 4oz. per pint, and provided the prints are not allowed to stick together in the fixing-bath. Also, one fixing-bath is enough, if you make sufficient of it.

H. G. MOBERLY.

[67907.]—**Fading Prints.**—Your query reads as if you left your prints in the fixing-bath for 24 hours; if so, no wonder that they fade. Probably this is a clerical error, and that you wash them for 24 hours. It is not uncommon for the toning to go back in the fixing; but I think the following suggestions will help you. 1. Wash for 15 minutes in three changes of water before toning; to the middle water add a pinch of salt. 2. Over-tone a little, that is, continue the toning a short time after they get to the tint you wish to be final. 3. Don't let them lie in the hypo. longer than from 15 to 20 minutes. 4. Instead of washing for 24 hours, take only one hour, but change the water entirely every five minutes.

Plymouth. B.Sc.

[67910.]—**Hammock.**—Procure some stout sail canvas or clean sacking sufficient to make the hammock the length required (it is sold about 18in. wide); take two pieces the required length, and join them together with a strong seam, this will give you a cloth the length you require your hammock, and about 3ft. wide. Make a hem about ½in. wide on each side, and at each end make a stout hem at least an inch wide. Along each of these ends work 24 good-size holes with strong thread or twine, and your hammock is complete. The next thing required is the clews. Obtain 24 lengths of small cord, known as cod line (or small cord a trifle thinner than a slate pencil); take 12 of the above, place them carefully together, and in the centre bind them round with small string for about 6in.; double this part, and put on a good seizing (or binding) to join them together; this will give you an eye, with 24 tails a little over 2ft. long. Cut the ends level, and bind each with strong thread to prevent it untwisting. Make up the remaining 12 lengths in the same manner, splice about 4ft. of stout line into one of the loops, and the clews are ready. The cord in the loop will enable you to adjust the height. To sling the hammock, hook one of the clews on a nail or hook overhead; take two of the outside lengths and thread one through the hole at each corner of your hammock, and make a hitch so as to hang the corners exactly level. Now thread the others and hitch them so that the centre is about an inch lower than the corners, serve the other end the same, and it is ready for use. This is the exact method in which hammocks are made in H.M. vessels of war.

AN OLD MAN-OF-WAR'S MAN.

[67912.]—**Engine—Errata.**—My method of working, as given, is correct; but x should be 1·13 (as will be found on working it out), and then my figures will agree with McGill's.

Bristol. T. C.

[67919.]—**Anti-Freezing Mixture for Hot-water Pipes.**—Spirits or glycerine prevents water freezing, but they would be required to be renewed frequently. If the pipes are not always kept heated, the better plan would be to have a cock at the lowest level, and allow the water to draw off when out of use or on the apparent approach of frost. Ecnal.

[67921.]—**Puzzle, or Letter Lock.**—To "Cowal."—The letter-lock contrived by me to be absolutely unpickable, as mentioned in the "E. M." of Jan. 25th, consists of the usual interior draw-bolt, contained in a split socket, on the outside of which the series of rings are fitted, each with an interior notch indicated by any combination of letters or numbers, selected by the outside removable rings. The inside rings are kept on the split socket by an end flange of steel. Within the groove, or split in the socket, is placed a bar of steel extending from end to end. This has two stems fitting nicely into cross-holes drilled through the core or draw-bolt, so that the bar can rise and fall in line with the axis of the lock, this bar being pressed upwards by a very light strip of watch-spring beneath it. Now, leaving the exterior index rings out of the question, as having nothing to do with the action, it is evident that when the steel bar is kept down flush in the groove of the socket, by means of the blank part of the notched rings, as the bar forms part of the draw-bolt, this cannot be pulled out so as to release the shackle of the lock, because it butts against the steel flange. But turn the rings till all the notches come in line over the bar; this then springs up into them, and the end of the bar comes opposite a corresponding hole in the steel flange, through which it can pass, so as to enable the bolt of the lock to be drawn out so far that the shackle can be released. When the plates of the lock are pressed together again, the end of the bar is carried out of the hole in the steel flange, and can be returned into the groove by turning any one of the rings, the notches in which, and also the corners of the steel bar, being sufficiently chamfered for this purpose. As there is some friction on the rings, and the steel spring being very slight, not the most delicate sense of feeling can detect the passage of a notch over the bar, and if an attempt is made to pick the lock in the usual way, by putting an outward pressure between the cheeks, the steel bar becomes jammed against the steel flange, and will not rise, and while the pressure is maintained the lock cannot be opened, even with the right letters or numbers. For additional security, very shallow false notches might be cut in the inner ring; but this I have found to be quite unnecessary. F. H. Wenham.

[67924.]—**Bichromate Battery.**—To Mr. Bottone.—The number, size, and disposition of bichromate cells required to give a current of 20 ampères, through any given circuit, will naturally depend in very great measure upon the resistance of that circuit. We know from actual trial that a bichromate cell exposing a negative surface of 15 square centimètres (about 7sq.in.) has an internal resistance of ·08 of an ohm, so that as the E.M.F. is, with a freshly-charged cell, about 2 volts, we get (on the short circuit) a current of about 25 ampères. Of course the current does not remain at this point for long, for the battery soon polarises, and the internal resistance increases pari passu. To get a current of 20 ampères through an external resistance, say, of 1 ohm, we should need practically 11 such cells in series; but then the pressure would be 22 volts nearly. Allowing for internal resistance, 6 cells in series would give a current of 20 ampères through an external resistance of ·52 ohm at a pressure of 12 volts. S. Bottone.

[67926.]—**Bagpipe.**—I have no doubt your pipes have become dry for want of use. The reeds may not be of much use, and I would advise you to get a new set for the chanter and drones. You can get good ones from Marr and Co., Inverness, or J. and R. Glen, 3, North Bank-street, Edinburgh. You could not make them yourself without some experience. The following is a good mixture for keeping the bag soft: Treacle, two parts; water, one part, and a small lump of melted beeswax added to it. Take out the drones and chanter, and pour a little of this mixture inside the bag, and rub it in well, and then hang it up so as to allow it to drain out of the drone sockets. Do this each time you use them, and it will keep your bag in proper condition. Ghilliebuig McTomah.

[67927.]—**Ebonising.**—Make a solution of green vitriol, say 2oz. to the pint; add a few drops of nitric acid. Now boil your reel ends in this. Take out and dry. Now get 1lb. of logwood and 1oz. of gall-nuts; boil them in an iron pot with a pint of water and a bit of soda as big as a pea. Place your reel ends in this decoction, and leave them there till they are of the desired colour. Again take out and dry. Lastly, let them be soaked in melted paraffin wax until thoroughly permeated. This latter process is to render them good insulators. Now polish on the lathe. S. Bottone.

[67931.]—**Granule Battery.**—If you charge your cells as directed below, then couple them up in series, you will be able to run your 5c.p. lamp (if it does not exceed 6 or 8 ohms resistance) for several hours; but you must remove both zincs and carbons after each run, and empty the solution out of the porous cells into a stone or glass jar until wanted again, allowing the porous cells to stand in clean water in the meanwhile. Remove all the loose carbon from the cells, using only a large block or plate of carbon in the porous cell, and a zinc plate or rod in the outer vessel. Now make a solution of chromic acid 1lb., water 1 quart, sulphuric acid ¼ pint. When cold, pour this solution into the porous cells along with the carbons. The outer cells, where the zincs (amalgamated) are, fill up with a mixture of sulphuric acid 2oz., water 1 pint. S. Bottone.

[67932.]—**Governor.**—Make the balls ¾in. dia., and arms 1¾in. long. Run it at 350 revs., and put a spring on the spindle to push down the sleeve. The strength of this spring had better be found by trial.

Bristol. T. C.

[67933.]—**Dynamo.**—The dynamo described will not light one 20c.p. lamp, because the resistance is too great. It will light two tens of 15 to 20 volts, if arranged in parallel. The armature should run at 2,000 revs. per minute; the wire, unless the distance is more than 50ft., may conveniently be No. 16. The dynamo in question would not do for charging accumulators, because, being series wound, it would have its polarity reversed when the accumulators reach the same potential as the dynamo. To run a 50-volt 20c.p. lamp for five hours, you will need 25 cells of accumulators, each presenting about 10in. by 10in. of positive surface, and you would need to charge for nearly seven hours. S. Bottone.

[67936.]—**Chemical.**—Prepare barium sulphide by igniting the native sulphate with coal or charcoal. The clear solution of the sulphide must then be heated with oxide of copper till free from sulphur. Evaporate as usual. Sm.

[67937.]—**Electric Coil.**—Bring a wire from the binding screw at the right-hand top corner, and connect it to E. Now connect D with either of the wires from the magnet at F. The other wire from the magnet must be connected with the nearest primary wire at B, the other primary wire end being connected to the binding screw at the left-hand top corner. The two ends of the secondary wire should be connected respectively to the left and right-hand lower binding screws. S. Bottone.

[67938.]—**Turbine v. Water-Wheel.**—Not worth while making a change. A good turbine would not be more than 10 per cent better.

Bristol. T. C.

[67940.]—**Practical Physiology.**—Most text-books of physiology, if not all up to date, describe and illustrate most of the important apparatus, and Foster's "Practical Phisiology" has an appendix devoted to the chief apparatus used in the Cambridge Laboratory, which would supply "Inter.B.Sc.'s" more urgent needs. A list of the instruments now used in any Honours course of physiology would occupy far too much space; and as a study of the subject without practical work will be quite useless, I can only recommend him to attend some class, such as that at University College, inasmuch as he can hardly be expected to construct a private laboratory and its instruments.

Uttoxeter. N. S. R.

[67943.]—**Power of Engine.**—Theoretically about 240I.H.P., but practically 200, or a little over. If steam is carried further, of course you will get more power; but it is far enough now.

Bristol. T. C.

[67944.]—**Lead Cistern.**—I have no personal knowledge of this matter; but a friend of mine being a large manufacturer of sulphuric acid, I asked him about it. He said they use no solder of any sort. The edges of the lead to be joined are placed together close, and an oxygen-hydrogen blowpipe is brought to bear on the two edges of the lead. These are melted and become joined, so that the two sheets in reality are united into one. Ecnal.

[67947.]—**Dynamo Current.**—It would take several pages of the "E. M." to give all the calculations necessary to work out the possible output of any given dynamo. Theoretically, the thing is easy enough. So many lines of force cut by a given conductor in a given time, so much current. Practically, you may say that with an armature rotating with an angular velocity of 1,250ft. per minute, each yard of active wire on the armature will give 1 volt of E.M.F. if the fields are properly excited. The current to be obtained can then easily be calculated by knowing the resistance of the armature itself, the amount of current required to magnetise the F.M. (if shunt-wound), and the resistance of the outer circuit. The watts obtained in a well-made dynamo are proportionate to the power employed. It is a waste of power to insert useless resistance. You can reduce the E.M.F. by driving at a slower rate of speed, and the power consumed will be proportionately less. S. Bottone.

[67947.]—**Dynamo Current.**—(1) There is no fixed rule, as it depends on the size of the wire on armature. As an instance, a Gramme armature wound with No. 16 wire is safe for 12 ampères, and with No. 18 wire for about 8 ampères. The current used in the shunt coils to excite the magnets may be 10 per cent. of that generated in the armature in a small machine, and must be deducted from the output available for the external circuit. (2) Yes, practically the power absorbed is proportional to the watts developed, though some machines produce more watts with a given power than others, because they have a higher efficiency. (3) Yes again. The energy absorbed by a resistance inserted as you suggest is waste. Since C·R = watts, the resistance R × the sq. of the current flowing through it will give the watts wasted. (4) With a shunt machine you would need to put rather more than 25 ohms extra resistance to reduce the current to 1 ampère, since by doubling the resistance of outer circuit the E.M.F. of the machine would be caused to rise. But this would be a very wasteful method. Reducing the speed would meet the desired result in an economical way; or you might insert a large resistance in series with the shunt field coils, and so reduce their magnetism and the power required to drive, without reducing the speed. The required resistance could be best found by experiment. W. A. Walton.

[67948.]—**Wind-Pressure Gauge.**—Will "J. F." kindly send a rough sketch of his pressure gauge? It is a subject I have spent a lot of time and money in, and I think there are very few patterns but what I understand. At present I do not see how the pressure plate is connected to the spring balance. Upon receipt of further particulars I shall be glad to help if I possibly can.

F.R.Met.Soc.

[67949.]—**Microscope Definition.**—Mr. Mandane does not quite give enough details for us to help him. If he will inform me what sort of instrument he possesses, what eyepiece, and also what are the powers he employs, I will try and help him. F. W. Mason.

[67949.]—**Microscope Definition.**—1st. The eyepiece lenses may be dirty. 2nd. The object-glasses may be dirty, cracked, uncentred, uncemented, or radically defective. Is it achromatic? What make is it? I have considerable experience in photo-micrography (which is what I suppose you mean, because microphotographs are not taken with the microscope at all), and shall be happy to assist you if you can give me an idea of the make of your instrument. S. Bottone.

[67949.]—**Microscope Definition.**—It is impossible to tell the cause of (and consequently to give a remedy for) the want of clear definition in your small microscope without seeing it, and if you cannot get clear definition with the eye it will be of no use for micro-photography. In the first place, take out each lens separately and see that it is thoroughly clean and clear; polish with chamois leather, and see that they are replaced exactly as you found them. If this does not improve it, then the fault may lie in your inexperience in manipulation, or in the microscope itself. If possible, get some one to look at it who is acquainted with the instrument, and he will tell you at once.

Plymouth. B.Sc.

[67950.]—**Berthon's Equatorial Stand.**—"Luna" may obtain a good deal of the information he seeks in "Hints on Refracting and Reflecting Telescopes," by W. H. Thornthwaite, which contains sketches of stands, alt-azimuth and equatorial, including the one he mentions. It is published at 416, Strand, London, W.C., price 1s. G. G. B.

[67950.]—**Berthon's Equatorial Stand.**—In answer to "Luna," I may say that a friend of mine here has a very fine 8¼in. With mirror so mounted, and also that the Rev. Jevon J. M. Perry, of Alnwick, has an 18in. so. The latter once belonged to the late Prof. Key, and was, I understand, got up under his superintendence. Both gentlemen are well pleased with the arrangements. I have seen both. They can be fitted with clockwork—indeed, the 8¼in. is. I observe "Luna" has one of Mr. Linscott's mirrors. I would advise him to correspond with this gentleman with respect to the mounting, as I think I observed an advertisement some time ago by him, and "Luna" would most probably find it much cheaper to be so supplied than to get patterns made, castings cast, and to pay a high price for experimental fitting. I have a drawing of a Berthon equatorial. If "Luna" would like to see it, and advertises or sends me his address, I will forward it to him.

Berwick-upon-Tweed. L. T. Fleming.

[67951.]—**Signalling.**—I would strongly advise your correspondent, "Barmouth," p. 18, to carefully examine the various inventions which have been brought forward for railway signalling before he goes to the trouble and expense of inventing something new. Nothing has been considered by numerous inventors more easy than to construct a model, in which, when a signal is at danger, a lever is raised between the rails, which shall come in contact with a lever on the engine, thereby opening a whistle, shutting off steam, ringing a bell, placing a miniature signal arm to danger, exploding a fog signal, and even applying a continuous brake. I have examined models and apparatus during the past few months which claim to carry out all these objects. Of course they may all work very well in model form, or experimentally; but in daily practice dust, dirt, ice, and snow would render such appliances perfectly unreliable. It therefore follows that if a man has to be employed to watch the self-acting fog-signalling appliances to see that they work, he may just as well place the fog signals on the rails by hand.

Clement E. Stretton, C.E.

[67954.]—**Dynamo.**—Your machine should give 45 to 50 volts and 6 amps. at 1,800 revs. per minute. Five 20c.p. lamps are the most you can expect. I would advise lamps of a lower candle-power, say, 16. and requiring only 1 amp. each. No. 14 gauge will do for the mains, and carry the current with very little loss, the resistance for the distance being barely ½ an ohm. An engine to do the work comfortably should not be less than ¾H.P.

W. A. Walton.

[67955.]—**Book-Keeping.**—Perhaps if "Trader" will add his "trading expenses" and "bad debts" to his net profit, he will arrive at what he wants; but if he will advertise his address, probably I can help him.

Accountant.

[67955.]—**Book-Keeping.**—I am not acquainted with Pitman's system by name; but, if "Trader," provided in the mean time he has not discovered his difference, can manage to let me see a statement of his accounts, from which, if explicit enough, I shall be able to help him, without reference to any entries; but the latter may be necessary.

W. E., Chartered Accountant.

[67957.]—**Voss Machine.**—For full information on influence machines, see paper by Dr. S. P. Thompson—"The Influence Machine from 1788 to 1888," *Journal* of the Society of Telegraph Engineers, Vol. XVII. No. 74, pp. 569 et. seq.

W. Perren-Maycock, A.I.E.E.

[67957.]—**Voss Machine.**—Has "W. B. C." thoroughly warmed his machine before using it?—for if it has been put aside for some time, no doubt it has got damp. Thoroughly overhaul the machine, warm and dry it, and put a little amalgam on rubber, and then try.

F. W. Mason.

[67957.]—**Voss Machine.**—There was a full description of the Voss machine in the back volumes of the Eng. Mech.; but as mine are at the binder's I cannot quote the number. Perhaps our kind Editor can oblige you by quoting the volume. In all probability your machine is dirty. Clean all the spaces between the bosses with a little bit of flannel dipped in benzoline. Dry well before the fire (not too near, lest you crack the plates).

S. Bottone.

[67958.]—**Centres of Shafting.**—No rule as to distance—generally a matter of convenience. But you should not be less than 20ft. between centres.

Bristol. T. C.

[67959.]—**Engine Query.**—If this is to be condensing, have l.p. cylr. 26in., and h.p. cylr. 15in. Cut off at ⅓ in h.p. and ⅔ in l.p. It is called 9 expansions under the circumstances you name. Use a double belt (on wheel 15ft.) 30in. wide. Why not drive with 1¾in. hemp or cotton rope (7 ropes)?

Bristol. T. C.

[67959.]—**Engine Query.**—You could not do with smaller cylinders than the following:—h.p. 11½in., cut-off ·5; mean pressure 48lb.; l.p. 22½in. diam., cut-off ·5; mean pressure 14lb.; terminal pressure 6lb. above back pressure. The above mean pressures are those which would be found in actual working, not theoretical pressures, which are useless in practice. Rule for rate of expansion = ratio of cylinders ÷ cut-off, or 3 ÷ ⅓ = 9. A 20in. single belt would be a good size to use. The diam. of flywheel is rather small; the usual size is between 3—4 times the stroke. Weight would be 4½ tons; or 5½ would be better, as the load will be an irregular one.

McGill.

[67960.]—**Starting Compound Condensing Engine.**—1. Without seeing arrangement it would be difficult to say. They may be for starting, if opening into cylinder; if not, for steam to jackets. 2. If you keep the injection open while air-pump is not working, you stand a great chance of filling the cylinders with water and blowing cover off. The best way of starting is to blow all air out through snifting valve, then close blow-through and snifting valves, and admit a little injection water to get vacuum.

McGill.

[67960.]—**Starting Compound Condensing Engine.**—1st. The valve mentioned on the l.p. cylinder is no doubt an auxiliary valve. This valve is placed on nearly all compound engines so as to render them handy at starting at any position of the cranks, live steam being admitted either on the top or bottom of the l.p. piston. 2nd. The injection valves should be opened before starting. 3rd. If the condenser will not take the injection, stop the engine and throw a few buckets of water over the condenser so as to cool it; this will get you over the difficulty.

Longsight. J. Stokes.

[67962.]—**Bluing Solution for Steel.**—The object of the process is evidently to form a thin film of sulphide.

Sm.

[67962.]—**Bluing Solution for Steel.**—I am afraid "W. T. E." will not get much of a result from that he mentions. I tried it some time back, and am sorry to say I cannot recommend it.

F. W. Mason.

[67965.]—**Aquatic Beetles.**—Wide-mouthed bottles of a fair size containing a little meat fastened to the bottom, and sunk upright in the ponds, may suit the purpose, especially if the inquirer adds some arrangement of string and a lid, whereby they may be closed before being drawn up.

Uttoxeter. N. S. R.

[67965.]—**Aquatic Beetles.**—If "Dytiscus" will procure a half-dozen wine hamper, remove the lid and fasten a strong cord to each handle, then place a brick or large stone inside, and get a companion to pull one cord while he pulls the other, by drawing this arrangement through the ponds he will be able to catch dytiscus. Should more be taken than wanted, a supply of males would oblige.

Great Yarmouth. J. J. Owles.

[67966.]—**Varnishing Maps.**—I spoilt my first in same way, but now use the size (made of gelatine or clear glue) cold, so as to keep it on surface of paper. I like mastic varnish best.

Kanet.

[97966.]—**Varnishing Maps.**—Dissolve some isinglass in water by simmering it over a fire, and strain it through fine muslin. If the size glistens when applied to moderately warm paper, it is too thick; if it sinks in it is too thin; it should merely dull the surface. Give your map two or three coats of it when you have got it right, and then varnish with the best mastic.

J. S. Mandane.

[67966.]—**Varnishing Maps.**—I do not know anything about "patent size," and possibly the fault may lie there. One coat of gelatine (1oz. to 10 of boiling water, strain, and keep hot on a sand bath) I find to work very well. Paper varnish not being so deeply coloured as ordinary copal, suits better for maps.

Plymouth. B.Sc.

[67966.]—**Varnishing Maps.**—Try sizeing with very weak glue (soak the glue all night before melting), and then varnish with white rosin 1lb., gum arabic 2oz., Venice turpentine 2oz., linseed-oil 2oz. First melt the rosin and strain it very hot, steep the gum in olive-oil till dissolved, and strain it. Put to this the turpentine and rosin, and mingle them over a slow fire till dissolved. Use it hot.

Bournemouth. Miles.

[67967.]—**Engine and Boiler.**—If your boiler is well made it could be worked with 60lb. on safety-valve, taking care to keep crown-plate of furnace well covered. You would get 2H.P. by running your engine at 350 revolutions.

McGill.

[67967.]—**Engine and Boiler.**—If the boiler is properly constructed you could carry a pressure of 150lb. in perfect safety. Assuming that you have a pressure of 100lb., engine making 200 revolutions per minute, and with a cut-off at ¼ stroke, the engine would develop 2 horse-power.

Longsight. J. Stokes.

[67972.]—**Dynamo.**—It is pretty evident that there must be very serious leakage of current somewhere for you to be able to get a spark from the F.M. wires, even when the commutator is not in contact with brushes. This is further proved by the fact that it will not work as a motor. If you can't find out the fault, send it to me (carriage paid), and I will put it right for you, free of charge.

Carshalton. S. Bottone.

[67973.]—**Small Dynamo.**—1. The armature or field-magnets leak. 2. The wire is too fine to give a large current. 3. The resistance of the bell is too small to allow the field-magnets to excite themselves to the full. Insert a yard or so of No. 30 iron wire between the dynamo and the bell, and try again.

S. Bottone.

[67975.]—**Bottled Fruits.**—Consult a cookery book, e.g., Mrs. Beeton's "All About Cookery."

Sm.

[67978.]—**Fucus.**—This is one of the "brown sea-weeds" or Melanophyceæ — the chlorophyll corpuscules being brown. The branches of the thallus of Fucaceæ often contain air-cavities for floatage (hence the term "bladder-wrack"), and the cell walls are very gelatinous. The reproductive cells occur at the ends of certain "fertile" branches of the thallus, and line depressions or pits (conceptacles). The female cells (oospheres) are developed from mother cells called oogonia, each oogonium producing four or eight oospheres. In other conceptacles the male cells (antherozoids, each a body or "brown spot" with two long hairs) arise from antheridia, each antheridium producing many antherozoids. The fertilised egg (oospore) at once develops into a new fucus. In Fucaceæ the epidermis adds to the growth of the plants, unlike its behaviour in higher plants, where it remains a simple layer. "H. W." will see that I have supposed him somewhat familiar with technical terms and general reproductive phenomena of plants.

Uttoxeter. N. S. R.

[67979.] — **Elementary Biology.** — Morgan's "Biology," published by Rivingtons, is just the book I fancy "H. W." is in need of. It is written for the Inter.B.Sc. (London) Exam., which, I fancy, "H. W." has in view. I used it for this exam. Huxley's "P. Biology," new and revised edition (10s. 6d.), will enable one to get a practical knowledge of the development of "Rana." McNab's "Classification of Plants" (1s. 6d.) has a short account and drawings of the several parts of the plant "fucus."

Sutton-on-Hull.

[67979.]—**Elementary Biology.**—Foster and Balfour's "Elements of Embryology" will be "H. W.'s" best aid to a knowledge of the history of the chick and rabbit. He should add as much practical work to his reading as possible, and, of course, should have dissected the adult forms before he begins. When he has gone through the above carefully, he will be able to understand Balfour's "Comparative Embryology," Vol. II., or Haddon's smaller "Introduction to Embryology," for the differences presented by amphibian development; but if he has done no embryology before, he must stick to the chick till he masters it.

Uttoxeter. N. S. R.

[67980.]—**Recovering Sulphate of Copper.**—Precipitate the copper by means of solution of sodic hydrate (caustic soda); collect this, strongly heat, boil in strong sulphuric acid, evaporate down low, then stand and let crystallise; dissolve again, and recrystallise.

F. W. Mason.

[67980.]—**Recovering Sulphate of Copper.**—Filter off through slag-wool or asbestos; evaporate in earthen vessels until it crystallises on cooling. Collect the crystals. If not pure enough, redissolve in clean hot water and recrystallise. Or precipitate all the copper by adding scrap-iron or zinc to the filtered solution as long as any brown copper powder is precipitated. Collect this, wash it on a filter, redissolve it in dilute sulphuric acid, and crystallise. This will give a very pure sulphate.

S. Bottone.

[67981.]—**Accumulators.**—To light an 8-volt 5c.p. lamp for four hours you will need four cells, exposing 9in. by 9in. of positive surface. You will have to run your dynamo for six hours.

S. Bottone.

[67984.] — **Forming Accumulators.** — The plates rapidly improve by continuous usage.

No Sig.

[67984.]—**Forming Accumulators.**—At best, your accumulators will not give much more than two ampère hours. To form, send the current in one direction till the acid begins to boil briskly. Now let the cells discharge. Now reverse the connection of the battery, and charge the contrary way. Again discharge, reverse, and repeat these operations till your plates retain as you desire. Then afterwards always charge in one direction, and do not entirely discharge.

S. Bottone.

[67985.]—**Engine.**—This will run at 290 revs., according to size of ports. If steam is carried ¾ of stroke you may get ¼H.P. Vertical boiler, say, 16in. by 9in., with firebox. Burn fine coke and coal or gas, as will suit you.

Bristol. T. C.

[67986.]—**Practical Electric Bell-Fitting.**—Try nitrate of silver, 30 grains; common salt, 30 grains; cream of tartar, 3½ drachms. Mix, and moisten with water for use; or you can immerse it in a solution of cyanide of potassium, which will silver it.

F. W. Mason.

[67986.]—**Practical Electric Bell-Fitting.**—I have found the following a good silvering paste for brass-work. Pour 1oz. strong nitric acid into a gallipot; set this on the hob near the fire. When the acid boils throw in about 1dwt. of silver wire; when this is dissolved add a good tablespoonful of common salt; then make the whole into a paste with powdered whiting. As soon as the action ceases you can use the paste. But you must be very careful not to inhale the fumes given off when you add the silver, as they are very poisonous. Have your work quite clean and free from grease, rub a drop of dilute sulphuric acid over it, and then rub some of the paste on with a bit of rag tied round the end of a stick. A coating of silver quickly forms, which can be polished with an old wash-leather.

Forest Hill. J. Minuto, Electrician.

[67990.]—**Counting Speed of Quick-Speed Engines.**—Use an ordinary counter; but if speed is very high, gear down the counter with a pair of wheels 5 to 1.

Bristol. T. C.

issued shortly.)—J. S. R. (Do you think it reasonable to ask such a question? If anyone has constructed a phonograph of the latest pattern he would scarcely take the trouble to make out scale drawings, which can be easily worked out by anyone competent to make such an apparatus, from the photographs and engravings already published. The probable cost would be about £20.)—A Friend. (See the indices of back volumes, and the last number.)—S. E. S. (The method of arranging photo-microscopic apparatus has been frequently described; but not "Foto-microscopic apparatus." Is that some new patent?)—A Turner. (They are tempered in the usual way, which has been described thousands of times. See Hints No. 4 above.)—Alloy. (It is not at all wonderful that your question has not been answered—for it is simply incomprehensible as it stands. What has leather to do in "resisting pressure of water" in an ordinary tap? It is simply a washer.)—Enquirer. (If you cannot take the gauge to pieces and examine it, better call in come competent man. We have no space for guesses as to the construction of the gauge. From what you say of the boiler and the tubes, we should imagine that someone is running a risk of finding a verdict of manslaughter brought against him by a coroner's jury.)—B. J. Wilson. (Consult the forthcoming index. Watt's "Electro-Metallurgy," Crosby Lockwood and Son, is a good work.)—Wholemeal. (It is not likely that the aërated process of breadmaking could be carried out in a private house, as powerful machinery is required. Compressed oxygen would not do as well.)—C. (You will find them scattered about in the various textbooks and serials, and important ones have, as a rule, been illustrated by their designers.)—Norfolk. (There is a capital work on Graphics published by Longman and Co., and "The Elements of Graphical Arithmetic and Graphical Statics," by Gray and Lawson, W. Collins, Sons, and Co., London and Glasgow. Several other publishers have textbooks, and possibly the syllabus indicates works that may be studied.)—Geo. Cannon. (No doubt if you went to one of the Heywoods' shops in Manches-chester, they could show you such works as would suit.) Balloon. (See indices, especially that to be published next week.)—Foreman. (Scarcely of sufficient interest. So few people want to make a Glover's tower. Consult works on manufacturing chemistry, the alkali trade, &c.)—R. (Look up the back volumes, or, failing them, the textbooks.)—Photus. (There is a good deal about testing lubricating oils in back volumes, and you might also consult Allen's "Commercial Organic Analysis." 2. Yes, a Masonic emblem, explained in the books of the craft. 3. Answered many times. See indices.)—F. G. (See the articles on Electric Bell Fitting, and many replies in recent numbers.)—Heliostat. (Both questions are answered in any elementary textbook of astronomy.)—B. H. (The simplest method of demagnetising a watch consists in allowing it to spin round in various positions within the influence of the field magnets of a dynamo. A simple method is described on p. 171, No. 1152.)—Subscriber. (It is not much use bringing it to the front unless it is very good and very cheap, and applicable to all kinds of railway waggons. Even then you will want considerable influence. There are plenty of devices of the kind.)—G. H. (The bones are dissolved by means of sulphuric acid and then mixed with some waste dust or cinder ash. See indices for several replies on the subject.)—Ispahan. (Anoint the parts well with a mixture of sweet oil and flowers of sulphur, or vaseline.)—F. J. (See indices.)—A Reader. (It has been stated many times that a chromic acid battery is the best to use for incandescent lamps.)—Ex. (At the Sanitary Institute, 74, Margaret-street, W. Inquire of the secretary.)—Col. Ross. (It is impossible to reproduce your diagram, so we shall have to leave that part of your letter out.)

Men and Women who wear Harness' world-famed Electropathic Battery Belt find that it invigorates the debilitated constitution, stimulates the organic action, promotes the circulation, assists digestion, and promptly renews that vital energy, the loss of which is the first symptom of decay. Its healing properties are multifarious; it stimulates the functions of various organs, increases their secretion, gives tone to muscles and nerves, relaxes morbid contractions, improves nutrition, renews exhausted nerve force, and thus promotes the health and vigour of the entire frame. All in search of health should wear this, the only bona fide reliable Electric Belt. Thousands of testimonials. Pamphlet and advice free, personally or by letter, on application to Mr. C. B. HARNESS, Consulting Medical Electrician (President of the British Association of Medical Electricians), 52, Oxford-street, London, W. (corner of Rathbone-place).

According to an American paper, graphite bearings are rapidly extending in their use. It concludes by saying that "enough is now known to show that dry lubrication by means of the graphite box has been very successful, simply in taking the place of the oiled box."

Iron Cement.—A cement which Mr. W. Watkins; of Chicago, has thought it worth while to patent in this country is made by stirring into one part of sweet oil and one part of molasses, one part each of barytes, Venetian red, litharge, and red lead, and one and a half part each of plumbago, Paris white, and yellow ochre. It takes several hours to prepare, but will remain plastic for years.

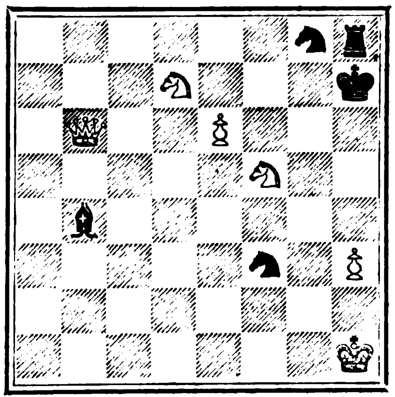
The Government of Western Australia has come to terms with the promoters of a gigantic railway project. A line is to be constructed from Eucla to Perth, a distance of 800 miles, which, when completed, will bring into railway communion Perth, Adelaide, Melbourne, Sydney, and Brisbane. It is expected that the work will occupy ten years. The contractors have agreed to construct the railway on the understanding that for every mile completed they shall receive from the Government the gift of 20,000 acres of land. Should they keep their promises the contractors will become the owners of an estate of 16,000,000 acres, equal in size to one-fourth the territory of Victoria.

CHESS.

All communications for this department must be addressed "Chess Editor, English Mechanic, 332, Strand."

PROBLEM MCXXXIX.—By H. F. L. Meyer.

Black.



White. [6 + 5

White to play and mate in five moves.

Solution to 1,137.

White.	*Black.*
1. Kt-Kt 3.	1. K-B 7 (a).
2. Q-R 2 (ch).	2. K-K 6 or 8.
3. Kt-B 5 (ch) or Q-Kt sq (ch), &c.	
	(a) 1. Any other.
2. Kt-K 4.	2. Any.
3. Q-Kt 3 (ch), &c.	

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,137 by J. Bryden, H. Planck (an excellent problem, by no means easy), J. G. Hankin, A. Wheeler, F. C. Cook (a very beautiful problem and quite worthy of Mr. Law's high reputation as a composer), A. Bolus, E. Sanders, and Janus; to 1,136 by H. Planck (very pretty), Link and Janus.

Names entered for Tourney:—J. E. J. Smith (C), Mendelssohn (C), F. C. Cook (A), Fr. Fernando (B), J. Macbeth (B), H. G. Walsh (C), J. Bryden (A), R. T. Hood (C), W. Gleave (A), E. Sanders (A), Janus (A), T. L. Robins (A).

We have now nine competitors entered for A, three for B, and ten for C. As in each case the numbers are below twelve, the minimum fixed, we must delay the commencement of the Tourney for a fortnight, by which time we trust the total in A and C will be reached. B must be abandoned.

A. Wheeler.—We do not know of any pending Problem Tourneys.

F. C. Cook.—We think with you that many problems in the English Mechanic are of a high order, and this is due not only to the support so kindly given by well-known composers, but also to the admirable productions sent by amateurs. Thank you for your letter and problem, which we shall have much pleasure in inserting shortly.

J. P. Taylor.—Thanks for problems. The twoer wants slightly altering. The other is too tall for us.

F. Fernando.—You have overlooked in your attempt at 1,137 that if 1. $\frac{\text{Q-K B 3}}{\text{P-Q Kt 5}}$, 2. $\frac{\text{P-Q B 4}}{\text{P takes P (e.p.)}}$, that W. K is in check.

Mendelssohn.—It is a four-mover and quite correct.

W. Gleave.—Thanks for problems; always acceptable.

J. Bryden.—We are much obliged for communication, the details will prove of value.

Received with thanks: the *Boy's Own Paper*, the March number of *Art and Literature* (quite up to the mark of the previous number, and containing, besides a Chess Column, some admirable engravings, one, a copy of a photo of Lord Tennyson); *Western Portfolio* (a Plymouth magazine just started, with a page devoted to Chess, the problem being by our former contributor, Mr. T. H. Billington); and *Pen and Pencil*, which is quite up to its usual high standard in all respects, and a marvel of cheapness.

Herr Bauer, of Vienna, announces a Chess Lexicon in which there are 2,000 variations of the opening carried to the fifteenth move. Price two florins. Address, 15, Wassergrasse, Vienna.

We regret to hear of the death, on the 27th January, of Mr. F. Perrin, of Brooklyn, in the seventy-fourth year of his age. He was the chess editor of the *New York Albion*, and competed in the first American Chess Congress in New York in 1857.

The prizes in the Tournament of the Canadian Chess Association were won by Messrs. R. P. Fleming, J. E. Narraway, J. P. Cooke, A. T. Davison, and G. Barfy in the order named.

Captain Mackenzie won his match with Judge Golmayo, in Havana, by seven games to four and one draw.

Messrs. Bell and Co. are issuing a reprint of the "Chess Congress of 1862," the original edition being out of print.

The sixth American Chess Congress is now definitely announced to commence at 1 p.m. on the 25th inst. Steinitz says that, owing to the change in the rules, requiring six instead of four games a week, he will be unable to compete. This is much to be regretted.

We learn that the match between Steinitz and Tchigorin has been won by the former, though, at the time of writing, we have not learnt by how many games.

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OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good value offered for all kinds of Instruments and Collections of Apparatus of Scientific nature.—Caplatzi, Science Exchange, Chenies-street, Tottenham Court-road.

Piano.—What offers for handsome rosewood grand, out of repair. Would suit amateur to learn tuning and repairing.—C., Finsbury House, Wood-green.

Astronomical Telescopes.—Several to be exchanged. —J. Bassett, 48, Leswin-road, Stoke Newington.

Dr. Nichol's Fountain Bath and Raising Douche, most valuable hydropathic appliances, quite new, not used, cost 63s. Offers, Lathe, Drilling Machine Books &c.—Below.

Circular Saw Spindle, 2⅜ thick, 4ft. long, with saw, sell at 20s. What offers in exchange?—Webster, Bridge-street, Bolton.

Electrical Appliances.—A lot to be disposed of cheap. What offers?—Apply, Goddard, High-street, Dorking.

Portable Fan Forge, hood and iron chimney, powerful Screw Press, lot of Magic Lantern Slides, mahogany case of Microscopic Mountings, second-hand Safety Bicycle.

Small Lathe wanted. Would exchange for thorough instructions on the Clarionet, by a Professor.—Address, H. M., 19, Mossbury-road, Clapham Junction.

American Organ, handsome £18 instrument, numerous stops, knee-swell, voxhumana, as new, unsoiled. Exchange Piano.—Mechanic, 47, Fernhead-road, Westbourne Park.

Wanted, Screw Plates, Taps, Stocks, Dies (Whitworth preferred), all sizes, in exchange for New Files, American Organ, Magic Lantern.—Mechanic, 47, Fernhead-road, W.

Wanted, Furniture, Carpet, Grocery, Drapery, and Provisions. Exchange Bicycle or Tricycle, from a large stock.—Heighton, Vinco Works, Elton, Peterboro.

Organ Pipes, open diapason and flute, tenor C to G, 44 pipes. Offers.—M. Johnson, 33, Market-place, Wellington.

Organ Pedals, set of birch, in good order, CC to E, 17 keys. Offers in exchange. Apply above.

Horizontal Engine, about 2in. bore by 3in. stroke, well made, with pump, &c. Want Locomotive or offers.—P., Stirling.

Good Self-feeding Bench Drill wanted. Exchange 24in. Lawn Mower. A genuine offer.—Address Lancaster, Brighton House, Redhill.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 15, 1889.

EXTRACTS FROM BERGERON.—XXI.

The Rose Engine.

THE art of cutting waved lines in the lathe only dates back about 150 years. [This was written in 1816.—O. J. L.] The invention appeared so ingenious that all the trinkets of that time, and especially snuff-boxes, were engine-turned. This kind of work had become somewhat out of fashion when the first edition of this work was published; but for some time past it has recovered favour, and deserves to be described with some detail. Nothing is, in fact, more curious than to see a heavy and complex machine yield to movements which the rubber imparts to it, which rubber acts against rosettes, the form, the combinations, and, therefore, the effects of which may be infinitely varied. There is reason to think that the Rose engine originated the square-cutting machine and the portrait lathe—two other inventions equally ingenious and captivating. In the Rose engine it is the headstock of the lathe upon which the work is mounted which has motion; but it has since been proposed to make use of an ordinary lathe by imparting the movement to the rest, and as the latter machine is less complicated than the other, and needs less room and less expense, we propose to divide the description of the art of Rose-engine turning into two parts—the one in which the rest is set in motion, and the other in which motion is imparted to the lathe.

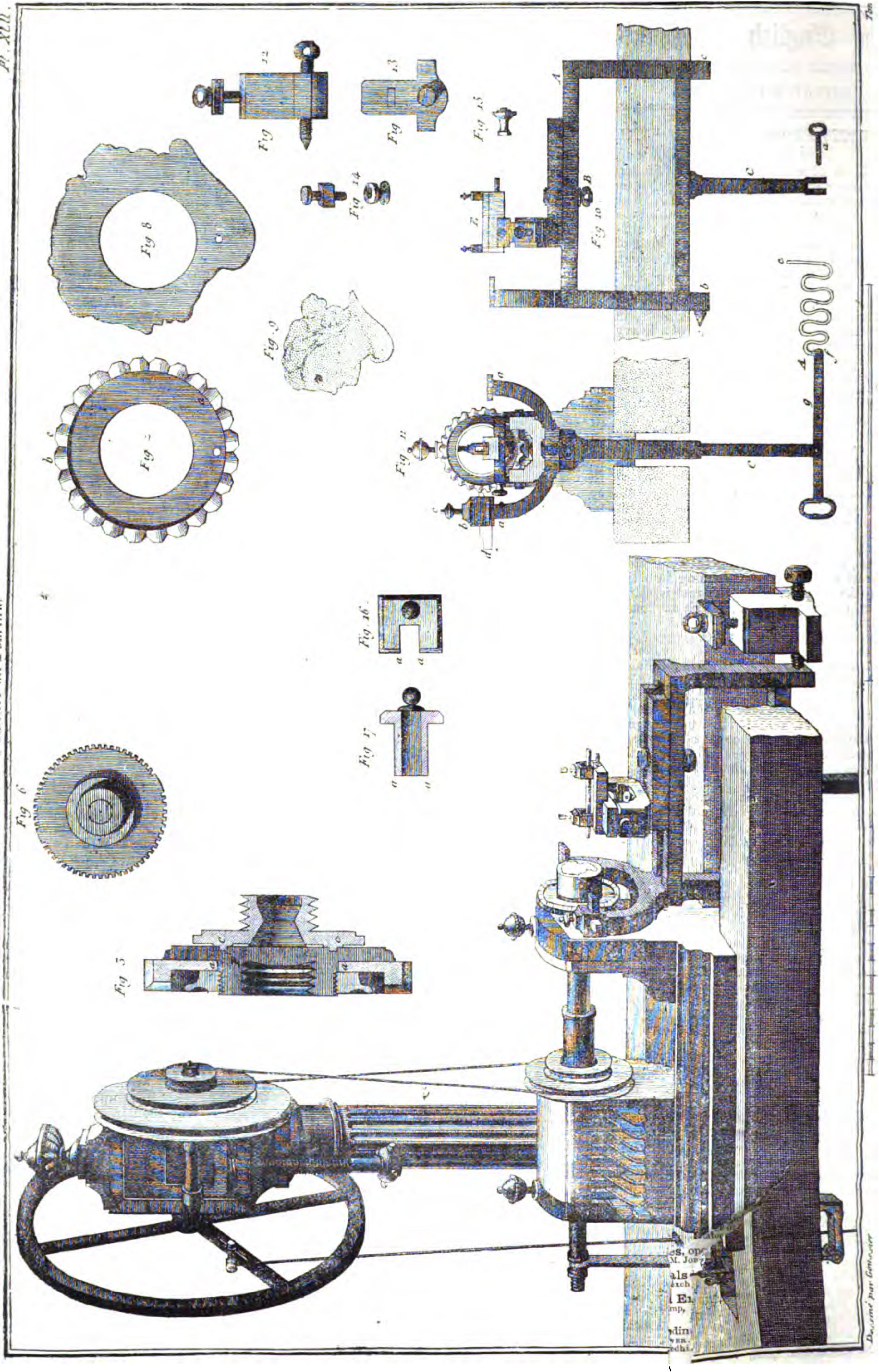
Method of Engraving on an Ordinary Lathe by means of a Movement given to the Rest.—Fig. 1, Plate XLII., represents an ordinary lathe, on the mandrel nose of which a chuck is mounted, carrying a rosette, the contours of which are to be imparted to the work. In ordinary Rose engines, if the rubber is presented to the circumference of the rosette, it communicates, as we have said, to the entire lathe (headstock) an oscillatory motion, the centre of which is below. Here, on the other hand, it is the rubber, and consequently the rubber holder, on which it is fixed, which receives motion by its following the sinuosities of the rosette, and which motion it imparts to the support on which the tool is placed. By this means the tool traces on the work the patterns which are upon the rosette. What is called a rosette is a plate of brass or iron, Fig. 2, of 6in. or 8in. in diameter, and four or five lines in thickness. At a certain distance from the circumference is a recessed part, *a*, which reduces the main plate to a thickness of three lines at most. The different kinds of curves (which have to be made with all the care possible, both as regards the perfect regularity of each and their equality in combination, and also the roundness of the rosette) are to be worked upon the circumference, as well on the edge as on the face of the fillet that has been reserved. It will soon be evident that if each section of the pattern is not precisely similar to all the rest, [illegible] hollows are not of equal depth, if when these rosettes revolve the corresponding points taken upon the curves are not equidistant from the centre — no regularity can be obtained in the result produced, and this irregularity becomes still more striking when it becomes necessary to bring the curves into opposition.

In the latter case the defect produced by a faulty wave coming continually in opposition with the line traced by a regular one results in a very disagreeable appearance. What we state here will become still more apparent by-and-by when we come to treat of the art of engine-turning. We have only represented here a single rosette. In a succeeding chapter will be seen those most commonly used, and which are mounted in combination upon the Rose engine. Here only one is mounted at a time, and it is changed at will. We will now describe the chuck which carries the rosette, and which is ordinarily mounted upon the nose of the mandrel. Fig. 3 represents this chuck in section in the direction of its axis and on a diameter. F is a plate of iron carrying at its back a boss, in which is made a screw, A, to mount it on the mandrel nose. On the outside is a smooth bearing, *a a*, upon which the rosette is fitted, and retained in position by a nut, B B, which is adjusted to a screw-thread cut upon the remainder of the bearing. At the edge of this nut may be made a ring of beads, in order to screw it up more readily with the fingers; or, preferably, two holes may be made at opposite points that it may be tightened by a chuck wrench. After the rosette has once been fixed, there will be no need to touch it. In front of the plate F is a truncated cone, on which turns a movable nose-piece C C, seen separately in Fig. 6, which is somewhat similar to those of an oval or eccentric chuck, except that the edge is not toothed in the same way. In the oval and eccentric chuck the teeth formed on the periphery are all equally spaced. Here, on the other hand, after having divided the circumference into six equal parts, a different pitch of tooth is worked on each. Thus, for example, the first may be spaced as if the entire circle were to be divided into sixty, for the second a spacing may be arranged for seventy-two; for the third, that which would produce eighty; for the fourth, eighty-four; for the fifth, ninety-six, and for the sixth a hundred. It is useless to divide the whole of each of the six spaces; it suffices to cut at most eight teeth, using always the same cutter, so that the same click can be used for all the divisions. Care must be taken to mark with figures the several divisions, the use of which will become apparent when we give instructions in Rose engine-turning. When all the pieces are put together and mounted on the lathe, if a rubber bearing against the rosette communicates to the tool-rest the motion imparted to it by the sinuosities of the rosette, the work on the movable nose will be cut according to the pattern of this particular rosette. Fig. 20 represents the movable rubber-holder A, and the rest E, which is fixed upon it, seen in profile in accordance with the direction of the lathe-bed; while Fig. 11 gives a cross view in a direction parallel with the headstock, as may be seen by the section of the lathe-bed. The rubber holder is made of a bit of curved iron, as seen in Fig. 11, forged in one piece. The two branches *a*, *a*, are in the form of a semicircle. On the top of each is a plate which overhangs on three sides, so that there may be fitted a sliding poppet, *b*, which serves to fix the rubber *d* by means of a set-screw *c*. The tail of this piece descends an inch or two below the lathe-bed. It is securely attached to a frame of iron, represented in Fig. 10, the upper part of which is composed of two parallel bars, accurately squared up on all sides, and which give passage to a bolt B, which fixes a slide-rest E, the height of which is such as to bring the tool point level with the axis of the lathe mandrel. This rest, which should be of special make, should have the power of turning in a horizontal direction, so as to meet the work at all points. At the bottom of the upright, *b*, of the frame, Fig. 10, is a steel point of conical form, *e*, which is securely riveted, and which centres in a fixed bearing, attached at the bottom part of the lathe poppet. The other branch has at its lower part a conical hole into which enters a pointed screw, Fig. 12, which is situated underneath the lathe-bed in a contrary position to that of the ordinary poppets. The wedge and capstan head of the screw are on the top of the bed, as may be seen at A, Fig. 1, in which the bearer has been cut away in front to show the position of the poppet and centre screw, so that power may be given when the poppet is in place to screw up the cones, to prevent too much play, or to loosen them, ever so slightly, as may be required.

It must be understood that the frame in its entirety, with the rubber and its carrier, have the power of moving in the direction of the width of the lathe-bed, as the frame is supported at two points by the two conical centres. Then when the rubber meets a projecting part of the rosette it necessarily recedes and carries the tool with it. When, on the contrary, it meets a recessed part, it approaches the centre, as does also the tool itself. It is not sufficient that the rubber bears against the contours of the rosette: it is necessary that some power compel the carrier, and consequently the rubber, to press constantly against the rosette, so that it shall traverse all its sinuosities, and that the resistance of the material to the tool shall not prevent the rosette from producing its full effect. This is accomplished by means of the spring A (Fig. 11), one end of which is fastened underneath and towards the back of the lathe-bed. An iron rod, *g*, secured by a pin, *a*, in a fork C, solidly attached to the bottom of the frame D of the same figure, communicates the impulse of this spring to the entire arrangement. The spring A (Fig. 11), is a plate of steel bent in the form of a serpent; the rod to which the spring is fixed at *f* by a pin has a certain number of holes placed near each other, by means of which it is possible to give to the spring such tension as may be necessary either by pushing it back or pulling it forwards.

When, therefore, all is thus arranged, and the spring put on the stretch, it is secured by the pin, and it is evident that as the spring forces the rod towards *b* (Fig. 11), the entire rest, and consequently the rubber, is carried against the rosette. When this rubber meets a concave part of the rosette, the spring compels the rubber to penetrate to the lowest part of it. When, on the contrary, the rosette presents a convex part, the same rubber is compelled to retreat, and so on in constant succession, in accordance with the hollows and projections of the rosette. As the work is mounted on the mandrel which rotates, the slide-rest follows all the movements of the parallel frame which carries it, and the tool marks on the work the contours of the rosette. Thus far the rosette has imparted no motion other than that perpendicular to the mandrel of the lathe, and, consequently, if the work is being done upon the periphery of the piece (as, e.g., on the cylindrical part of a box), mouldings can only be produced which are perpendicular to the axis, more or less waved according to the greater or less relief given to the waves of the rosette.

If, on the other hand, the rose-cutting is to be on a flat surface, such as the cover of a box, only round or triangular fillets can be produced, of equal depth throughout their entire circumference. In order to obtain the opposite results—that is, to incline the lines upon the circumference, or to obtain mouldings in relief upon the plane surface, it becomes necessary to take advantage of the power which is possessed by the mandrel of moving lengthwise to and fro in its collars. For this purpose there is placed at the back a spring, just like that of which a description has been given when speaking of swash-plate work; and, as the rubber holder must have no oscillatory motion, it is fixed in a perpendicular position by making to fit into the interval of the lathe-bed a wooden clamp, shown in Fig. 16 and in profile Fig. 17. The two branches, *a a*, embrace the tail of the rubber-holder. There is then placed on one of the branches of the rubber-holder a rubber which bears


Pl. XLII.
Manuel du Tourneur
Fig 3
Fig 6
Fig 7
Fig 8
Fig 9
Fig 10
Fig 11
Fig 12
Fig 13
Fig 14
Fig 15
Fig 16
Fig 17
A
B
C
a
b
c
d
e
f
g
Dessiné par Goussier

against the waves cut on the flat of the rosette, as can be seen in Fig. 2.

Fig. 14 represents the bolt which fixes the slide-rest upon the main support. The two parts represented separately in Fig. 14 are united, and in their place in Fig. 10, at B, Fig. 15, is an iron knob which fits upon a square at the end of the screw of the slide-rest in order to withdraw or advance the tool. When a rosette is used which has deep undulations, more especially if they are abrupt, it is necessary to place the lathe cord upon the smallest speed pulley of the fly-wheel, that the work may revolve very slowly, and that the rubber may be able to traverse the surfaces to their entire extent, and enter all their contours. For this purpose there should be used a "cabriolet," by means of which the mandrel may be turned as slowly as desired, and the motion of which can be stopped instantaneously when desired.

[This "cabriolet" is merely a frame fitted to the lathe-bed in front in the same plane as the mandrel headstock. It carries a driving pulley worked by a winch-handle, by which the necessary slow motion is obtained. As in this form of Rose engine the headstock does not oscillate, the lathe-cord will remain uniformly tight, not being affected by the required limited longitudinal motion of the mandrel in its collars.—O. J. L.]

Such is the ingenious appliance which stands in place of a Rose engine, and which we have had sketched from the machine itself, which acts perfectly. We are far from accrediting to it the perfections of the Rose engine; but for an amateur who does not wish to incur great expense, or whose workshop is somewhat restricted in size, and in which there is not room to place a Rose engine, the machine we have just described will suffice for ornamenting an infinity of articles. The machine offers one great advantage. An amateur needs much study and somewhat lengthened practice upon a Rose engine, in order perfectly to understand its construction. If he should need to change the rosettes, he runs a certain amount of risk of injuring the sleeves or other parts, the accuracy of which constitutes their merit; instead of which, with the machine which has just been explained, one single rosette suffices, and it may be removed and changed in a moment.

O. J. L.

HARDENING AND TEMPERING BY ELECTRICITY.

ELECTRICITY is rapidly coming into use for all sorts of processes in the arts, and if it can be used for welding, as it can, there seems no reason why it should not be also employed for hardening and tempering steel. At all events, Mr. W. P. Thompson, the well-known agent, has obtained a patent on behalf of Mr. P. Diehl, of Elizabeth, New Jersey, for a process of hardening and tempering small articles, such as needles, for instance. The invention consists in heating a suitable tube, chute, or conveyer (through which the objects to be hardened may pass) to any required temperature by means of electric currents, and in causing the objects to move through the same while so heated with any required speed, so that they may be heated to the required temperature. As they are discharged from the tube or chute they may be dropped into a vessel of oil or other suitable material. In carrying out the invention it is convenient to employ a dynamo electric generator or other suitable source of electric currents in connection with an inclined tube, duct, chute, or conveyer, which constitutes a portion of the electric circuit, and is, therefore, made of electrical conducting material. The current is of such character as to heat this chute to any required temperature. The points of electrical connection with the chute may be changed, if desired, so as to vary the length which is heated. The strength of current may also be varied as required, thus varying the temperature to which the chute is raised. The chamber may be inclined from a horizontal position, and suitable means may be provided for turning or vibrating the heating chamber, so that the objects will readily pass through it. A suitable feeding device delivers the articles to the heating chamber with such frequency as may be required.

Fig. 1.

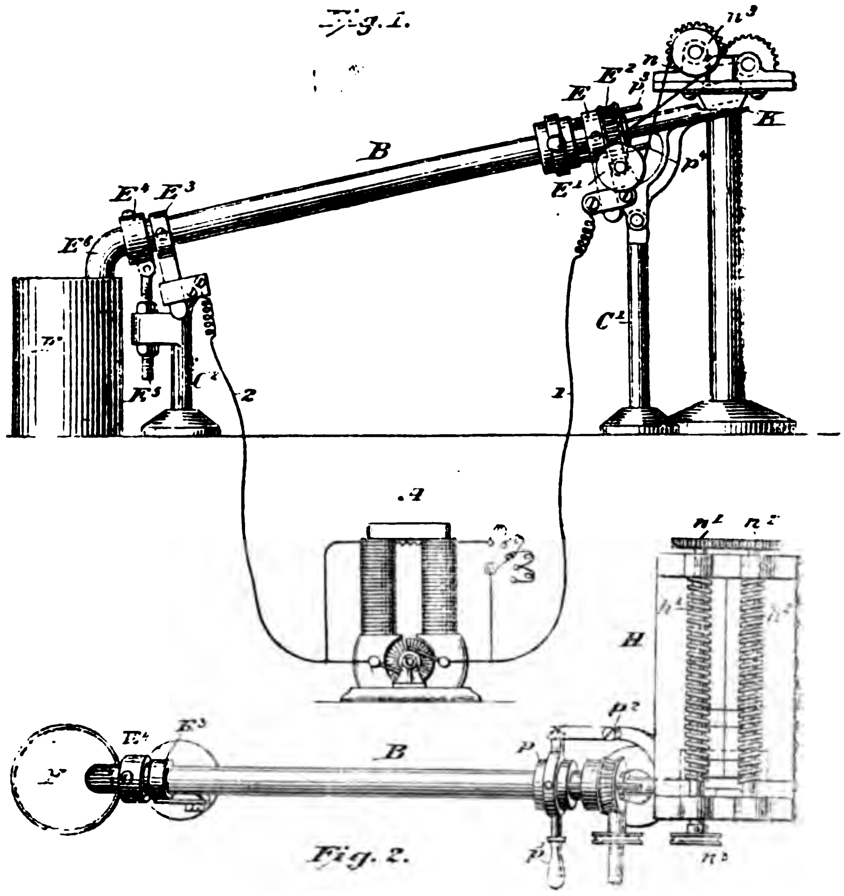


Fig. 2.

Fig. 1 is a side elevation, and Fig. 2 a plan view of a suitable apparatus. A represents a suitable source of electric currents, and B a tube, or chute, which is to be heated to any required temperature by currents from the source. The source of electric currents may be a generator of any suitable character, such, for instance, as a shunt-wound dynamo, and the currents therefrom may be regulated in any well-known manner. One pole is connected, by a conductor, 1, with the metal supporting one end of the conducting chute B; the other end of this chute is connected, by the conductor 2, with the other pole of the generator A. The chute B is inclined sufficiently to allow the needles or other articles to pass readily through it. One end of the chute is shown as being supported upon a standard C^1 which carries a wheel E^1 geared with a wheel E^2 upon the tube. The wheel E^1 is revolved in any convenient manner, and thus the chute B is revolved continuously. This causes the articles passing through the chute to pass down its length and to be constantly brought into contact with different portions of the heated surface. The lower end of the chute is carried in a collar E^3, which in turn is supported from a pillar C^2. The height of this end of the chute may be regulated by an adjustable collar E^4 supported upon an adjustable screw E^5 carried by the pillar C^2. The collar E^4 may also carry a tube E^6 which extends into a vessel F for containing oil or other suitable substance, into which the articles are dropped as they pass from the chute B.

The needles or other articles are fed to the chute B by means of a feeder or conveyer H of any suitable form; that shown consists of two threaded rods h^1 and h^2, which are revolved in opposite directions, and which are at such distance apart as to receive the respective ends of the articles, and thus convey them from one end to the other separately. At the end adjacent to the chute they are dropped into a receiving tube, K, which delivers them to the chute B. The threaded rods H^1 and H^2 may be turned in opposite directions by a belt, *n*, coupling the wheel E^1 with the belt-wheel n^3, which in turn communicates its motion to the gear-wheel n^1 and n^2 upon the respective rods. For the purpose of modifying the active length of the chute B, or the portion which is heated, a sliding collar, *p*, may be moved along its length by means of a lever, p^1, which couples the collar in any suitable manner with a support, p^2, connected with the pillar C^1, and thus in electrical connection therewith. The lever p^1 is pivoted to the collar *p*, and this permits movement of the latter a short distance, which is all that is necessary in practice; but the movement may be varied by changing the length of the support p^2 and the link connecting it with the lever p^1. This collar may be connected by suitable pins p^3 and p^4 with the supporting collar E of the corresponding end of the chute B, so that it is prevented from turning.

A modification is described, in which the tube B is vibrated, instead of being revolved. This is accomplished by supporting the upper end of the chute above a revolving cogged wheel or cam, which is turned at any required speed in any convenient manner. The end of the tube resting upon this cam is moved up and down with any required rapidity, thus tending to cause the articles to move towards the lower end of the chute. In this instance electrical connections are made directly with collars adjustable along the length of the chute, and thus the portion of the chute which is in the electric circuit may be varied. In case the chute is vibrated either vertically or laterally, instead of being revolved, it may be of other form than tubular; thus it may be U-shaped, or V-shaped, as it may be convenient in either of these instances to cover the open surface with transparent material such as mica. The operation of the apparatus will be evident without further explanation, and it is evident that different forms of apparatus may be employed to carry the invention into effect. After the needles or other articles have been passed through the chute and heated to such temperature as may be required for hardening them, they may be passed through as many more times as may be required, and at such temperatures as may be necessary for tempering or toning them.

OIL AS FUEL.

THE fact that at the ninth annual meeting of the National Electric Light Association, held at Chicago last month, three separate papers were read on "Oil as Fuel," with slight variation in the title, will show that the American electricians are desirous of getting the power to drive their dynamos as cheaply as possible. There does not seem to be any desire to utilise the oil in the form of an explosive for petroleum engines, but simply as a fuel for heating steam-boilers. Oil—that is, dead oil—has been used for many years in this country for raising steam, and the other week a new torpedo boat was tried at Portsmouth in which liquid fuel is to be used instead of coal. The oil, which consists of creasote, the refuse of the chemical works, is stored in tanks in the double bottom, and is pumped into air-chambers in the stokehold, whence it is projected into the furnace in the form of spray. The boat was under way at full power for about two hours, during which the following data were obtained:—Steam in boiler, 158·6lb.; revolutions, 312. The mean indicated collective horse-power developed was about 900. Five runs were made during the trial upon the measured mile in Stokes Bay, the mean speed being 19 knots. The whole question, however, resolves itself into one of cost. The oil consumed was purchased at 2½d. per gallon, whereas the Admiralty contract for coal is at 14s. per ton. But although 1lb. of coal will evaporate 10lb. of water, and oil will evaporate about 15lb., that still leaves an important superiority in favour of coal at existing prices in England. On the other hand, with oil there is no dust, and little or no smoke. Trimming is also dispensed with, and the potential energy, weight for weight, stored on board is one-half greater. At the Chicago convention, the first paper was by Mr. S. S. Leonard, who pointed out that it was essential to have proper settings and methods of working to make a success of burning oil for raising steam. His statement is: We have been using oil for about 18 months, and for the last six months exclusively under our seven boilers; these boilers are 14ft. by 60in., with 44 four-inch flues. During the first part of the night, these boilers are all in use furnishing steam to four Reynolds-Corliss condensing engines, from which we are using about 1,100H.P. The steam pressure is easily maintained at any desired point, usually with us at 100 pounds. Mr. Leonard says the furnaces are in as good condition as when first built,. and that the boilers have not been injured; but precautions are taken to prevent the flame always impinging on one spot. There is practically no smoke, and little dirt to clear away. In the comparative tests made by him, 2½ barrels (104 gallons) of oil costing 260 cents evaporated as much water as a ton of coal, costing at Minneapolis 315 cents—altogether he worked out a saving of 21 per cent. in favour of the oil; but the coal used evaporated only 5·38lb. of water per pound of fuel, and was therefore of inferior quality, such as could be bought for less than 315 cents in this country, while oil, especially of the quality used—capable of evaporating 14·8lb. of water—could certainly not be bought in this country at 2½ cents per gallon. Perhaps a better comparison was that made in the paper by Mr. M. J. Francisco, who, however, claims for the oil an evaporative power of 18lb. of water for every pound of oil. Then he said: The heat in coal transferable to water is about 70 per cent., while the heat in petroleum transferable to water is about 80 per cent. Therefore, with coal, 70 per cent. of 12,000 units gives 8,400, and for petroleum, 80 per cent. of 20,000 is 16,000, a gain of 7,600 heat units in each pound. This is on the basis of pure coal; but when we consider the waste (amounting in some cases to 25 per cent., and the master mechanic of one of the largest railroads in the country claims 55 per cent.) found in nearly all coal, such as sulphur, slate, and earthy substances which are incombustible and retard, instead of generating, heat, the difference in the per cent. obtained in actual practice is far greater than shown by the above comparison. There is also in coal a large percentage of loss in transportation and combustion in the heap, varying from 5 to 10 per cent. From these facts we can safely conclude that the heating capacity of oil is nearly twice that of coal as generally used. On this basis the only question to be considered is the cost of power furnished by each at the dynamo. Three and one-half barrels, or 955lb. of oil, equal 2,240lb. of pure coal; therefore, with oil at 100 cents per barrel and coal 350 cents per ton, or oil at 150 cents per barrel and coal at 450 cents, the difference would not be so marked if there were no other factors to be considered. When, however, we calculate the great saving in stoking, removing cinders and ashes, cleaning flues, and benefit to boilers, besides securing a steady heat, combined with the quickness and ease in starting and shutting down, we have an argument in favour of oil that stockholders who care for dividends can appreciate.

The storage and handling of the oil are, however, points in the comparison, and it appears that there are some difficulties in that connection—the insurance companies putting up the rates when oil is used; but that is the only real drawback: one that can be avoided by providing suitable safety arrangements. The gist of the next paper read, that by Col. C. M Ransom, was that there is no doubt about the economy of the oil, provided the arrangements all round are adapted to its use. It would seem to be almost essential—that is if economy and convenience are to be studied—to run the oil-fed furnaces continuously, or, at least, to keep a pressure of not less than 30lb. of steam in the boilers. Col. Ransom's conclusion is that to obtain the best results the oil must be turned into gas, and the gas be consumed after due admixture with air. The question is in a fair way towards settlement by our Transatlantic cousins, who have cheap oil awaiting their attention, and are likely to retain their supply, for, as some of the speakers pointed out, the export trade will probably cease entirely as soon as the oil regions of Baku are brought into rapid connection with the European ports. The present output of the United States wells is about 25,000 barrels per day; but M. de Tchihatchef estimates the yield of the Baku wells at 88,000 barrels per day, and though prices will rise as soon as conveniences are established for distributing the Russian oils, they are available in such quantities that there would be no likelihood of the cost of the American product increasing, even if it were extensively used for firing steam boilers. Hence oil fuel is just now attracting much attention in the United States, especially in connection with electric-lighting plants.

ELECTRO MOTORS: HOW MADE AND HOW USED.—V.*

By S. R. Bottone.

§ 15. ALL the previously described motors labour under one great disadvantage, and that is that when the movable electro-magnets (the armature) are in the most favourable position to be affected by the attractive or repulsive effects of the field magnets, they are also at the greatest distance from them. This would be bad enough if the attractive or repulsive powers of the electro-magnets decreased proportionally to their distances; but since, in fact, this decrease is, at least, as the square of the distances, it will be easily understood how great is the loss of power from this cause alone, without reckoning that accruing from the "churning of the air" performed by the (comparatively) wide-spreading arms of the armature.

By the adoption of another form of armature, known, from the name of its inventor, as the "Siemens armature," or, from its shape, as the "H girder armature," it is possible to do away, to a great extent, with both these objectionable features at one and the same time.

§ 16. The Siemens armature consists essentially, as shown at Fig. 7, in a solid cylinder of soft iron, having a length of from 3 to 4 times its diameter, with a deep square channel cut all round its length and ends. Several ways are open to the amateur to make these. If small, say up to 1in. diameter and 3in. long, two saw-cuts are made on two opposite sides of a rod of good soft Swedish iron bar, about ¼in. apart, and the channel cut out between these by means of a cold chisel and hammer, the channels being afterwards smoothed up and made truly square by filing. Or the two semi-cylindrical cheeks may be filed up out of a piece of soft iron, and attached to the square central piece (technically known as *the web*) by means of four screws. It is possible to make a very good armature in "malleable" cast iron. For this purpose the student need only make himself a neat wooden pattern, precisely like the sketch (in which the *relative* proportions of the parts are given), but a trifle larger to allow for shrinkage and cleaning up.

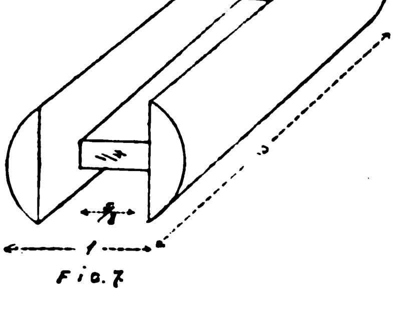


FiG. 7

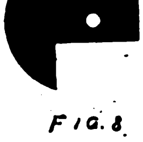


FiG. 8

This pattern should then be sent to the iron founders, with instructions that it should be cast in the best and softest iron, and then annealed "malleable." It is of the highest importance that the iron of the armature be *soft*, since the harder the iron the longer it retains the magnetism, hence a hard iron armature does not lose and reverse its magnetism with that rapidity which is needed to get the best effects while approaching to and receding from the poles of the field magnet. Sometimes, for the sake of increased ventilation, and also to minimise the "eddy" currents which are set up in the iron when it is massive, the armature is not made in one solid piece, but is built up of a number of punchings or laminations, of which one is illustrated at Fig. 8, and a complete armature formed of a sufficient number of these laminations strung on a steel spindle, and held in place by a shoulder at one end and a nut at the other at Fig. 9. The "eddy" currents just mentioned are detrimental in many ways, but more especially by causing the armature to get very *hot*, so that in a badly-constructed solid armature the insulation of the wire is frequently burnt up.

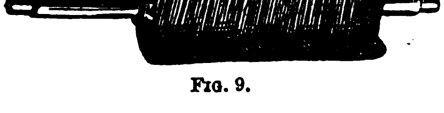


Fig. 9.

§ 17. The Siemens armature, if of the form shown at Fig. 7, must be fitted with a brass head at each end, to which the spindle must be attached. The amateur can make these heads from stout sheet brass. This may be ⅛in. thick for small armatures up to 1½in. in diameter, but for larger armatures, cast brass heads are better and easier to make. The brass should be cut out into two circles, a little larger than the diameter of the armature, the centre found, a hole bored through the centre of each, and then a female screw thread put in to take 3-16in. or ¼in. screw. Two pieces of ¼in. or $\frac{5}{16}$ steel rod, of sufficient length to form the spindle, are now tapped with a screw-thread to fit these holes. They are then screwed in, and burred over the other side to prevent them working loose. The brass discs are then filed (or better, turned) up into perfect circles, exactly the size of the armature, great care being taken that the spindles are central. Holes are now drilled through these brass heads, and also in the ends of the armature cheeks, these latter being tapped to take small screws. In one of the discs (the one which will afterwards be the nearer to the commutator) two other holes, at right angles to the screw holes, must also be drilled. These are to allow the passage of the ends of the wire, which are to be connected with the commutator. In the other form of armature (in which the spindle passes right through centre of the web, whether this be a solid casting, or a laminated armature, as at Fig. 9) does not require heads at all, but both varieties should work in *brass bearings*.

§ 18. The mode of winding these armatures is extremely simple, and only one precaution is needful to insure success. This precaution is *thorough insulation*. For this purpose, the armature channel and sides thereof, as also those parts of the spindle where the wire may have to touch, must be carefully covered over (taped or dressed are the technical terms) with some insulating material, which may prevent all chance contact with the wire, the covering of which would be almost certain to be abraded during winding by friction against the sharp edges of the bare iron. For these small armatures, nothing perhaps is better than good wide tape, soaked in good, hot, rather thin glue, and then drawn tightly round the channel and insides of the armature, and round the shoulders of the spindle. This must be allowed to get quite dry and hard before the winding is attempted. Holding the armature in his left hand, with the commutator end nearest to him, the operator, starting at the left-hand side of the channel, proceeds to wind right round the channel and ends, until he has filled in the channel nearly up to the edges. He must be careful in doing this to lay the layer evenly, closely, and tightly, and when he reaches the right side of the channel he winds back again (always winding in the same direction) until he reaches the left side. As he started at the *left* side above, so for convenience of attachment of wires to commutator, he will end on the *right* side below.

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* All rights reserved.

§ 19. The commutator for the Siemens armature is of the same pattern as that shown in § 10, with this difference, that the slits may be cut slightly diagonally to the axis of the commutator, instead of being *quite* at *right angles*, though this is immaterial in armatures of the small sizes referred to above. The advantage of having the slits of the commutator slightly on the cross is, that by this device the brushes are at no time off the conducting portions of the commutator, so that the induced spark, which makes its appearance at the time of breaking and making contact, is to some extent overcome. The exact *position* of the slit with reference to the armature will be decided by the position given to the brushes, and will form the subject of future consideration. Owing to the peculiar form of the Siemens armature, it is advisable to use field magnets having pole pieces of suitable shape, if the best results are desired.

A very convenient shape is shown at Fig. 10, of dimensions proportionately marked to the dimensions given for the armature at Fig. 7. From the sketch it will be seen that the armature rotates in a nearly completely circular tunnel, so that at no time is it at any distance from the field of action of the magnets. The field magnets for these small motors may be conveniently cast from a wooden pattern of the shape of one half of the sketch, since the field magnets are made up of two exactly similar halves, bolted together at the yoke by a long screw. These field-magnets, after being "dressed" (see § 18), are to be wound with five layers of wire, precisely as were the magnets described at § 10. A convenient sized wire for small motor, the armatures of which do not exceed 3in by 1in. is No. 22 gauge. This may be either silk-covered copper or single cotton-covered; in this latter case, before winding, it will be well to run it through hot melted paraffin wax. This operation not only facilitates the winding, but greatly improves the insulation.

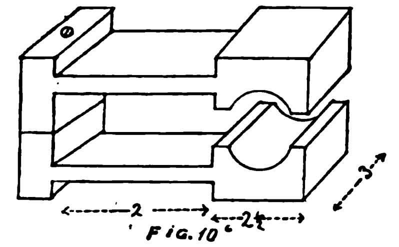


FIG. 10

But before proceeding with the winding of the field-magnets it will be necessary to fit them with brass bearings, to take the ends of the armature spindle. These bearings should be cast in brass, patterns being made in wood of the shape shown at Fig. 11, in which *a* is the back bearing (the one near the pulley) and *b* the front bearing (the one near the commutator). When the bearings have been cast they must be filed up clean and true, and the holes *d* and *d'* bored to take the ends of the spindle. The smaller holes, *c*, *c*, *c*, are to take the small screws which attach these bearings to the pole-pieces of the field-magnets (Fig. 10), which, of course, must be drilled and tapped with corresponding holes.

§ 20. As a great deal of the efficiency of these motors depends upon the exact point at which the supply of electricity is cut off from the armature coils, so it is well that the brushes should be *adjustable*—i.e., that they should be capable of being turned round the commutator until they are at the best point of commutation. For this purpose the brushes, instead of being merely two fixed springs, as shown at Fig. D, § 11, are carried on a *rocker* (see Fig. 12) which slips over the nozzle of the front bearing (Fig. 11 *b*), and can be fastened thereto at any desired angle by means of the set screw. At *a a'* are two holes, through which the pins which support the brushes *b b* pass, and in order that these may be insulated from each other, the holes themselves are bushed with little boxwood or ebonite washers. These pins must have a thread cut on them at the extremities which project forwards through these bushed holes, and on to these two small brass nuts (circular) are screwed, in order to facilitate coupling up the wires of the field-magnets. The brushes themselves may either be soldered to the pins, or attached to them by a couple of screws. These brushes should be cut out of thin springy brass about $\frac{1}{20}$in. thick, and tipped where they rest on the commutator with an inch or so of very thin sheet copper, soldered by one extremity to the inner face of each brush. Two holes should be bored and tapped for screws, in the lower pole-pieces, and under side of corresponding yoke of the field-magnets (Fig. 10), so that the motor can be at will either fastened to a baseboard or screwed under a sewing-machine, &c.

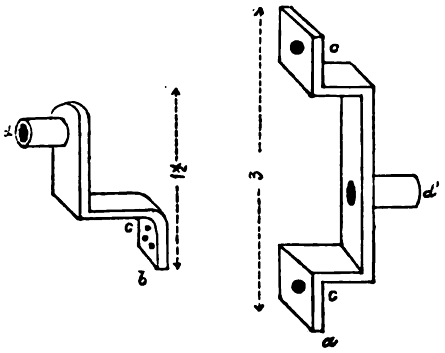


Fig. 11.

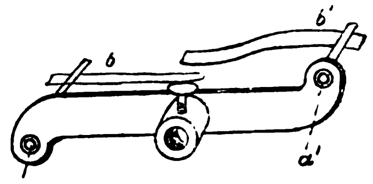
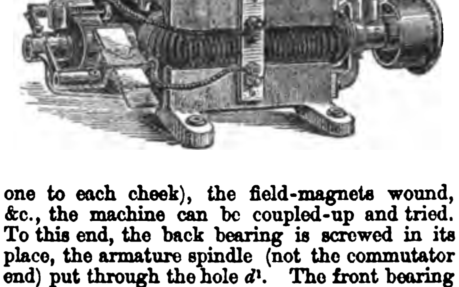


Fig. 12.

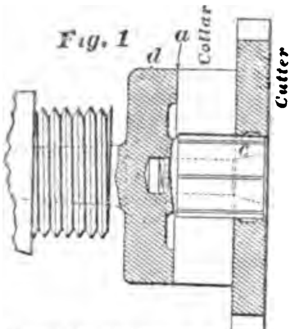
§ 21. All the parts being now ready, the armature wound and fitted with its commutator (to which the armature wires have been duly soldered, one to each cheek), the field-magnets wound, &c., the machine can be coupled-up and tried. To this end, the back bearing is screwed in its place, the armature spindle (not the commutator end) put through the hole d^1. The front bearing is then put on, allowing the spindle to pass through the hole *d*. The front bearing is now screwed into its place. Now is the time to decide what position shall be given to the brushes, and consequently the position of the slits of the commutator relatively to the *web* of the armature. If we decide to place the brushes *horizontally*—that is, in a line with the field-magnets (and this will be found to be the most generally convenient position), then the slits must be both in a line with the centre of the *iron* portion of the armature; but if we decide upon placing the brushes *vertically*—that is, *across* the field-magnets, then the commutator must be turned on the armature spindle until the slits are in a line with the centre of the wire channel of the armature. If not previously done, the ends of the wires of the field-magnets nearest the yoke are now soldered together and coated where soldered with a little guttapercha applied hot. The other two ends of the field-magnet wires are now attached, one to each of the brush pins, by means of the circular nuts described at § 20.



§ 22. On coupling up these same nuts with the poles of a battery of two or three chromic-acid cells in series, each exposing about 16sq.in. of negative surface, the motor will at once start rotating its armature, and if a small pulley and band be affixed to the back end of spindle, the power thus called forth can be transmitted and utilised. With a battery of six quart cells sufficient power is generated from a motor of this pattern, having an armature 3in. by 1in., to drive an ordinary sewing machine. Fig. 13 illustrates a finished motor of this description, furnished with a front terminal board, so that the battery can be connected to the motor without having to disturb the brush connections.

POPULAR ERRORS ABOUT SNAKES.

THE *Madras Mail* has some remarks on this subject, in which it says:—"King Solomon acknowledged that there were 'three things which are too wonderful for me, yea, four which I know not,' and one of these was 'the way of a serpent upon a rock,' and for years the mode of progression of a snake remained to men of science as much a mystery as it was to Solomon. It is thought that the absence of limbs is a great disadvantage to snakes, but the fact is their ribs take the place of limbs, so that instead of having two pairs, they sometimes have over 200. Aristotle thought they had as many ribs as there are days in a month, but, in fact, the number varies, and reaches 400 in pythons. The movements of the snake's ribs have been likened to those of a caterpillar's legs. Each vertebra supports a pair of ribs, which act like a pair of legs, having the extremeties connected together by a broad plate; the hind part of this plate is free, and when the ribs are moved forward, this end is raised so that it takes hold of any roughness or irregularity of the ground. When rapid motion is required, some portion of the body in front gains a purchase by means of the ventral shields on some projection in the ground, the ribs are drawn together on alternate sides, throwing the body into alternate curves, some portion of the hinder part of the body gains a purchase, and the fore part is straightened out. It is an error to think that they move forward in a series of vertical coils, or that they move with rapidity. I once followed a large snake, and found a smart walk sufficient to keep up with it. Nor do snakes exercise any fascination over their victims. Pepys alleges that they ejected poison on larks in full flight so that they fell into their mouths; but, in fact, chickens, rats, guinea-pigs, rabbits, hens, show no fear of snakes when given to the latter in a cage. A hen has been known to roost on a python and another to peck at a snake's tongue in motion, evidently taking it for an insect or worm. When it has killed its prey either by constriction or poison, the snake is supposed to salivate or lubricate the meal by means of its tongue. This is not the case, as the tongue is too small to lubricate the tiniest bird. The snake moves its head about the prey, feeling with its tongue for the right part to begin upon, and when that is in its mouth, but not till then, the salivary glands begin to aid deglutition. The functions of a snake's tongue have also been the subjects of popular error. Job speaks of the viper's tongue slaying one, and Shakespeare is full of similar remarks. The tongue is really a very delicate organ of touch, for the eyes are so placed that the snake cannot see in front or below, and by means of its tongue it literally feels its way. The stories of two-headed snakes owe their origin to the existence of a species, *Bungarus fasciatus*, which possesses an abrupt rounded tail that is sometimes mistaken for a second head. The popular notion that every snake is poisonous is of course absurd, but the proportion of poisonous to harmless snakes is much less than is generally supposed. In India only one genus in ten is poisonous, and the same proportion is probably accurate as to individuals also. In all Southern Indian there are only twelve



Chuck for Grinding Cutters

Fig. 2

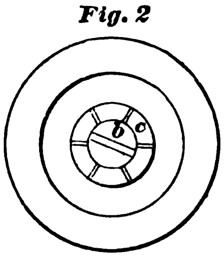
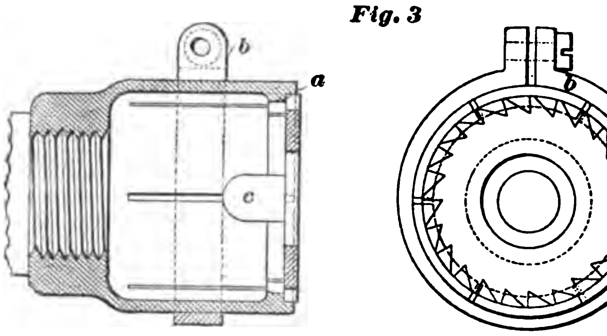


Fig. 3



Chuck for Grinding small thin Cutters

kinds of poisonous snakes, the largest being the hamadryad, which reaches 15ft. in length. A bite from one of these would probably produce death in three minutes; it has the reputation of being fierce and ready to attack on the slightest molestation. The cobra is timid; the charmers who play a pipe in front of it do not attract it by the music, for it is nearly deaf, but by the peculiar movement from side to side which is always followed by the snakes."

THE MILLING MACHINE AND ITS OPERATION.*

A True Arbor and Cutters—How to Make Them.

IN this article I propose to give my plan for maintaining a true arbor, since it is always more to be preferred to have a true arbor than otherwise, although I gave my plans of overcoming a trouble experienced with them. An arbor sprung out of truth in the manner set forth, and the remedy described for that particular work, will not at all times bring about desirable results in surface milling, since the arbor may be slightly out of truth between the spindle and centre, and therefore cause the miller to cut only on one side, and make wavy work.

There are a number of points to be looked up and watched with great care, to preserve a true arbor. The first essential thing would be to be sure that the hole in the spindle is true (once proven, however, is sufficient), then to see that the arbor is true on its centres throughout its length. In making, it should be finished throughout by grinding. The next thing is to have the collars used on the arbor faced true on each end; then the cutter with a ground-out hole to fit the arbor closely, and its sides ground true and parallel with each other, and the teeth ground true with the holes, and lastly put together clean of any dirt in the joint of the collars. If these conditions are carried out, a true arbor will always be the result. But to do this, you must have some facilities, especially in the case of the milling cutter, to have its side ground true and parallel. The idea of ground sides of millers is not new; but I have seen a great many in use which were used as they came from the tempering process; and no matter how true they were faced before tempering, they are not to be depended upon as such afterwards. A slight variation in the thickness of the cutter will invariably make an arbor run out of truth.

In Fig. 1 and 2 is a plan I adopted for grinding the faces of cutters up to 4¼in. thick. A piece of steel with a collar, *d*, is fitted in the grinder head spindle, with the upper end *c* ground to fit the standard holes of the cutter, which is bored and tapped to receive the screw *b*, operated with screw-driver, the arbor being split into six parts. The face *a* is faced true by grinding (which operation should be repeated whenever placed into the machine to insure its truth), then I used several thicknesses of collars (as one shown), to bring the face of cutter over end of arbor *c*, according to thickness of cutter. These collars being once faced true, always serve their purpose. By putting the cutter on the arbor, and holding it against the collar with two fingers while tightening the screw *b*, parallel sides will be produced.

In the case of the "Gang Milling," I used thin saws, and as a great many were used, it was highly important that all should be parallel, in order to preserve a true arbor, and also they had to be equal thickness throughout, to preserve correct time or distance, so that a perfect job was obtained. For the grinding of these cutters I made a chuck, as shown in Fig. 3, made like a bell, and to screw on the grinding machine spindle. A shoulder, *a*, against which the cutter rests, was carefully trued off each time put into the machine. The bell was split in six parts, and a band, *b*, with lugs for a screw, and split, was slipped over the bell for the purpose of clamping the cutter. An opening, *c*, was cut at one of the slots for the purpose of admitting the micrometer caliper, by which means the whole cutter could be calipered from periphery to the hole, to insure its being correct at all points. By this same chuck the holes were also ground out to correct size. The cutters, after tempering, were all strung on an arbor to fit the unfinished hole, and fastened with a nut, and the outside of the teeth ground off to fit this chuck, and the cutting clearance ground, after all was finished. The advantage of this chuck is its convenience for getting the cutters to correct size before removing them.

There is another error frequently made with milling arbors, and that is, they are adjusted to the centre, and afterwards the nut which holds the cutters is drawn up tightly, by which means the arbor is stretched, the centre and the bearing of the machine are jammed, and, when not noticed, damage of no small consequence is frequently done, as the bearings and centre become roughed by abrasion, which causes them to heat and give trouble. This point should be watched, as novices will frequently make this blunder.

There was a case of this kind under my own observation, and left to me to remedy. I had to have the spindle re-ground to a smooth bearing and grind up the centre points, and the centre hole in the arbor as well, entailing loss of time and expense. Therefore a timely warning to the novice in this particular would avert the calamity.

In the case of dressing the centre hole of the arbor I adopted the plan of using a copper centre for the purpose, and by chucking a piece of copper in a chuck of the lathe, turning it to the correct angle of centre (60°) by holding the arbor in the tail centre and the end to be lapped out on the copper centre, allowing a little play between the two. Use emery and oil on the copper, run the lathe at a high speed, and turn the arbor, and work it endwise between the two centres. The reason for end-moving is to prevent grinding ridges. After grinding a short time, remove the arbor, re-shape the copper centre (as it grinds itself out of shape), and proceed as before. Repeat the operation until you have a smooth centre-hole and the copper centre has retained the true shape. By carefully turning the arbor while lapping, there will not be much danger of having it out of truth.

The plan of making a centre with very slight taper coming in contact in the bottom, something like a vertical shaft "step-bearing," in my experience, does not have much virtue, as it does not remain a smooth bearing, and is hard to correct. My preference is a large and deep centre, which, properly handled, will give no trouble.

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* By A. B. Landis, in *American Machinist*. (Abstract).

SIMPLE EXPERIMENTS IN PHYSICS.*

THE experiment illustrated in Fig. 1 shows the great elasticity of certain solid bodies, and the almost total want of elasticity in other solid bodies. This experiment is introduced here mainly on account of its adaptability to projection with a lantern. A thick plate of glass, a small slab of marble, or, better, a bar of tempered steel, is supported so that its upper surface appears in the field of the lantern. A small glass ball, or a ⅜in. or ½in. hardened, ground, and polished steel ball, such as is made by the Simonds Manufacturing Company for ball-bearings, is dropped upon the glass or steel from a measured height within the field of the lantern. The impact compresses the ball and the plate. At the instant following the stopping of the ball, the ball and the plate, by their own elasticity, return to their normal condition, and the force stored by the impact is given out instantaneously. If undisturbed, the ball will fall and rebound again and again, losing a little of its force each time until it finally comes to rest.

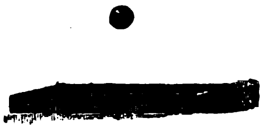

Fig. 1.—Elasticity of Solid Bodies.

By substituting a lead plate for the glass or steel plate, or by substituting a lead ball for the glass or steel one, it is found that the force acquired by the ball in its descent is expended mainly in changing the form of the plate or ball, and that, as the inelastic nature of the material prevents it regaining its former shape, there can be no rebound, as in the other case

The property of elasticity is also shown by the collision balls illustrated in Fig. 2. This well-known experiment is adapted to the lantern, and shows well on the screen. Six of the steel balls already referred to or six small glass balls or marbles are required. Each ball is provided with a small metallic eye, which is attached by means of cement or fusible metal used as a solder. Five of the balls are suspended from the two wire supports by fine silk threads, so that they all hang in line and touch each other very lightly. The sixth ball is suspended by a wire, which is bent down between the supports to receive a thread which extends through an eye attached to the supports, and serves to draw back the sixth ball. The thread by which

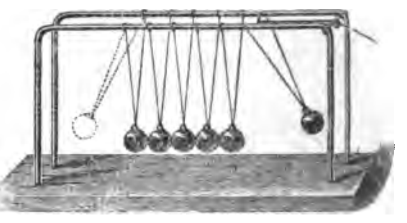

Fig. 2.—Collision Balls.

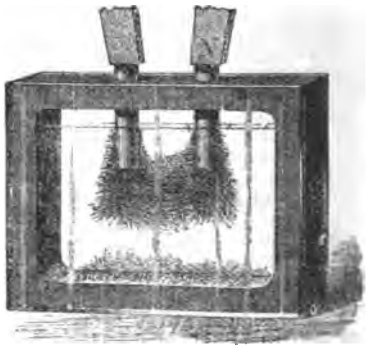

Fig. 3.—Magnetic Field.

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* By Geo. M. Hopkins, in the *Scientific American*.

the ball is moved is not noticeable, as it is partly or wholly concealed by the supports. By drawing back this ball in the manner indicated, and then allowing it to fall, its impact will slightly flatten the ball with which it comes into contact, and each ball in turn transmits its momentum to the next, and so on through the entire series. The last of the series is thrown out as indicated in dotted lines, and upon its return its impact produces the same result as that already described, but the effects are in a reverse order.

In Fig. 3 is shown a method of forming magnetic curves for projection, in which the iron particles slowly arrange themselves under the influence of the magnet, giving the appearance of crystallisation. In a closed cell is placed a quantity of glycerine, into which is introduced a quantity of fine iron filings. In the top of the cell are inserted two soft iron pole pieces, arranged to receive the poles of a permanent magnet. The glycerine is thoroughly agitated, so as to distribute the filings as evenly as possible throughout the cell. The cell is then placed in the lantern, and the magnet applied to the pole pieces. The iron particles will be drawn slowly towards the pole pieces, arranging themselves in symmetric curves.

In Fig. 4 is shown apparatus for the projection of the static discharge. It consists of a stand having two vulcanite columns, in the upper ends of which are inserted adjustable brass rods, provided with brass balls at opposite ends. The adjacent balls are adjusted to the striking distance and focussed on the screen. The light for projection should be only strong enough to show an image of the balls. When the conductors of a static machine or induction coil are connected with the brass rods, the path of the spark will appear as a brilliant white line on the screen. The discharge of a Leyden jar is still more brilliant.

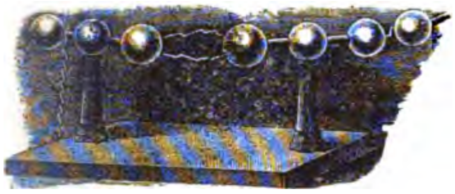
Fig. 4.—Projection of Electric Spark.

The apparatus shown in Fig. 5 is designed to show upon the screen the experiment known as the electric fountain. A small glass vessel provided with a capillary tubulure at the bottom is supported above a tumbler. The vessel is filled with water, and the capillary aperture allows the water to drop slowly when acted upon by gravity only; but when the water is electrified by connection with a static machine or induction coil, it issues in a fine stream, the change in the character of the discharge being caused by the mutual repulsion of the particles of water. In all these experiments an erecting prism is required.

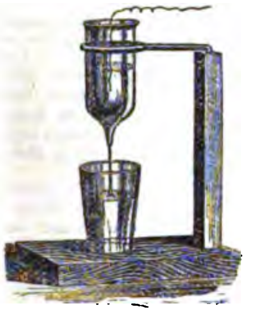
Fig. 5.—Electrical Repulsion.

FLASK WEIGHTS.*

THERE are rules governing the weighting down of copes and flasks which if carried out correctly no more weight need be handled than is really necessary to hold down the cope while pouring the mould; but the exact calculation is rather a difficult thing to determine, for there are many conditions which if not taken into consideration will cause the loss of the casting. Then, too, all moulders do not have the time, if they have the ability, to figure out problems of this kind, and it is very doubtful if any foundryman ever has or ever will take the trouble to reduce the question to a science in actual every-day practice.

All things considered, it is a better plan to take a little more time and labour and have on weight enough to be sure, than to try to figure it down so fine that you just lacked that "enough" to hold the cope down. With some moulders it is a rare thing for them to have "a run out." They exercise good judgment about the amount and number of weights to be used and how to place them. With others, again, it is an uncommon occurrence for them to pour off the work without having "a run out." They weight or clamp a mould without seeming to give a thought as to the best points of distribution, and apparently the fact has never dawned on them that it costs as much to handle and melt the iron that runs out on the floor, as it does to melt iron for the careful moulder who does not run it all over the shop, besides the bad casting and lot of scrap iron that can be used only as scrap, notwithstanding the extra cost of the pig iron that was in the mixture.

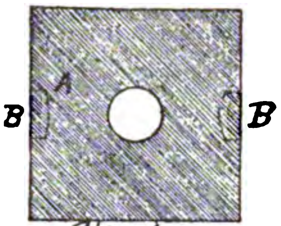

Fig 1

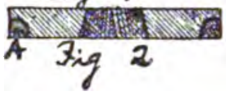

Fig 2

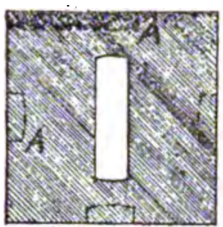

Fig 3

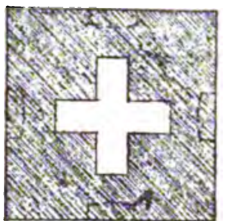

Fig 4

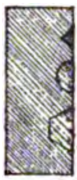
Fig 8

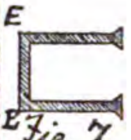

Fig 7

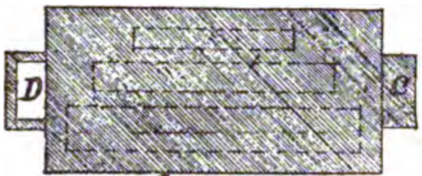

Fig 5

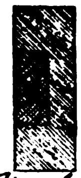
Fig 6

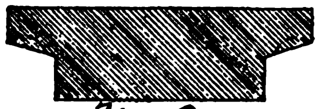
Fig 9

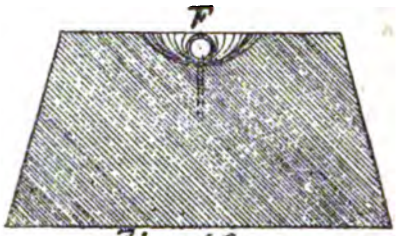

Fig 10

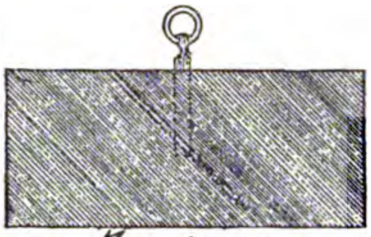
Fig 11

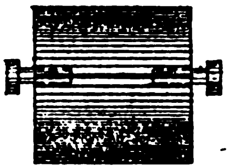
Fig 12

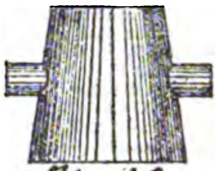
Fig 13

There are some foundries that use pig iron altogether for weights, while others are well equipped with weights that are easy to handle, some of which, taken from various foundries, are shown in the drawing.

Figs. 1, 3, and 4 are weights for snap moulds or very small flasks. The dotted lines A A are recesses for hand holds. Fig. 2 is a section of Fig. 1 from B B, showing the hand holes, and it also shows the hole for pouring the metal through into the mould, the reverse from what they usually are. This is, the large side of the hole is down as the weight rests on the mould. When the small end of the hole is down and the weights fit snug and level (as they should) on the mould, it is often the case when the moulder is pouring the work and does not "cut short" enough, the hole in the weight will be filled with metal, and, becoming solid in a very short time, the weight cannot be lifted off to change on to another mould without lifting gate, casting, and all with it. Then the gate has to be broken before it can be gotten out and the weight used again. Whereas, if the large end of the hole is down and gets filled with iron, no matter if it has become solid, the weight can be lifted off without any trouble or loss of time. This plan is practised in a foundry extensively engaged on snap-flask work, and is carried out in the different styles of openings in the other weights. Fig. 4 is for moulds that have two or more gates or a riser; they are made in size and thickness in proportion to the class of work they are to be used on. Fig. 5 is a weight used in the brass-foundry of a large railroad system. Fig. 6 is the right-hand and elevation as it is in the pattern, showing the core prints C C. When making the weights after the pattern has been drawn from the mould, the wrought-iron handles, Fig. 7, are placed in the print and filled over, making both ends of the weight like D, Fig. 5. Fig. 8 is a cross-section through centre of Fig. 5. The grooves E E are for making bars of Babbitt, of different weights to be dealt out in the shop.

In one of the largest jobbing foundries in this country there were a number of tons of Scotch pig iron scattered around through the shop to be used as weights, and there were tons of almost worthless cast and malleable iron scrap (that had been culled from the good scrap) lying in a pile in the yard, and yet this company had not bought a pound of Scotch iron in over fifteen years. A change was finally made in the administration of the foundry, and among other improvements a pattern was made on the plan of Fig. 9. A boy made some of them every day. A lot of the refuse scrap was put in the cupola at the close of the charging, and run into weights. They weighed 75lb. each, and gradually replaced the pig iron (to the delight of the men, as they were better to handle), and the Scotch pig was put to better use.

Fig. 10 is a section of a heavy weight. They are made round and square. The ring F for lifting it being down in a cup or recess makes it convenient for piling the weights up one on the other with the crane, and not have them in everybody's way all through the foundry.

Fig. 11 is a heavy oblong weight, and Fig. 12 is round, with wrought trunnions cast in it for lifting. All these latter weights are made from 200lb. to 2,000lb. each, and even higher, owing to the requirements of the foundry they are to be used in.

A certain foundry firm engaged on heavy work bought a lot of old cast-iron cannon as scrap. They cut them in two in front and behind the trunnions, and used the centre as indicated in Fig. 13 for weights.

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* By Robert E. Masters, in the *Manufacturers' Gazette.*

OUR COAL SUPPLY.[*]

IN 1865 Prof. Jevons gave to the world his startling calculations on the coming failure of the British coal supply. Failure, rather than exhaustion, is the climax to be anticipated, for it is well understood that the coal supply will suffer a virtual collapse long before anything like all the coal is fetched up from beneath the surface. Absolute exhaustion is declared to be a point that "will never be reached." Yet this is the point which can be calculated upon with greater ease than that of practical failure, providing we know with sufficient accuracy the total quantity of unworked coal, and can estimate the rate of consumption. It is not so easy to determine the period when the cost of winning the coal will be so enhanced by the increasing depth of the workings, and the market price will be raised in consequence of the comparative scarcity that the supply will cease to maintain our manufacturing industries in competition with the world. It is here that an element of uncertainty intrudes itself, and this again is aggravated by possible variations in the rate of consumption, as well as by the difficulty of determining the limits of the natural supply. We may be tolerably well assured that there is no less than a certain quantity of coal underground lying within a certain depth. But how much more there may be within that depth, and how far science may enable us to work economically at a yet greater depth, are matters about which more or less doubt may exist. Something must be taken for granted, and the whole question becomes based on a balance of probabilities. The Royal Commission which began to investigate this question in 1866, presented its report in 1871, and within a month afterwards Prof. Jevons issued a statement in which he complained that the Royal Commission had misunderstood him, and had not given his conclusions correctly. One of the Commissioners had made a special protest against the introduction of any allusion to the Professor's calculations, because they seemed "to imply the possibility of exhaustion" in 110 years. Prof. Jevons declared, in reply, that he had "never made an assertion or prediction of the sort." In the second edition of his work on "The Coal Question," published before the Commissioners drew up their report, he had stated: "I am far from asserting, from these figures, that our coalfields will be wrought to a depth of 4,000ft. in little more than a century." Considering that Prof. Jevons's book had so alarmed the nation that the Royal Commission may be said to have been the result, it is well to understand what the professor really did say. The controversy is not a mere matter of the past. It concerns us at the present hour, and is revived just now by an admirable and highly interesting paper read a few days ago before the Royal Statistical Society by Mr. Price-Williams. This gentleman appeared before the Royal Commission, and to a certain extent combated the supposed views of Prof. Jevons, by asserting that the increase in the consumption of coal in this kingdom would not go on at the rate at which the professor had apparently calculated upon. That there would be a persistent increase was admitted; but it was contended that the ratio of advance would fall off. The explanation given by Prof. Jevons amounts to this—that he spoke hypothetically. He puts the case in this way: "What I asserted was, that if the consumption progressed at the rate of 3½ per cent. for 110 years, the whole of the coal would be exhausted." He then adds, "My conclusion, therefore, was that the consumption could not possibly progress at that rate for so long a time."

The question at issue has been complicated by a difference between the parties in estimating the future growth of the population of this country. Mr. Price-Williams expected that the ratio of increase would decline, and that this would tend to diminish the rate at which the coal was being consumed. On the other hand, we find Prof. Jevons saying, in his reply to the Royal Commissioners, "Mr. Price-Williams's theory of a decreasing rate of increase, even if it were not contradicted by the results of the last census, is wholly delusive." The professor pointed to the altered distribution of the population. The agricultural portion, consuming little coal, had ceased to increase; but this was not the case with the manufacturing portion, with whom the chief consumption lay, and where its enlargement was especially to be looked for. In giving evidence before the Royal Commission, Mr. Price-Williams showed that, according to his view of the diminishing rate of increase, the coal measures down to 4,000ft. would not be exhausted until the lapse of 360 years.

The Royal Commissioners showed that by calculating on an arithmetical increase in the rate of consumption—that is to say, adding three millions of tons each year—all would be gone in 276 years. But they went on to state, "In all the foregoing estimates of duration, we have, for the sake of simplicity, excluded from view the impossibility of supposing that the production of coal would continue in full operation until the last remnant was used, and then suddenly cease." The Commissioners pointed out that a time must be anticipated when it will be more economical to import part of our coal than to raise the whole of it from our residual coal-beds. They concluded their report by saying, "But it may well be doubted whether the manufacturing supremacy of this country can be maintained after the importation of coal has become a necessity." It is the date of this crisis which England is concerned to know as near as may be. We are admonished by Mr. Price-Williams that the beginning of the end already begins to show itself. A considerable falling-off in the production from both the Durham and the Northumberland coalfields has been apparent during the last four or five years, more especially in the case of the latter. There is said to be every indication that the maximum limit of coal production from the Newcastle district has been reached, and that the supply from that quarter will continue to decline.

"To realise what is coming," we are told to look to that part of the "Black Country" where the coal has been already worked out. In that locality we are bid to recognise in the many ruined and deserted houses, surrounded with all the other indications of decay, "a picture of what must inevitably happen in this country when the other great coalfields are exhausted." With the failure of the British coalfields trade and industry will seek a home beyond the seas, where, as in New Zealand and New South Wales, an almost inexhaustible supply of the precious mineral is to be found, although of a somewhat inferior kind. However, there is something yet to be said, and we venture to suggest a few considerations. Coal is to be found in this country at greater depths than 4,000ft. The greater depth doubtless involves greater cost. But the superior quality of British coal will tell in its favour, as compared with the resources possessed by other countries. Even at a lesser depth than 4,000ft. there may be stores of coal yet undiscovered, and which may postpone the ultimate collapse. Concerning the South Wales coalfield, with an output nearly one-sixth the total of the United Kingdom, the most experienced mining engineers of the district assert that the supply will last for hundreds of years to come, though it is acknowledged that in fifty years, or probably less, the cost of production, owing to deeper sinkings, must be increased. Unquestionably, it is necessary that we should learn to husband our present resources. Important economies in the consumption of coal have been effected in recent years in the raising of steam and the production of iron and steel. The smoke of our manufacturing towns tells us that great waste is still going on, and this is true in the case of towns generally, owing to the extravagant mode in which coal is used for domestic purposes. When coal begins to get dearer than it is, more attention will be given to this matter, and improved modes of working our mines may also be found to assist.

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[*] Extracted from *The Engineer*.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

FRIDAY, March 8th. Mr. W. H. M. Christie, Astronomer Royal and President of the Society, in the chair.

The Rev. Chas. D. P. Davies, of Ringmer, near Lewes, was balloted for and elected a Fellow of the Society.

Mr. A. M. W. Downing, the new secretary of the society, mentioned that among the presents received by the society were some glass transparencies from the photographs of the Corona taken during the eclipse of Jan. 1st, 1889. Mr. Downing also read a paper on "The Greenwich Standard Star-places for 1888," from which it appeared that, on comparing the Greenwich places with the fundamental places which Prof. Auwers has lately deduced from a discussion of star-places and proper motions from the time of Bradley, that there was hardly any practical difference in the declinations, and that right ascensions only differed by very small quantities.

Capt. Abney read a paper on "The Value of a Scale of Density on a Photograph." He showed to the meeting an apparatus which he had devised for comparing the density of two photographs or two parts of the same photographic plate, by transmitting light from the same source through the two parts of the photograph to be compared, and cutting down the intensity of one of the transmitted beams by means of a revolving screen. The two rays of light are then received on a photometer screen and compared. By means of this instrument he has compared the density of photographic plates exposed for various periods of time to the same source of light and for the same time to sources of light of different intensity, and he finds that the length of exposure necessary to give a certain density is inversely proportional to the brightness of the light. Photographs of curves were thrown upon the screen showing the intensity of photographic action in various regions of the spectrum, and density curves corresponding with variations of exposure and light intensity. He proposed to apply his instrument to measuring the density of the photographs of the corona taken during different eclipses, and requested that in future eclipses observers should register a scale of densities corresponding to known amounts of illumination on the plates to be used for photographing the corona.

Mr. Common said: This is the first attempt I have seen to apply numerical data which will enable one to determine the brightness of the object photographed from the density of the photograph obtained. From the first I have wished to have such data to apply to photographs of nebulæ. It is easy enough to obtain contour lines corresponding to regions of equal brightness; but what is needed is a method which will enable one to determine whether the brightness of the whole nebula changes from year to year. If this power has been given us by Capt. Abney, we shall have made a very important step.

Mr. Ranyard said: Captain Abney seems to have made an important advance in his method of measuring and comparing the density of photographs. There will be some difficulty, however, in comparing the brightness of one corona with another with the exactness that Capt. Abney hopes for. For the corona is only seen through the illuminated atmosphere, the brightness of which depends on the amount of clouds on the horizon and local circumstances outside the area of total shadow. The atmosphere is so bright that if the exposure is continued long enough the whole plate is fogged by it. It probably adds 5 or 10 per cent. to the brightness of the corona. I am glad to find that Capt. Abney's experiments corroborate the comparatively rough experiments which I described to the Society two or three years ago, showing that doubling the time of exposure is equivalent to doubling the intensity of the illumination, and that for any required density the illumination and the time of exposure are inversely proportional.

Mr. Knobel read a paper, by Mr. Isaac Roberts, entitled "Photographic Analysis of the Great Nebula in Orion." The paper was accompanied by a series of photographs showing the extension of the nebula on photographic plates with exposures of from five seconds up to three and a half hours. The longest exposures showed an immense nebulous area—three or four times greater than that photographed by Mr. Common. The structure shown is altogether different in character from that traceable in the photographs of the Andromeda nebula or the nebula in the Pleiades.

Mr. Turner read a note "On the Law of Increase in Diameter of Star Discs on Stellar Photographs with Duration of Exposure." He said that Bond, in 1858, had found that the area of the photographic star disc varied nearly directly as the time of exposure. Prof. Pritchard had in 1886 found that the star discs varied nearly as the square root of the time of exposure, and he had found, on measuring the star discs on some Greenwich photographs taken with a Dallmeyer lens, that the law of increase was intermediate between that found by Profs. Bond and Pritchard—namely, the diameter of the star disc was approximately as the cube root of the time of exposure.

Mr. Ranyard said Mr. Turner's result need not be considered as contradictory to those of Profs. Bond and Pritchard, for one would expect the law of increase to vary with different instruments, according to the accuracy with which they brought the light of a star to a point.

Mr. Plummer said that the Oxford measures of photographic star discs were put forward as only true for the instrument with which they were taken, which was a reflector. The star discs measured by Mr. Turner were taken with a refractor, which, of course, did not bring all the colours absolutely to the same focus.

The Rev. A. Freeman described a new form of equatoreal coudé, in which the observer looked up the telescope, which was fixed in a position directed to the pole of the heavens, and the light of the stars was reflected into the object-glass by means of two flat mirrors—one at an angle of 45° to the polar axis, and the other at right angles to it, and capable of being turned round the object-glass at the end of a short arm, which would permit of its being directed to any part of the heavens.

Mr. Common suggested that in the case of a reflector with its axis in the pole of the heavens, the observer might look through a hole at the centre of the first mirror, and need not move his position, as the second mirror was directed to any part of the heavens.

The following papers were taken as read:—

Papers received 1889, March 8: Prof. H. Glasenapp, "On a Graphical Method for Determining the Orbit of a Binary Star;" W. R. Brooks, "Discovery of Comet Brooks, *a*, 1889;" J. Tebbutt, "Observations of Phenomena of Jupiter's Satellites, made at Windsor, New South Wales, in the Year 1888;" J. E. Gore, "Observations of the Variable Star S (10) Sagittæ;" A. A. Rambaut, "Observations of the Planet Iris and Comparison Stars, made with the Meridian Circle at Dunsink;" F. Folie, "Preuves de la Nutation diurne; Mode d'Observation propre à la mettre en évidence en une seule Soirée;" Rev. W. J. Crofton, "Observations of Comet *f*, 1888 (Barnard), made at Stonyhurst College Observatory," Lt.-Gen. J. F. Tennant, "On the Orbit of Comet I. (Sawerthal), 1888; Lt.-Gen. J. F. Tennant, "On the Determination of Normal Places;" Radcliffe Observatory, Oxford, communicated by Mr. Stone, "Observations of Comet Barnard (1888, Sept. 2), and Comet Barnard (1888, Oct. 30);" E. J. Stone, "Note on a Red Star;" E. W. Maunder, "Spectroscopic Observations of Sundry Stars and Comets, made at the Royal Observatory, Greenwich, chiefly in the Years 1887 and 1888;" E. W. Maunder, "Note on the Spectrum of the Great Nebula in Orion."

SCIENTIFIC NEWS.

THE comet discovered by Mr. Brooks on Jan. 14 does not seem to have been re-observed—in fact, it has been looked for at the Lick Observatory without success.

The death is announced at New York of Capt. John Ericsson, who was a native of Sweden, and was born in 1803. He came to this country in 1826 to introduce his flame or caloric engine, and his locomotive, "Novelty," it will be remembered, could have run Stephenson's "Rocket" a close race for the prize offered by the directors of the Liverpool and Manchester line in 1829. The "Novelty" was withdrawn from the competition, some portions having given way; but in the early trials it eclipsed all the other locomotives. Ericsson was associated with Braithwaite in that device; but in 1837 we find him associated with Mr. F. P. Smith in the introduction of a tug fitted with a screw propeller, which towed a large ship on the Thames. Ericsson is credited with the invention of the screw propeller; but it is certain that it was invented many years previously to the trial of Smith and Ericsson's boat, and all that can be said for the distinguished Swedish engineer is that he made the screw-propeller a practical success. In 1839 Ericsson went to New York, and ever since has devoted his talents to perfecting his caloric engine, in the intervals between his inventions of the *Monitor* and the *Destroyer*. A remarkable man in many ways, he takes his position amongst the first line of engineers, and his solar engine, or sun-motor, on which he spent many years of thought and labour, may yet be developed into a machine commercially successful—at all events, in tropical countries.

The death is also announced of Dr. Johannes Brock, ex-Professor of Zoology at Dorpat, and latterly of Göttingen, where he had filled the Chair of Natural Science. He was known to the scientific world by his account of a journey to the Indian Archipelago, undertaken by the aid of the Academy of Berlin.

At the Royal Institution last week, Prof. O. J. Lodge discoursed on the oscillatory character of the well-known Leyden jar spark. Each spark is in reality not simple, but complex, and though it lasts only an inconceivably small fraction of a second, yet by a sufficiently rapid revolving mirror it can be analysed into a number of distinct oscillations analogous to the vibrations of a loaded spring or the reed of a musical instrument. If the discharge is interrupted before it is complete, the jar is found charged in a precisely opposite way to what it was at first. The fact is that the discharge has inertia, and overshoots the mark first in one direction, then in the other, precisely as happens with a swinging pendulum. After referring to the labours of Joseph Henry, of Washington, who was the experimental discoverer of the fact of oscillation in the Leyden jar discharge, to those of Helmholtz, and Sir William Thomson, Dr. Lodge explained that the oscillations had been seen after considerable labour and careful experimenting by Feddersen in Germany. They are often more than a million per second, and usually more than a hundred thousand. They can be easily got as high as a hundred million per second, and if they were made very much more frequent still they would begin to affect the eye with the sensation of light. It is this fact, as worked out by Maxwell and Herz, which invests the whole subject with such profound interest and importance. Prof. Lodge then proceeded to show how he had found it possible to make the oscillations much slower, and ultimately to bring them within the range of audition. Exhibiting these comparatively slowly oscillating sparks to the audience and analysing them in a slowly rotating mirror, they were seen spread out into a long and serrated band, having much the appearance of a singing flame similarly analysed. The lecturer next proceeded to exhibit another recently-discovered fact—namely, that the plane of polarisation of light could be easily rotated by a Leyden jar discharge, and that the restored light was oscillatory in precisely the same manner as the spark.

Mr. Eadward Muybridge, of Philadelphia, who, by arrangement with the managers of the Royal Institution, had agreed to give a discourse after Easter on "The Science of Animal Locomotion in its Relation to Design in Art"—illustrated by the zoopraxiscope—a subject of great novelty and interest, has kindly consented to deliver it on Friday evening, the 22nd inst., Dr. Edgar Crookshank being compelled through illness to defer his discourse on "Microbes" on that evening, as previously arranged.

At the meeting of the Royal Society of Edinburgh last week, Sir W. Thomson, president, announced that a Keith prize had been awarded to Mr. J. Y. Buchanan for a valuable series of communications extending over several years, and dealing with subjects connected with ocean currents, compressibility of glass, &c., which were communicated to the Society between 1885-87. A Macdougall-Brisbane prize for the period of 1884-86 had been awarded to Dr. John Murray for papers on the drainage areas of continents, the rainfall of the globe, height of land, depth of the ocean, &c.; and a Macdougall-Brisbane prize for the period of 1886-88 had been awarded to Dr. Archibald Geikie for numerous communications, especially that entitled "A History of Volcanic Action during the Tertiary Period in the British Islands," printed in the Society's *Transactions*. Sir W. Thomson then exhibited and described a gyrostatic model of a medium capable of transmitting waves of transverse vibration. The object was to show the result of elasticity in matter having no elasticity, but having quasi-elastic properties in virtue of motion, and to give the result that was wanted to aid in the struggle to explain the undulatory theory of light and electro-magnetic induction. Such a medium required a mechanism which fulfilled various conditions, and in the model which he exhibited, and which consisted of three rayed particles connected with each other by pistons moving freely in these rays, he showed there could be dilatation and two distinct distortions without rotation, and with three gyrostats rotating in each of these three-ray solids, the conditions of medium were met from two dimensions. Prof. Chrystal, discussing the model, remarked how much Sir W. Thomson had done in the way of giving practical illustration to the most abstruse problems in physics.

At a recent meeting of the Physical Society Prof. S. P. Thompson read a paper on a "New Polarimeter," in which he gave a *résumé* of the ordinary methods of determining the position of the plane of polarisation, pointing out their advantages and disadvantages, and exhibited his new polarimeter in which two black glass mirrors placed at a small angle (about 2½°) are used to polarise the light in two different planes. By using a suitable analyser, the plane can be determined to one-tenth of a degree, when the substance examined does not absorb much light, but for dark-coloured liquids Prof. Thompson prefers to use one of his "twin prisms" described before the British Association in 1887, in which the planes of polarisation are 90° apart. Mr. Glazebrook considered Poynting's glass cell, with different thicknesses of active solution, a very convenient means of obtaining two beams polarised at a small angle, as by altering the strength of the solution the angle may be varied at will. Prof. Thompson also read a note "On the Formation of a Cross in Certain Crystal Structures." Several specimens (including benzoic acid, stalactite, &c.), which exhibit a radial structure and show a cross when examined by polarised light, were thrown upon the screen, and the fact that the cross remains stationary when the specimens are rotated, demonstrated. Similar effects were produced by mica sectors arranged radially, thus showing the stationary cross to be caused by the light not being analysed in those directions.

At the meeting of the Royal Botanic Society held last Saturday, a branch of coffee thickly set with ripe fruit from a plant growing in the society's conservatory was shown at the meeting. Dr. Prior mentioned, as a curious fact, that in parts of Abyssinia the fleshy outside husk only is eaten, the part we use being thrown away as worthless.

The Croonian lecture before the Royal Society this year will be delivered by Dr. Roux, of the Pasteur Institute, on the subject of "Preventive Inoculation," founded on observations made in the institute. The date is not yet fixed; but if his health permits M. Pasteur himself will be present.

The council of the Geologists' Association have under consideration a proposal to organise an excursion during October next to the active volcanic regions of Italy. The proposal was submitted by Dr. Lavis, who is intimately acquainted with the regions in question, and who will probably be the principal leader of the party, in the event of the excursion being decided on.

The utter uselessness of a system of examination which hinders intending patentees and does not guarantee them against taking out patents which are invalid, because anticipated, is beginning to dawn on the minds of American inventors. The abolition of the present American system of granting patents is strongly talked of, and complaints against the Patent Office are very frequent. Nearly all the official malfeasances and misfeasances in the calendar are charged against the officials of the Patent-office. "Carelessness, neglect of duty, favouritism, corruption, fraud, bribery, systematic efforts to swindle, persecute, and defeat inventors in their endeavour to secure patents," are charges made by the New York *World*. Amongst others the *Scientific American* concludes an article by striking at the root of the evil—advising the abolition of the present examination system of granting patents, and letting each inventor judge for himself whether it is for his interest or not to take out a patent for his alleged invention. Here is a specimen of the way in which the work is done: it is a static induction generator, in which the glass discs have varnished surfaces, and are provided with strips of foil. Each of the discs has a central notched opening, and wooden hubs fit into these openings, and are secured by screws. There does not appear to be a single feature of any value but what has been tried and made public by Mr. Wimshurst.

An instance of going a long way round to arrive at an easily-accessible spot may be found in the following, which we quote from an American paper: An iron draw at Bridgeport (Conn.), weighing 300 tons, attached to the new bridge over the Pequonnock River, will be turned by electricity, and is believed to be the first of the kind in the country. To move the draw in the ordinary way requires the muscle of from two to five men, according to circumstances, and as it must be opened an average of 20 times daily throughout the year, the labour is great as well as expensive. The city authorities, with a view to lessen both, have introduced an electric motor of 7½H.P. power, the force being transmitted from the Bridgeport electric light plant half a mile away. This motor makes 1,600 revolutions each minute, and by the use of gearing the number is reduced, producing a power both steady and sure. The motor may be reversed, so as to turn the draw either way.

The paper read recently before the Royal Society, by Prof. S. P. Thompson, is an important contribution to electrical knowledge. It is entitled "On the Magnetic Action of Displacement Currents in a Dielectric," and describes apparatus by which induction currents can be received and rendered audible in a telephone. Prof. Thompson thinks the device may be regarded as a kind of "proof plane" for exploring varying electro-static fields, and is probably capable of being used for the investigation of specific inductive capacities.

The *Journal* of the Society of Arts for last week contains an illustrated report of Prof. S. P. Thompson's paper on "Arc Lamps and their Mechanism," which will be valued by all who have to deal with those appliances.

The Royal Meteorological Society's tenth annual exhibition of instruments will be held at the Institution of Civil Engineers, 25, Great George-street, Westminster, in conjunction with the society's meeting, on Wednesday, the 20th inst., and will be very interesting and instructive. The exhibition is specially devoted to actinometers and solar radiation apparatus. It will also include several new instruments, and a number of photographs of flashes of lightning, clouds, &c. The exhibition will remain open till Friday, the 22nd inst. Persons, not Fellows, wishing to visit the exhibition can obtain tickets on application to Mr. W. Marriott, Royal Meteorological Society, 30, Great George-street, S.W.

The tramway line of the Séries Electrical Traction Syndicate, Limited, which has been just completed at Northfleet and Gravesend, has been built to show the practicability of running electrical tramcars in series with each other, a method which obviates the difficulties of the parallel distribution method.

The Mekarski compressed-air motor for street tramways is being taken up by American capitalists for introduction into the United States. The car has been modified in some details to suit the supposed exigencies of American practice, and as now arranged the air reservoirs under the car store 70c.ft. of air, compressed to 600lb. per square inch.

Among the improvements lately introduced on the London, Chatham, and Dover Railway for the convenience of passengers are some commodious carriages, fitted with lavatories, and divided into five compartments, the two end ones containing ordinary first-class accommodation; the central compartment is divided into two very complete lavatories, divided by a diagonal partition, and communicating each with a small saloon accommodating five passengers.

A laboratory mainly for the bacteriological study of milk is about to be established in Berlin, at the suggestion of Dr. Hueppe, of Wiesbaden, who has investigated the subject for years, and has definitely proved that lactic-acid fermentation is caused by a special fungus, and butyric-acid fermentation by another. Prazmowski, Liborius, Fuchs, and Neelsen have discovered other bacteria in milk, and their purely scientific researches, undertaken solely with a view to widening the limits of bacteriology, are now bearing valuable practical fruit. It is known that infant mortality is due largely to unwholesome milk, which can now be rendered harmless by sterilisation.

At a recent meeting of the Paris Academy of Medicine, Dr. Dujardin-Beaumetz exhibited a new alimentary substance, which he names Fromentine. It is obtained from wheat by the aid of special millstones, and is really the embryo of the wheat reduced to flour. It contains three times more nitrogenous substance than meat, and a large proportion of sugar. It is thought that it may advantageously replace powdered meat as a concentrated food. It may be employed for making soups, and even for making biscuits.

An international anthropometric laboratory on Mr. Galton's plan will be established in connection with the Paris Exposition. The congresses on anthropology will be held in August.

A prehistoric station has been discovered on the banks of the Vezère, opposite that of the Langerie, by M. E. Rivière. It is of the Quaternary period, and M. Rivière has already collected cut stones and instruments of bone amongst the remains of reindeer and birds.

The Prudential Assurance Company.—From the fortieth annual report of the Prudential Assurance Company, it appears that in the ordinary branch the number of policies issued during the year 1888 was 42,475, assuring the sum of £4,399,769, and producing a new annual premium income of £235,487. The premiums received during the year amounted to £718,848, or £183,717 more than in 1887. The claims amounted to £210,056, and there were 146,966 policies in force. Turning to the industrial branch, we find that £3,256,346 was received in premiums—an increase of £197,845. The deaths numbered 142,751, and the claims reached £1,231,186. A saving of 1¼ per cent. was made in the expenses for the year, as compared with those of the previous year. The assets of the company were raised from £7,867,103 to £9,302,007, being an increase of £1,434,904 on the year. The efforts of the directors to promote the stability of the industrial policies have succeeded, as is shown by the fact that, notwithstanding the enormous increase in this branch during the past two years, the average duration of the 8,063,293 policies in force at the end of the year is no less than six years.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions o our correspondents. The Editor respectfully requests that al communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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NEPTUNE AND SATURN.

[29707.]—JE vois avec grand plaisir dans "l'E.M." les communications au sujet de Neptune, des satellites de Saturne, &c. . . . Il est intéressant, pour les amateurs, de pouvoir comparer la puissance de leurs télescopes, de savoir ce qu'on voit avec un objectif donné. C'est pourquoi je vous écrit ces quelques mots dans l'espoir de voir continuer de pareilles correspondances. Avec mon huit pouces, réfracteur, de Grubb, Neptune se montré comme un petit disque très-net avec les gross. de 150 et 250 fois; mais je n'ai pas réussi encore à le voir nettement avec des gross. plus forts; ceux-ci le montrent cependant très différent d'une étoile. Quant à Encelade et Mimas, je puis en dire exactement ce qu'en dit "Amateur, F.R.A.S.," lettre 29683. Je vois Encelade très bien, assez souvent, mais ce n'est pas un objêt facile; quant à Mimas, je n'ose encore rien affirmer.

Louvain, 9 Mars, 1889. **Dr. F. Terby.**

ASTRONOMY, AND THE "ENGLISH MECHANIC."

[29708.]—I HAVE been waiting to see whether any notice would be taken of the remarks made by Mr. Mee on p. 398 (Jan. 11) about the "growing tendency to desert," &c. It should not be forgotten that the Liverpool Astronomical Society is a society which to a certain extent came into existence through the ENGLISH MECHANIC, and to a certain extent also it encourages the study of astronomy. All its members are presumably acquainted in some degree with astronomy, and join the society because they are interested in the study of celestial science. The work of the society, and that of the ENGLISH MECHANIC, seems to me to lie on different lines, for the circulation of the "E. M." is world-wide, and it introduces astronomy to the notice of those who possibly know nothing about it, but may be induced to take it up by reading what they do in these pages. I do not think there is any tendency, as Mr. Mee suggests, to "desert our old friend for the pages of the *Journal* of the L.A.S."; but if there is, that is not the way to promote the study of astronomy. Those who join the L.A.S. do not want telling about the wonders of the heavens; they presumably are acquainted with astronomy; but if it is desired to spread a knowledge of that sublime science, we must appeal to those who know nothing about it, and that cannot be better done than in the pages of the ENGLISH MECHANIC, which is read, I verily believe, by many thoughtful men in all parts of the world. After making these comments, I must also say that I cannot admit that astronomy has been neglected in our "old friend."

Mimas.

A MODEL LOCOMOTIVE.

[29709.]—SEEING "J. G.'s" letter (29695) respecting the above, we suggest that "J. G." make, in a proper manner, a complete set of patterns for a loco., the size now being described in "Ours" by "J. H."; then, perhaps, he would alter his opinion about the "regular trade" price being "monstrous."

Nevertheless, we think his suggestion worthy of notice, and shall (if agreeable to "J. H.") be willing to take the matter up, and supply the sets as cheap as possible.

It seems to us rather bold on his part to say that "the engine might be well made in twelve months." One of our customers has been over eight years (in his spare time) making a model loco. and tender.

Whether the loco. now being described by "J. H." is to be such an elaborate affair as this remains to be seen.

Butler Bros., Engineering Modellers.
Bentham-road, South Hackney, London,
March 11.

THE LATE MR. JOHN ERICSSON.

[29710.]—No more remarkable figure will be found in the history of mechanical invention than that of the subject of this notice, whose death occurred at New York on Thursday, the 7th inst.

Born in Sweden in 1803, Ericsson, after a precocious boyhood, had rapidly reached the rank of lieutenant in the Swedish army, his beautifully-executed military maps having attracted the notice of King Bernadotte. At the age of 22, having invented a "flame engine," the parent of his "caloric" motor system, the youthful officer obtained leave to visit England in 1823; but he never returned to his native country. This was the year in which another celebrated engineer, Mr. C. B. Vignoles (whose forthcoming biography will contain many references to Ericsson) had returned from the United States, these two pioneers in engineering science becoming acquainted through the intervention of Mr. John Braithwaite. This was not long before the birth of railways, for the practical success of which some sort of "locomotive" engine was indispensable. Ericsson soon heard of the competition that had been invited by the directors of the Liverpool and Manchester Railway, and at once determined on contriving a machine to be worked by caloric action, from which idea, in an incredibly short time, sprang the famous "Novelty." The inventor was hardly pressed for funds, which were to a large extent advanced to him by his friend Vignoles, who, in fact, was a third patentee in the ingenious invention of Ericsson, which, as might be expected, had no pecuniary success. The full particulars of the trial will (we understand) be given in Mr. C. B. Vignoles' biography. Ericsson, nothing daunted, constructed two more locomotives, the "King William the Fourth" and the "Queen Adelaide," which were an advance on the "Novelty," though not yet equal to G. Stephenson's improved engine in tractive power; but they were the earliest locomotives in which the link for reversing the engine was introduced. Ericsson was also the first to use superheated steam, which had an experimental trial in an engine on a boat in the Regent's Canal.

In 1839, Ericsson went to the United States of America, which has ever since been his home. Here for half a century his unwearied and fertile genius has had full play. He had invented the "screw propeller" in 1837, which the British Lords of the Admiralty rejected, because "its motive power being in the stern, it was impossible that it should be steered." But the success of the *Princeton*, in American waters in 1841, was the best answer to this; and for the next twenty years the gifted designer worked on till the triumph of his crowning achievement in the world-famed *Monitor*, built in a hundred days, which defeated the *Merrimac* in March 1862, and turned the current of naval victory in the civil war. From that time to the present Ericsson's work has never ceased nor his invention flagged. The complete catalogue of his mechanical contrivances and improvements fills a volume of several hundred pages; an enormous display of his machines being exhibited in the Centennial Exhibition, at Philadelphia, in 1877. But since that, up almost to the day of his death, Ericsson's brain has teemed with inventions: designs for new or better "caloric" engines, applied impartially in every direction, from marine, stationary, and domestic engines to sewing-machines, being continually worked out at his New York factories, following one another with bewildering rapidity. The latest form his constructive genius has taken was in perfecting the various "solar-engines," which he has devised from time to time, among them being actinometers to measure solar radiation, calorimeters for its dynamic agency, and others to utilise the wasted sunshine which falls upon the earth. On this point we quote his own words: "More than twenty-two millions of solar engines of 100H.P. each could be kept at work, nine hours a day, utilising the heat now wasted along the water fronts of some only of the sun-burnt regions of the earth." These ideas may possibly turn out to be more visionary than others of unquestionable value, as his "screw-propeller" and his *Monitor* type of war vessels, which the late Mr. Scott-Russell characterised as "a creation peculiarly American and altogether original."

The remark attributed to Mr. Boulton, the partner of Watt, made to Boswell on his visit to the famous "Soho" works in 1784, may be applied with an increased intensity—measured by the century that has intervened—to the gigantic results of Ericsson's brains and operations: "I sell here, sir, what all the world desires to have—power!"

Mr. Ericsson (or Captain, as he is called in New York) was in almost perfect health up to a few days ago. His last letter, we believe, to an English friend, dated 11th January, 1889, shows his handwriting as clear, legible, and careful as in those now before us, written in 1829 and 1830. They are symbolic of a rare constitutional strength and vigour retained to an advanced age; his eye undimmed, and his natural strength unabated.

O. J. V.

RILLS NEAR CAUCHY.

[29711.]—On March 6, about 7h., the rills near Cauchy were well seen with a 3¾ Wray, 220 e.p. The southern rill, near the terminator, appeared to have a very marked depression on its S. side, which became less towards Cauchy; close beyond which it divided, and the two branches curved towards the S., on which side were three detached hills.

The northern rill was less conspicuous; S. of it there seemed two depressions, N.E. of Cauchy. S.W. of Cauchy was a mound, opposite a gap in a long mountainous ridge. N.W. of Cauchy was a crater, connected with a mountain and semicircular ridge, also a crater near the terminator.

A little later the five satellites of Saturn were much easier than usual. Star discs were small, and it seemed as if a small star was visible just clear of the flare of Sirius, at about 20°. It did not appear to be part of a broken ring.

Reading. **G. T. Davis.**

ANHYDROUS ANALYSIS. III.—THERMOCHROMATICS.

[29712.]—Plattner, in his celebrated "Blowpipe Tables," says that "gold oxide, in borax and salt of phosphorus, before the blowpipe, is reduced to metal without dissolving." This statement, which I had been poring over some ten years previously, stimulated my youthful (in the study of this science) ambition, in India in 1869, to find some reagent in which gold *would* dissolve before the blowpipe.

I argued to myself that the chemist does not commence his solutions of substances in the best way—with *salts*—such as borax and microcosmic salt, but with *pure acids*. If instead of beginning to attack his *corpora vilia* with aqueous solutions of nitric or hydrochloric acid, he were to persist in using a solution of sodium nitrate or of common salt, should we not be able to justly apply to him the opprobrious epithets of the old German chemist Becher ("Physica Subterranea," lib. V. cap. III.), when writing in favour of alchemy in 1670:—"Asinus est, stultus, et nebulo, qui illam practicè exponit"? Yet if, as the term "Blowpipe *Analysis*" certainly implies, the pyrologist, like the chemist, pretends, or (to be more polite) proposes, to effect the *separation* of the oxides, &c., he is examining, his persistent use of fused sodium borate (2NaBO$_2$ + B$_2$O$_3$ or Na$_2$B$_4$O$_7$), or of fused microcosmic salt (NaPO$_3$), when the constituent acids are at his service, surely renders him liable, in the coarse language of the old Teutonic alchemist, to be called (chemically) "an ass, or a fool, or a blockhead?"

I determined, therefore, at Simla, in India, in 1869, to try the effect of using, as blowpipe reagents, pure fused boric acid, of which I had brought a small quantity with me in the case of blowpipe apparatus I had purchased at Freiberg in 1867; and, fortunately, I was able to procure what I thought pure phosphoric acid (but I found afterwards it contained about 10 per cent. of soda: it acts as a powerful acid before the blowpipe), in the shape of "glacial phosphoric acid," at the principal druggist's shop in Simla, where they used it for making what they called "chemical food."

I began by attempting to dissolve the most easily soluble and highest colouring oxide I could think of—namely, that of cobalt—in my pure fused boric acid; but found that, so far from dissolving, as Sir Henry Roscoe and the other chemists taught (for twenty years afterwards), the CoO only formed little black sphericles, which floated about in the bead as pyroborates, giving it no colour whatever. Disgusted with this failure (for I did not at first see the importance of the reaction I had been so fortunate as to be the first to obtain), I next tried my "glacial phosphoric acid" with the same substance (CoO), and I shall never forget the delight with which I manufactured, without the least difficulty, a "magnificent red-violet bead, like a combination of ruby and amethyst" (*vide* my notebook of the time). With a very minute proportion—a mere trace—of CoO, the phosphoric bead remained a bright pink colour; but in both cases it was deep blue while hot, gradually changing, as it cooled, to blue-violet, and then red-violet or pink when cold, according to the proportion of cobalt. Two obvious observations were to be drawn from this new experiment:—1. As the hydrated salts of cobalt are pink, and the anhydrous blue, it was evident that the hot bead in cooling must *chemically* absorb atmospheric moisture from the air in certain proportion; after which the bead deliquesced from the same source, until, in a few hours, it became a little pool of red-violet water. 2. As the microcosmic-salt bead (NaPO$_3$) + CoO *remains* blue when cold, it is evidently the additional soda, or alkaline predominance in the bead, which produces this effect; and (this last seemed to me a *very* curious point, well worthy of attention) the soda thus seemed to have the same ultimate effect upon the *mechanical* or physical constitution of the cobaltine bead, as the application of intense (blowpipe) heat had to it temporarily; both causing it to assume a deep-blue colour. I say "mechanical constitution" because the additional soda having completely altered its *chemical* constitution, it is evidently the former alternative to which we must look for an explanation.

This reflection, coupled with the observation above mentioned—viz., that the red-violet (or phosphoric) bead in cooling, changed from blue, hot, *through* blue-violet, to red-violet, cold—that is, changed in the chromatic order of the solar spectrum, from blue to violet, led me to believe that the *texture*, so to speak, of the phosphoric bead had been precisely similarly altered by the application of heat in one instance, and by the chemical combination with its molecules, of molecules of sodium and oxygen in another. But the effect of heat application to almost all substances is to expand them, or rather the pores or minute circumjacent spaces of their molecules; and it seemed to me, therefore, exceedingly probable that this temporary pore-enlargement would temporarily admit the undulations of rays of higher refrangibility, as red, yellow, green, blue, &c.; excluding those in the prismatic order, as the hot bead cooled and its pores contracted, until the vibrations of violet only (the normal colour of cobalt hydrate) were admitted. The great English discoverer, or rather elucidator of the undulatory theory of light—Dr. Young—says (Lect. xxxix. "On the Nature of Light and Colours"): "From a comparison of various experiments, it appears that the breadth of the undulations constituting the extreme red light must be supposed to be, in air, about 1-36000th of an inch, and those of the extreme violet about 1-60000th." It seemed natural, therefore, to suppose that the molecular pores of this cobaltine bead had been expanded by heat just sufficiently to admit the blue undulations (a little more than half-way between the two extremes above-mentioned by Dr. Young), and to have gradually excluded in cooling and contracting first the blue and then the blue-violet undulations, until they remained, when the bead was cold, of just sufficient breadth to admit those of the red-violet.

If this hypothesis of mine were true, it evidently led to at least one most important conclusion—namely, that the heat-expanded molecular pores of the *acid* cobaltine-bead, being of precisely the same undulatory breadth as those of the cold (or normal) *alkaline* bead, *the atoms of which those molecules are composed must be larger in the case of acid-forming elements* (or, at all events, in the case of phosphorus) *than in the case of the alkaline metals* sodium, potassium, and lithium, which all have the effect of bluing the acid cobaltine bead. The fact that the combining weights of the latter, especially of lithium, are, as a rule, lower than those of the other so-called "elements," seems to confirm this hypothesis.

I now thought it time to attempt the solution of *gold* (which has led me to try other than the old blowpipe reagents then in use more than 100 years) in my new flux, and taking up a minute portion of pure gold leaf on a red-hot bead of glacial phosphoric acid, succeeded after a few minutes with my mouth blowpipe (for I possessed no other at that time) to my intense delight, in obtaining, as a beautiful blue-violet bead for the first time in the history of blowpipe analysis, *a pyrological solution of gold*, on the 30th June, 1869. Well do I remember putting my auro-phosphatic, blue-violet bead carefully into a bottle, and it was well I did so, for it was not until several days after, and many trials, that I succeeded in obtaining another similar bead. The fact is, as in the case of the trials with boric acid, I was misled by the account I found in chemical and other books, which taught that the violet powder obtained by volatilising gold in the electric arc and by other intense heat (which I afterwards produced with the mouth blowpipe on aluminium plate) was nothing but metallic gold in a minute state of division. I therefore kept my auro-phosphatic bead when working, after the first successful experiment, in a perpetual state of reduction with the "H.P." of the blowpipe, and, consequently, obtained constantly a bluish "dirty" brown, and exceeding dim, bead only: when I kept the bead in a state of peroxidation with the blowpipe, or "P.P.," I got only a beautifully transparent and highly refractive, but perfectly colourless, bead. After innumerable trials and many days' work, I found the only way to produce the blue-violet colour, was to keep the bead *exactly* ½in. from the point of the blowpipe pyrocone, or in a considerable, but not the highest, state of peroxidation. Afterwards, when I had produced a purple powder by subliming pure gold with pure lead before the blowpipe on aluminium plate, I succeeded quite easily in reducing some of this powder, dissolved in a bead of glacial phosphoric acid, to metallic gold by "H.P.," and then in oxidising it to a purple bead by a ½in. "P.P." backwards and forwards, several times in succession, so that there could be no reasonable doubt that the purple colour was due to an *oxide* of gold, and *not* to metallic gold in a state of fine subdivision, as all the chemists stated.

But I found that my purple auro-phosphatic bead proceeded, in cooling, right through the colours of the solar spectrum, from those of highest refrangibility, or greatest undulatory breadth, as red and orange, through yellow, green, blue, &c., down to the colour of almost lowest refrangibility or least undulatory breadth—violet—for it stopped at blue-violet when quite cold. **W. A. Ross.**

GOLD: ITS EXTRACTION.

[29713.]—Permit me to add to the remarks which, on a previous occasion, I have made in your journal upon this subject. In your issue of December 14, 1888, p. 310, you give a short notice of Dr Crookes's method of treating auriferous ores. Those interested in this subject must be disappointed with the result, after all they were led to expect from notices in the papers concerning this new process, which, after all, is only a modification of "chlorination."

The chemical treatment of gold and other ores has always fascinated the metallurgist whilst in the laboratory; but in few instances only has he ever seen accomplished, on a practically commercial scale, the processes which he may have thus devised. A man of science pure and simple rarely possesses those business attributes which insure the successful carrying out, on a large scale, of processes, the correct theory of which has been abundantly proved. One of the most remarkable instances of success has been Claudet's iodide of zinc process for obtaining the silver from copper; or, again, in the cupellation of silver from lead on a large scale; in another branch of chemistry, the wonderful exactness of the aniline process is another instance.

In discussing this question from an almost purely quantitative chemical point of view, I have said, upon a previous occasion, that "mercury must be done away with." But before doing away with mercurial amalgamation, this question must be considered in other aspects besides those which are chemical and quantitative. In South Africa chlorination and all its attendant advantages cannot be made to pay so well as the mercurial process.

Experiments made in England upon or from this district show a net extraction result of 88 per cent. by chlorination. At the works here we are able to extract by mercurial process alone 70 per cent. of the gold. With regard to cost:

Chlorination.—Each ton of ore or concentrates treated requires a certain quantity of several chemical reagents—bleach, hydrochloric acid, manganese dioxide, &c.—according to the special process employed. Not counting first cost, nor freight to South African ports, each cwt. of chemicals will cost 15s. to 20s., to be transported from the coast to these fields (Witwatersrand included), add to this a very heavy duty to Cape or Transvaal Government, freight, agent's dues, &c., &c. Again, many of the ores require roasting, even if not to split up sulphides, &c., to disintegrate quartz; then fuel has to be considered. In this part of the world very indifferent fuel costs 30s. a load of about two tons. At the Rond there appears to be plenty of coal. Then come the numerous other expenses. A practical chemist and assayer must always be at hand during working shifts to attend to the chlorination barrels, tubs, or vats; the machinery used for producing the necessary amount of pressure will require special supervision night and day, &c. From the most careful calculations we have estimated in this district that chlorination would cost from £6 to £8 per ton of stuff treated, if not more, and the best result has been 88 per cent. of the assay value.

Mercurial.—By using plates, blanket tables, concentrating buddles, Californian pans, we save an average of 70 per cent. of the gold shown to be present by fire assay. By treating blanketings alone in the Californian pans we have had results as high as 90 per cent. in smelted bar gold. The whole of the milling and panning expenses are well within 20s. per ton of ore treated, really much less, for that figure more than includes breakdowns, renewals, loss of time, &c.

Comparative Table.

Process.	Value of ore in dwts per ton.	Wins.	Cost per ton.	Profit.
Chlorination.	80 dwts.	88p.c.	160s.	£5 19 0*
Mercurial ..	80 ,,	70p.c.	20s.	10 14 0*

* This is reckoning 1dwt. as worth 4s. sterling.

In the above table I have carefully considered the concentrating required by the chlorination and pan process; and even taking the total gold extracted at 50 per cent. by the mercurial process there is still a profit of 21s. more than by chlorination.

Now, with regard to Dr. Crookes's commercia perchloride of iron process, allow me to say that, beside the preliminary crushing and roasting, heat is required to render the chemical action complete, and this heat means additional fuel. Again, although the theoretical exposition of the process leaves nothing to be desired, I am inclined to doubt the practicability of trusting too much to the extra atom of chlorine "left available to attack the gold." It is well known that nitrate of soda or peroxide of manganese will upset the equilibrium of iron (Fe_2Cl_6); but perchloride of iron is in itself a most unstable compound. The variation in its composition is well known. I believe that the commercial salt is sometimes used as a disinfectant, being able, by means of the aforesaid available atom of chlorine to liberate oxygen from water, taking the hydrogen to itself to form hydrochloric acid—the oxygen being the agent which changes the bad matter into harmless oxides; but I should think that it was used only upon such occasions as when nothing better could be obtained. I fear the process is too delicate for big work—it will, as they say out here, require "too much watching"; and to anyone who knows the fearful drawbacks there are to gold-mining in South Africa this will be a fatal objection. Of this I desire to speak presently. The process of Dr. Crookes's reads as if the gold mine were somewhere in the Newcastle-on-Tyne district, with a professor of chemistry and staff always at hand, and a vast chemical works in the immediate neighbourhood.

I would point out that, if the ores are not roasted thoroughly "sweet" (i.e., until all sulphides, arsenides, &c., are turned into oxides), the amount of perchloride required would be very great for treating such half-roasted ores in bulk. With ordinary chlorination this difficulty can be met by turning on more gas and using greater pressure, and is not attended with so much extra expense, because the reagents are comparatively cheaper. Experienced "roasters," or furnace men, assert that many ores require the most terrific roasting before they will give up their sulphur, &c. Terrific roasting is not desirable, because, in the case of arsenical ores, gold, when heated to redness and above that point, will take up arsenic vapour (arsensious acid, As_2O_3); and besides being rendered very brittle will amalgamate with great difficulty. In roasting ores containing sulphides, at a low heat, the free gold becomes coated with sulphur, rendering amalgamation impossible and greatly increasing the quantity of chlorine required. If the quartz be roasted at a great heat various complications arise which defy the attacks of free chlorine. The oxide formed acts as a flux, holding the gold in the form of most minute globules. FeS is also formed, which takes up gold, rendering its amalgamation impossible. It can be understood that whenever roasting *forms* sulphides the Fe_2Cl_6 process would hardly be economical.

I have no reason to think lightly of Dr. Crookes's modification of the chlorine process; but it must be confessed that everything cannot have been considered. When people can make a profit by the mercurial process, they will not forsake it to obtain more gold with a *less net* profit. Gold mining companies have little admiration for genius in any form; they look for dividends, and the best means to secure them, be it by chlorination, mercurial, perchloride of iron, or any other process. It may happen that Colonial intelligence will some day be cultivated up to the level of these chemical processes, and that the Legislative Assemblies and Volkraads will lessen the duties on chemicals and decrease railway tariffs accordingly; yet to those who know anything of the political relations between the colonies and republics, it must be a firm conviction that so long as duties and tariffs can be made into political platforms, so long shall we have to endure these grievances in spite of science. Our railways were made to gratify the whims of statesmen (!), and so it is with everything else. Again, how can men, who cannot even grasp ordinary mercurial plate work, be expected to enter into the intricacies and details of a process which requires a competent chemist to watch over it? Many of the managers and their assistants at Witwatersrand, for instance, never saw a mine nor a mill before in their lives. They are mostly fresh from behind store counters, helped up the ladder by influential friends who are directors, and absolutely without experience.

Here is a typical case. A syndicate hired the use of a mill and the services of the amalgamator and his staff for the purposes of carrying out a trial crushing. The crushing was worked at night and day. The amalgamator was one of those men who are fond of what is called out here "a whisky evening," and upon one occasion while he and his assistants were away indulging, the pump supplying water to the battery boxes broke down. The Kaffirs feeding the battery not noticing anything amiss, went on with their work, and when the amalgamator returned *some hours afterwards* (the plates having been entirely neglected in the mean time), the screws were found to be broken, and the ore piled up on the plates, &c., &c. The ore was removed from the plates in such a way that the plates were scoured. The trial crushing was not a success; the mine it represented condemned; but very few know anything about that pump accident and the whisky evenings, which are a regular thing. I have, nor had, no interest in this affair: I merely relate it that you may judge what such men would make of a high-pressure chlorination plant.

This much can be said with safety: "That the old processes, carefully worked, will hold their own for years against all chemical (pure and simple) processes." In spite of the genius of inventors, nothing has superseded the old gravitation stamp mill, *because it is simple;* and that is the main thing to be considered in work of this sort. This may appear like bigotry and prejudice. I am prejudiced in so far as this: that I believe that the fittest process will survive. The mercurial process has survived all raids on its fitness time after time; yet I do not doubt but that it will succumb in the end, but not for many years, as far as we are concerned, do what we will.

I have devoted many years of my life to chemistry professionally, and I well remember (for the remembrance is often forced upon me) the words of my old master, an eminent chemist now dead: "Have lots of ideas; think and work them out thoroughly, and reject them at once if false (though it is often difficult to do this); and if ever you should think out something likely to benefit mankind, learn the trade to which you wish to apply your invention; seek and work out all its intricacies, go over old processes, and make a balance-sheet, and if it is decidedly in your favour, think about a big experiment; and if *that* succeed, get to work with 'bricks and mortar.'" The remark was meant as a rebuke at the time on account of some high-flown, youthful idea which was to revolutionise everything. I made a note of it, and it has been of great use to me since. Many things are brilliant successes in the laboratory, as many of us know to our cost; but when they are called upon to stand on their merit of usefulness to mankind, how often is the test their downfall!

Chlorination should pay well in the United Kingdom and on the Continent, and we look not without hope of some chance for it here in the future,

V. I. A., F.I.C., F.C.S., C.E., &c.

Pilgrim's Rest, Jan. 28.

THE HELM WIND.

[29714.]—Having witnessed this local phenomenon (see p. 8) in two opposite parts of the world, I can bear witness to its destructive effects on horticulture in N. England and the anchorage of ships in Table Bay, besides which, the S. African blast is loaded with chromate of iron, penetrating European wearing apparel, and obscuring the sun in red dust.

Eos.

The following is extracted from a lecture before the Penrith Literary and Scientific Society:—

At the request of the Council of the Royal Meteorological Society, I visited the district on August 19th to 21st, 1885, in company with Mr. T. G. Benn, F.R.Met.Soc. We made the ascent of Crossfell, drove through most of the villages between the mountain and the river Eden, and also went over Hartside Fell to Alston on the eastern side of Crossfell. By this means we gathered a great deal of general information, but nothing very precise as to what persons had *actually* seen or experienced. We came to the conclusion that if we were ever to get at the cause of the helm wind, it would be necessary to have observations made on a systematic plan. The lecturer proceeded to describe his ascent of Crossfell on Aug. 19th, 1886, when he was accompanied by Mr. Benn, Mr. R. W. Crosby, and a nephew of the latter. The ascent was made in the afternoon; and the temperature at Kirkland, from where they started, was 65°, which gradually decreased until the top was reached, when the thermometer stood at 46°. On their arrival at the top, they had only had time to look around when a helm wind was turned on for their special edification. A sudden fall in temperature was the first indication of the formation of the helm. The misty cloud soon covered the top of the fell, and the wind increased in force as they descended. At night, the helm bar was suspended above Melmerby, Ousby, Kirkland, and Milburn. The bar was in two parts, with a decided clear space between them. These two parts appeared like huge spheres of cloud, decreasing in size as they got away from the centre. This was the appearance of the bar from the top of the fell, which is very unlike what is seen of the phenomenon in Penrith. Although the bar appeared to be about stationary it was evident there was a deal of commotion in the clouds, portions of their upper and lower surface being whirled about in all manner of ways. Just before reaching Kirkland on their return they found the wind suddenly cease and the air become warmer. Mr. Benn returned fifty yards and found the wind blowing quite strong. The helm bar was then directly overhead, which showed there was an upward current. Mr. Crosby, who descended in another direction—by Fellfoot and Milburn—observed the same peculiarities. The observations sent in had been examined by the lecturer, and, with the aid of the reports from their correspondents in the north of England and south of Scotland, he had prepared small charts on which were marked the direction of the wind, the temperature of the air, and the amount of cloud at each station on that area, on the days when the helm wind was reported. From these charts it was at once observed that the helm wind occurred when the general direction of the wind was east or north-east, although it occasionally occurred when the wind was from the south or south-east. The lecturer stated that the phenomenon was not peculiar to Cross Fell, but occurred in other parts of the world where the conditions were similar. To prove this, the following extract was read to the audience:—"That the mere self-expansion of the ascending air is sufficient to cause precipitation of some of its vapour, when abundant, is rendered matter of ocular demonstration in the very striking phenomenon so common at the Cape of Good Hope, where the south or south-easterly wind which sweeps over the Southern Ocean, impinging on the long range of rocks which terminate in the Table Mountains, is thrown up by them, makes a clear sweep over the flat table land which forms the summit of that mountain (about 3,850ft. high), and then plunges down with the violence of a cataract, clinging close to the mural precipices that form a kind of background to Cape Town, which it fills with dust and uproar. A perfectly cloudless sky meanwhile prevails over the town, the sea, and the level country; but the mountain is covered with a dense white cloud, reaching to no great height above its summit, and quite level, which, though evidently swept along by the wind, and hurried furiously over the edge of the precipice, dissolves and completely disappears on a definite level, suggesting the idea (whence it derives its name) of a 'Table-cloth.' Occasionally, when the wind is very violent, a ripple is formed on the aerial current, which, by a sort of rebound in the hollow of the amphitheatre in which Cape Town stands, is again thrown up, just over the edge of the sea, vertically over the jetty, where we have stood for hours watching a small white patch of cloud in the zenith, a few acres in extent, in violent internal agitation (from the hurricane of wind blowing through it), yet immovable, as if fixed by small spell, the material ever changing, the form and aspect unvarying. The Table-cloth is formed also at the commencement of a 'north-wester,' but its fringes then descend on the opposite side of the mountain, which is no less precipitous." (Sir J. F. W. Herschel.)

Sir Samuel Baker, in his book entitled "Eight Years in Ceylon," says:—

"From June to November, the south-west monsoon brings wind and mist across the Newera Ellia mountains. Clouds of white fog boil up from the Dimboola valley, like the steam from a huge cauldron, and invade the Newera Ellia plain through the gaps in the mountains to the westward. The wind howls over the high ridges, cutting the jungle with its keen edge, so that it remains as stunted brushwood, and the opaque screen of driving fog and drizzling rain is so dense, that one feels convinced there is no sun visible within at least 100 miles. There is a curious phenomenon, however, in this locality. When the weather described prevails at Newera Ellia, there is actually not one drop of rain within four miles of my house in the direction of Badulla. Dusty roads, a cloudless sky, and dazzling sunshine astonish the thoroughly-soaked traveller, who rides out of the rain and mist into a genial climate, as though he passed through a curtain. The wet weather terminates at a mountain called Hackgalla (or more properly, Yakkadagalla, or Iron Rock). This bold rock, whose summit is about 6,600ft. above the sea, breasts the driving wind, and seems to command the storm. The rushing clouds halt in their mad course upon its crest, and curl in sudden impotence round the craggy summits. The deep ravine formed by an opposite mountain is filled with the vanquished mist, which sinks powerless in its dark gorge; and the bright sun, shining from the east, spreads a perpetual rainbow upon the gauze-like cloud of fog which settles in the deep hollow. This is exceedingly beautiful. The perfect circle of the rainbow stands like a fairy spell in the giddy depth of the hollow, and seems to forbid the advance of the monsoon. All before is bright and cloudless; the panorama of the Ouva country spreads before the eye for many miles beneath the feet. All behind is dark and stormy; the wind is howling, the forests are groaning, the rain is pelting upon the hills. The change appears impossible; but there it is, ever the same, season after season, year after year, the rugged top of Hackgalla struggles with the storms, and ever victorious the cliffs smile in the sunshine on the eastern side; the rainbow reappears with the monsoon, and its vivid circle remains like the guardian spirit of the valley. It is impossible to do justice to the extraordinary appearance of this scene by description. The panoramic view in itself is celebrated; but as the point in the road is reached where the termination of the monsoon dissolves the cloud and rain into a thin veil of mist, the panorama seen through the gauze-like atmosphere has the exact appearance of a dissolving view; the depth, height, and distance of every object, all great in reality, are magnified by the dim and unnatural appearance; and by a few steps onward the veil gradually fades away, and the distant prospect lies before the eye with a glassy clearness made doubly striking by the sudden contrast. The road winds along about midway up the mountain, bounded on the right by the towering cliffs and sloping forest of

Hackgalla, and on the left by the almost precipitous descent of nearly 1,000ft., the sides of which are clothed by alternate forest and waving grass. At the bottom flows a torrent whose roar ascending from the hidden depth increases the gloomy mystery of the scene. On the north, east, and south-east of Newera Ellia the sunshine is perpetual during the reign of the misty atmosphere, which the south-west monsoon drives upon the western side of the mountains. Thus there is always an escape open from the wet season at Newera Ellia, by a short walk of three or four miles. A long line of dark cloud is then seen, terminated by a bright blue sky. So abrupt is the line, and the cessation of the rain, that it is difficult to imagine how the moisture is absorbed. This sudden termination of the cloud-capped mountain gives rise to a violent wind in the sunny valleys and bare hills beneath. The chilled air of Newera Ellia pours down into the sun-warmed atmosphere below, and creates a gale that sweeps across the grassy hill-tops with great force, giving the sturdy rhododendrons an inclination to the north-east, which clearly marks the steadiness of the monsoon."

BALLOONING.

[29715.]—ALTHOUGH one of the early subscribers to your paper, it is not often of late years that I have had an opportunity of seeing your interesting paper. I have one now before me, lent by a friend, dated July, 1888, and notice several papers upon navigable balloons: Now, as this is a subject in which I am deeply interested, having for the last twenty years been working out a design, which now perfected, I claim to be the most perfect machine for aërial navigation yet introduced.

You will pardon, I am sure, the conceit of an inventor in thus expressing himself, yet, when I tell you that for many years I lived near London—indeed, in what would now be called London—and within sight of some of the most noted places from which balloon ascents have been made—viz., Vauxhall and Cremorne Gardens and Crystal Palace—having witnessed ascents by Messrs. Green, Gale, Graham, Bell, Coxwell, Glaisher; Mons. and Madame Potivar, and Goddard and others in Paris, you will perhaps allow that I may have some little knowledge of the subject in hand.

It early occurred to me, while watching the ascents and descents, the uselessness of ballons as then existing. I then set to work to devise some means by which they could be controlled. I have by me a sketch, made about the year 1868, embodying the principle of my present design, modified and perfected during the years that have intervened.

I claim, first, to be able to steer in any direction, and this is accomplished by means hitherto never attempted, but is entirely new.

Second, to be able to rise and fall at will, without loss of gas. This also is accomplished in an entirely new way.

My balloon also possesses many principles and new ideas that will add to the safety of the machine, so that it would not collapse by being shot. It would not be well at present to explain all details, as it is in the hands of my agents in London, and my doing so might interfere with some of their arrangements.

I believe, with one of your correspondents, that the balloon for many purposes, has no equal, and that its power for good or harm will be immense. I claim that with one of my balloons Gordon could have been relieved, and so now could also Stanley and Emin Bey. All exploration of unknown lands could be carried on by this means.

Your correspondent, "W. J. G.," p. 566 (Aug. 24, 1888), has hit upon several points covered by my invention (and patent). First, he says, "although not advocating further attempts to steer balloons, yet I think the flying machine will be dependent upon gas to carry some of the weight." In this I agree with him, and my idea is to have only sufficient buoyancy to carry the machine above ordinary obstacles. Again, he finds fault with the plan hitherto adopted in reference to the propeller. Here, again, he and I are one. I have placed mine on the balloon. Again, "Common Sense" (p. 547) predicts that the future vessel w illbe shaped like a cigar, with propeller at each end to work backwards and forwards. This desideratum I have also anticipated; in fact, all these desiderata are provided for in my patent, and I have no hesitation in saying that Crook's navigable balloon will be the balloon of the future.

Since writing the above, your papers dated September and October have come to hand, and I notice one of your correspondents asks for information as to the safest way to leave a balloon. Well, I can assure "Nephesh" that there need be no bumping or pounding in the case. I will descend to within 3ft. or 30ft. of the earth, and he can descend by ladder or step out by gangway like from a ship.

I may write you again. Meanwhile my invention is in charge of Messrs. W. McArthur and Co., 18 and 19, Silk-street, Cripplegate, E.C. I may add my balloon has been patented two years in this part of the world, so that I shall be free from the charge of copying.

John Crook.

Karangahape-road, Auckland, New Zealand,
Jan. 10, 1889.

JINMAN'S LAW OF STORMS.

[29716.]—I FEAR I am one of those unfortunate persons who may be classed, with Mr. Sadler, as a disbeliever of any known law of storms. In our Northern part of the world we have two different authorities on predicting storms; but unfortunately, although they, according to their accounts, go upon sure and certain principles, yet in nine cases out of ten they are wrong.

I notice this fact, however: that supposing we have a run of a few weeks of good weather, and a change, which anyone may see, takes place, our prophets are sure to have their prognostications inserted in the daily papers immediately. Alas for their wisdom, they are more often wrong than right! I have suggested that they might arrange matters better, and that one should say that a certain day was to be fine and the other stormy; then one would most probably be right, which would be much more satisfactory than both to be wrong.

I am apt to believe that Mr. Scott is correct when he says that "no living man can forecast the weather two days in advance, much less six weeks." I can quite understand that by having an observatory, say, 500 miles south of a central station and others 500 miles to the north, east, and west, and to have immediate information from each of them, then an observer may be able to judge for a certain time ahead, say a few hours, but even then changes unsuspected may intervene and upset all his notions. How much more, then, may this happen when the time is extended to, say, a month?

If Mr. Wilson is acquainted with, and is so confident of the accuracy of Jinman's laws—as scientific facts, he ought to explain them for the good of mankind. That would be in accordance with the desires of all scientific men. Their object is simply to inquire into matters and to extend knowledge. If these laws are to be kept hidden, then I would class them with such subjects as spirit-rapping, table-turning, and so forth, which can only be done in the dark—the reason why, anyone can understand. Mr. Wilson gives the dates of twelve storms, which, he says, were predicted successfully. This may be, or it may not be, as I find many can predict after the event; but if Mr. Wilson will give the dates of six storms that will occur during this year, and if these predictions come fairly true, then we unbelievers may put some faith in Jinman's laws, and endeavour to inquire into the mysteries thereof.

Inquirer.

DUODECIMALS VERSUS METRIC.

[29717.]—THE question of the best system of numeration and measures has always attracted the attention of thoughtful mechanics, and your columns have contained not a few weighty letters on the subject. I venture to bring before the notice of your readers—and at the same time give a wide circulation to—a paper read by Mr. G. Halliday, the president, before the Finsbury Technical College Engineering Society. It is an abstract only; but the argument is stated clearly enough. What a pity, says Mr. Halliday, the scientific men who introduced the metric system had not taken a step still farther back and considered whether the base of numbers was the best possible. The physical men who argue so fondly in favour of the metric system appear to forget that no divinity doth hedge about a ten, and that had it occurred to the Frenchmen that ten was not the best base, they would not have hesitated to change that too. Had they done so, and taken, say, twelve as base, and had the Englishmen still retained ten, physical authorities would no doubt have had exactly the same praise for it, and ridiculed ten. Now, there is a number of objections to the decimal system. First, ten does not give us the highest possible number of subdivisions; to all practical men the system is found quite a nuisance when the eye and hand are required for subdivision. Secondly, it has no even measurement of such important angles as 30° and 60°. Thirdly, the mind likes to treat of halves, quarters, thirds, and sixths, and never thinks of fifths. Lastly, the decimal system has been thoroughly tried, and it has been found wholly wanting. Sir Joseph Whitworth had seen his plane surfaces, his gauges, and his V threads adopted almost universally, and had therefore become the greatest practical authority of the century. Everyone, especially workmen, believed in his great practical sense. He became, or was advised to become, enamoured of the decimal system. He read papers, got resolutions passed in its favour, marked his gauges so as to force the system on men. With what result? No workman reads the decimal equivalents. This was Whitworth's one failure.

Well, what is wanted for a proper system of units? First, it must commend itself to the practical man in the very first place. The base must be capable of the highest form of subdivision. The unit must be connected with some constant physical length, and must be connected with the circumference of the earth, and so suit the sailor. Of numbers twelve, and a part of the circumference of the earth obtained by dividing constantly the circumference by twelve per unit, seems best. If a twefth of a right angle be taken as the degree, the twelfth of a degree as the minute, and the twelfth of a minute as the second: then the arc subtending the second measured from the Equator to the Pole $\times 12^{-4} = 11{\cdot}996293$in., which is very nearly the foot. As the arc along the Equator would be taken, and not the arc from Equator to Pole, the distance would come still more nearly the foot.

Under our present system counting of numbers, which has ten for base, we count up to the number nine before we begin to represent numbers with two characters. In the present system ten is represented by 10; in the new, twelve must be represented by 10. Ten and eleven, which in the old system were represented by double characters, will in the new be represented by single characters. It has been suggested by Mr. Lousley of the Royal College of Science, Dublin, that ten might be represented by an old English six laid on its side:—

↊,

and eleven by the same laid on its back:—

↋.

MULTIPLICATION TABLE.

	2	3	4	5	6	7	8	9	↊	↋	10
2	4	6	8	↊	10	12	14	16	18	1↊	20
3	6	9	10	13	16	19	20	23	26	29	30
4	8	10	14	18	20	24	28	30	34	38	40
5	↊	13	18	21	26	2↋	34	39	42	47	50
6	10	16	20	26	30	36	40	46	50	56	60
7	12	19	24	2↊	36	41	48	53	5↊	65	70
8	14	20	28	34	40	48	54	60	68	74	80
9	16	23	30	39	46	50	60	69	76	83	90
↊	18	26	34	42	50	5↊	68	76	84	92	↊0
↋	1↊	29	38	47	56	65	74	83	92	↊1	↋0
10	20	30	40	50	60	70	80	90	↊0	↋0	100

Measure of Length.

1 foot = 11·996293 inches.
10 lines = 1 inch
100 ,, = 10 inches = 1 foot
1,000 ,, = 100 ,, = 10 feet = 1 yard
10,000 ,, = 1,000 ,, = 100 feet = 10 yards = 1 pole
100,000 ,, = 10,000 ,, = 1,000 feet = 100 yards = 10 poles = 1 furlong =
1,000,000 ,, = 100,000 ,, = 10,000 feet = 1,000 yards = 100 poles = 10 furlongs = 1 league.
1,000 leagues = quarter of the earth's circumference.

Measure of Area.

For small areas the square inch may be taken as the unit, and for land the square pole would be most convenient.

Measures of Volume.

The cubic inch will be the most convenient unit for finding the weights of materials.

One cubic inch
1,000 cubic inches = 1 cubic foot.

Measures of Mass.

The best unit of mass would be the quantity of matter equal to the matter in a cubic inch of water at 4° Centigrade. This might be called a mass, and the confusion already existing with regard to having the same name for the units of pressure, mass and weight, would be obviated. The table might then stand as under:—

1 millimass
10 ,, 1 centimass
100 ,, 10 ,, = 1 decimass
1,000 ,, 100 ,, = 10 ,, = 1 mass
1,000 masses = 1 kilomass
1,000,000 ,, = 1,000 ,, = 1 quatre tonne
1 mass weighs ·03612lb.
1 kilomass weighs 62·425lb.
1 quatre tonne weighs about 4 tons.

Measurement of Time.

1 second
100 ,, = 1 minute
10,000 ,, = 100 ,, = 1 hour
100,000 ,, = 1,000 ,, = 10 ,, = 1 day

The present second is one 86,400th part of the day. The new second would be one 248,832nd part of the day.

The units in the duodecimal system, equivalent to the centimetre and gramme-second in the C.G.S. system, will be the inch, mass, and second.

As the price of things should also be found by the mere placing of the duodecimal point, it will be necessary to make a table for money. The following might do:—

Table of Money.

One penny.
10 pence = 1 shilling
100 ,, = 10 shillings = 1 mark
1000 ,, = 100 ,, = 10 marks = 1 note.

If a change is desirable, do not let us be contented with half-measures. Let the change be a radical one. The physical people have expressed a desire for changes; let them adopt all that is best in both systems. Let them combine the systems of the French and the English engineers.

It must be acknowledged that there is here something to think about. Although the scientists—that is those of the "classes"—persist in using the metric system, it is certain that the foot-rule has not been banished from the workshops either here or in America, and to all appearance does not seem likely to give way to millimètres and mètres. Should like to have the opinions of "E. L. G.," "J. K. P.," and others on the above. **Old Hand.**

HEAT—EXPANSION OF BODIES—GROWTH.

[29718.]—It is well known that heat expands bodies. What account is to be given of this? If heat is a mode of motion, consisting of vibrations, it is evident that all phenomena which are due to it must in some way be due to vibrations, and it is remarkable that while vibrations have been so successfully employed in explaining the phenomena of light, so little use should have been made of them in explaining those of heat. In fact, the whole method of treating the subject, nomenclature and all, seems to ignore the fact that what we observe is due to vibration.

If we try to apply these, however, in the present instance, the explanation of expansion seems to be of the simplest kind possible; it is merely this: "When the molecules of a body are vibrating, they require more and more room to move in, in proportion as the vibrations become greater, that is, they require a larger envelope to contain the whole mass."

Thus, suppose we had a box filled with shot, and fastened down, they could not vibrate without bursting the box. Supposing that it was partly filled, they could not vibrate without *rising* in the box, like mercury in a thermometer, where vibrations cannot go on in the bulb without causing the fluid to rise in the stem. And the same thing must happen whether the initial distance between the molecules is nothing or not—any increase of vibration requires increase of room, or it cannot take place. Granting, therefore, the existence of vibrations, the increase of the size of the envelope required to contain them all is merely a geometrical necessity.

It will be said that if this is true the vibrations of *light* ought also to expand the body; and doubtless this is really true, though they do not *sensibly* expand it. But we may readily understand that a cause which produces heat vibrations may cause much greater effects than could be produced by mere exposure to light. Thus, a blow given to a piece of iron or to the finger will cause much more motion of the particles than would be caused by exposure to light; so would the touch of a hot poker.

The account usually given of expansion is to say that "heat develops a repulsive force among the particles." That it *does* develop a force of some sort or the other is very evident; and it is also easy to see what *kind* of force it is, and how it acts. Take the case where heat is produced by a blow. The first effect of the percussion will be to cause the particles to move *nearer* to each other. And what will be the effect of this motion? It will be this: previous to the blow the molecules were at rest, and not only so, but in a state of *equilibrium*, seeing that they are under the effect of molecular forces, &c. Now, this equilibrium must be either stable, unstable, or indifferent. It is not the last, for the particles do not remain in their new position; nor is it unstable, for such a state, though it exists in theory, does not in nature. The first, then, is the only possible one which remains. Now, when a body is disturbed, but not too much so, from a position of stable equilibrium, it *vibrates* about it, and the force which has been developed among the molecules is not a repulsive, but an *alternating* one, always tending to bring back a molecule to its position of equilibrium.

The case, then, is thus: when the body expands, *motion* must have taken place, and when this motion results from disturbance of stable equilibrium, vibration follows; so that the connection between vibration and expansion is evident, whether we start from the assumed fact of vibrations, or from the observed fact of expansion.

And this may throw some light upon a question which I have not seen explained. How is it that some bodies, such as clay, *contract* under heat? It might seem from this that expansion in consequence of vibrations breaks down. But it is not so; it only shows that something else must be going on at the same time, besides vibration, and it is easy to see what this may be. Supposing that the molecules were *contracting* in bulk at the same time that they were vibrating, the whole mass would occupy less space by reason of their contraction, at the same time that it wanted *more* space because of the vibration, and the entire result will be an expansion or contraction, according as the one or the other preponderates.

That such a tendency to contraction always accompanies vibration is evident on dynamical principles. When a molecule is moving to and fro, like the piston of a steam-engine, it is under the action of a *pressing* force acting on opposite sides alternately, and therefore tending to compress it, or reduce its bulk.

Growth.—There are numberless instances where we may get just a glimpse of what the effect of vibrations may be, though we may not see the way in which they act, so closely as we may in the above case—the growth of an organism, for instance. When its particles are vibrating, it is in a greater state of *activity* than it would otherwise be in, and therefore we may suppose it to be progressing towards some end which it otherwise would not do, whether of growth or decay. Arrest activity, and change is arrested, as in frozen meat; promote it, and change goes on, and the more violent the action the greater the change. But the action should not be *too* violent, or it will produce change which is not good for growth;—too much exertion kills.

W. G. Penny.

WHERE DO FLIES COME FROM?

[29719.]—The question is often asked, "Whence come all the flies, and where do they go in the winter?" You had some interesting replies in Vol. XLVII. pp. 475, 484, 526, and the following, which I cut from an American paper, may appropriately supplement the information already given, especially as it contains a method of reducing the number, and may be useful in the coming season. The common fly is too well known to need description. It belongs to the order Diptera, as it has two wings, suctorial mouth parts—flies and mosquitoes stab and suck, but do not bite—and passes through complete transformations. By this last we mean that the first stage, maggot, is not at all like the succeeding stages of the insect. It belongs to the family Muscidæ. Such insects have short antennæ, with a full plume on the last joint, and heavy, short bodies. This fly hibernates in winter as a fly. Fortunately, most of them never wake to life in the spring; but enough of them survive to make things lively about August and September. The house-fly lays more than 100 whitish, elongated eggs. These are laid in horse manure, on which the maggots feed. The eggs hatch in about twety-four hours. The larva, or maggot, looks very much, and is very much, like that of the meat-fly, or blow-fly, with which all are doubtless familiar. When fully grown it is from one-fourth to four-tenths of an inch long, and is about one week in getting its full growth.

This fly, like many others, pupates in its last larval skin. It is rounded and seedlike, as a pupa. Such pupæ are called puporiums. The pupa state lasts about a week. We now see why these flies become pretty numerous along in dog-days. Each female lays more than 100 eggs, and the time from egg-laying to maturity is only about two weeks. Most of us have studied geometrical progression. Here we see it illustrated. Suppose one fly commenced "to multiply and replenish the earth" about June 1. June 15, if all lived, would give 150. Suppose 75 of these are misses, July 1 would give us, supposing no cruel wasp or other untoward circumstances to interfere, 11,250 flies. Suppose 5,625 of these are females, we might have, July 15, 843,750 flies. For fear of bad dreams, I will not calculate what might be by Sept. 15. Some of us who have some time stopped at third-rate hotels quite understand it. From what I have said, it is easy to see how that a horse-stable near the house is favourable to the fly nuisance. Slops about the wood-shed, of course, attract flies. So the neat, tidy housewife is less tormented than one not so blessed with this kinship to godliness.

We provide in three ways against these pestiferous house flies. First, we have screens to all our windows, and to such doors as are much used especially the outside doors to kitchen and dining-room. The screens to the kitchen windows are full length, so the windows can be opened either from above or below. We believe in fresh air, and with this arrangement we get it. Secondly, the screen to the pantry window, to each of the dining-room windows, and to one window of each of the other rooms, is hinged at the top to the upper sash. Thus, by darkening all the other windows, the flies alight on this hinged screen. We now push the screen quickly out at the bottom, brush rapidly with a palm-leaf fan, and, lo! the flies are all outside the window.

Thirdly, in case the flies get too thick, we use pyrethrum, or, better, California pyrethum, or, buhach. Toward night we try to attract all the flies into the kitchen by darkening the other rooms, and placing odorous sweets exposed in that room. At ten o'clock, bed-time, we scatter, by means of a 10-cent bellows, a little of the powder into the room. The next morning the flies are dead, or partly paralysed, on the kitchen floor, and are swept up and cremated in the kitchen stove before any revive.

Of all flies, the most annoying are those known as blowflies, against which the careful housewife wages as relentless war as she does against wasps. It is better, however, to tempt these insects to commit suicide than to use the cruel catch-em-alive or the rather dangerous poison papers. **J. T. M.**

THE RAILWAY RACE.

[29720.]—We have not heard much about the "railway race" lately; but it is well known that the great companies running North are preparing for the coming season. Our old friend, "Express Driver," does not often favour us now; but as I have recently come across a letter written from the "roundhouse," which appears in a professional paper, some extracts from it may interest your readers, especially the remarks about compound locos. The writer, who describes himself as a driver on the L. and N.W., says:—"As there have been so many foolish tales going the round of the papers about this so-called race to Scotland, I have thought I should like to give my version of the run or race. Now as I understand a race, each racer is allowed to do his or her utmost to win. We were not. We had a set time to run the train in, and we had to run to that time, and although we ran a little under that time, we were not expected to do so, otherwise we could have run much faster than we did (and mark this, with perfect safety), for I always put safety first, punctuality second, and economy third and last. But working the engine economical is a very great point, as an engine properly worked will last longer and do more work than one worked anyhow, and of course burn less coal. We get a little coal premium, and I think I can challenge any driver for taking good loads and keeping good time with little expense, with all sorts of engines. I had about 15 years on Ramsbottom 7ft. 6in. engines, but I think I have done the best work ever I did in my life with Webb's small compounds, taking the heaviest loads, and making the best time and working the cheapest. In fact, I have been surprised at the work I have been able to do with these engines, and I have received many a bright sovereign coal money. I have run through from Liverpool to London with one oiling many a time with the 11.5 a.m., with eight or nine and sometimes more coaches, with four or five stops, in 4 hours 10 minutes, and 4 hours 15 minutes, and could do it in less time than that, only for running before time, and I could give you cases of heavy loads, as well as long distances, were it needed, with great speed; but you must bear in mind that no engine ever built yet will maintain a speed of 60 miles an hour with such loads as are run on our main line, varying from 12 up to 18 or 20 vehicles. I see nothing to hinder us from being in Carlisle at 3.50 p.m., leaving Euston at 10 a.m., with the four stops; or the small compound would run from Euston to Carlisle with the Crewe stop only, which would make it so much the easier, and I will warrant they would do it on about 27lb. or 28lb. of coal per mile; it would not want two firemen to put that on. We the drivers of the L. & N. W. fear no others. We have been brought up to hard-and-fast running, from our childhood, many of us, and I believe our bosses glory in us, and we in them. When men in the various papers speak of the dangers attending fast running, they speak of what they do not know. I say again there is no danger only what is common to other trains; everything is as near perfection as it is possible to be—that is, men, rolling-stock, permanent way, signals, and other arrangements. If they want anything more let them pay their fare and ride with the trains and tell the truth at the finish, because we know every yard of the line from Euston to Carlisle, and what the engines can do and what they cannot do. One man gave his timing of the train from Euston to Carlisle, and said that the engine, 7ft. 6in., 16in. by 24in., travelled fastest up Lichfield Bank, that is between Tamworth and Lichfield, all up-hill and pick up water into the bargain, and again from Preston to Lancaster, 21 miles in 18 minutes, where it would take two minutes to go the first mile and do well, leaving only 16 minutes to go 20 miles, very slightly up hill 19 miles out of 20. I could go on with cases of the same sort of nonsense, [illegible] I have said enough to show that there is no danger [illegible] fast running either one way or the other. Tell the nobles to patronise us and we will do our very best to convey them in safety and comfort, and they will not complain about the speed being excessive and irregular, but quick and smooth. Now one word for myself: I have battled summer's heat and winter's cold without anything stronger than coffee, cocoa, and the like, as I signed the pledge on

March 16, 1858, and am well and hearty now after about 36 years on the footplate."

There you have a voice from the footplate; but as there are other voices and other footplates, perhaps we may hear something from the Great Northern and also from the Midland. That front cab was not fitted to No. 26 M.R. single without some object, and it is not unlikely that we may expect some developments in railway travelling in the coming season. **The Motion Bar.**

ENGINE CASTINGS.

[29721.]—I AM inwant of such an engine as described by "Ex" in the Eng. Mech. of March 1, and was about to commence the drawings of one having a cylinder 3¼in. bore and 5in. stroke. In common with the majority of amateurs I do not possess a planing machine, and so the type I was about to select was one having a minimum of plane surfaces in its construction, and within the capacity of a 5in. centre lathe and fairly powerful drilling machine; I shall be glad to supply sketches for criticism by "T. C., Bristol," and other practical contributors, and hope other fellow readers will do likewise. Through being connected professionally with an iron-founding company in the neighbourhood, I get any castings I require made at very low rates, and no doubt could arrange that the castings of the proposed engine, which I would suggest should be christened the "English Mechanic" Engine, could be supplied to subscribers on the same terms as to myself. The boiler might be a coil one, as recently described by Mr. J. J. Cam, in this paper.

Solicitor.

THE DISC OF NEPTUNE.

[29722.]—In answer to Mr. Hunt (letter 29667, p. 11), Dr. Galle discovered Neptune with the Berlin (Fraunhofer) Equatoreal of 9·6in. aperture and 174in. focal length.

The Writer of the "Astronomical Notes."

BAYER AND FLAMSTEED.

[29723.]—It is generally stated that Bayer was the first to name the stars by Greek letters. Chambers, however, in his "Astronomy," states that Piccolomini did so at an earlier date. Will "F.R.A.S." kindly tell me if these statements are correct? For, if so, why should Mr. Sadler, on p. 398, "E.M." for Jan. 11, 1889, say that 845 B.A.C. is μ Ceti, *according to* Al-Sufi? and on p. 1 of "Uranometria Nova Oxoniensis," we read in footnote that α Andromedæ is called δ Pegasi in the Almagest.

The number of Stars in Flamsteed's Catalogue, according to the "Encyclopædia Britannica," is 2884. This does not agree with number given in Chambers's "Astronomy," where it is 3310. Kindly say which is correct. **Chas. Grant.**

SATELLITES OF SATURN, &c.

[29724.]—I QUITE endorse the opinion of "Amateur, F.R.A.S." (letter 29684, p. 30) that it is only a waste of time in trying to see Enceladus with a 3¾in. or 4·3in. telescope by observers with average vision, except indeed that Mr. P. F. Duke has exceptional powers of vision exceeding Mr. Ward, whose observations some twelve or fifteen years ago showed that he possessed very abnormal keenness of sight with the telescope. From the remarks, however, in the letter of "Amateur" above referred to, I presume he questions that even Mr. Ward may have glimpsed Enceladus with a 4·3in. aperture; but I think there can be no doubt of it after reading the remarkable letter (No. 11991) by Mr. S. W. Burnham on p. 242 of Vol. XXIV. "E.M." as to Mr. Ward's extraordinary power of vision on difficult test objects, confirmed by Mr. Burnham with the 18½in. Chicago refractor.

C. M. D.

BLUNTNESS OF SOUTHERN CUSP OF VENUS.

[29725.]—This phenomenon, referred to by Webb (pages 52 and 53), was plainly visible this evening, and was noticed by me without any knowledge of its having attracted previous attention.

On coming indoors I turned to the above volume to see if it was mentioned, and found that it had been a matter of considerable debate in past days; but there could be no doubt about it this evening, as I had never seen or heard of such an appearance previously, and it was distinctly noticeable.

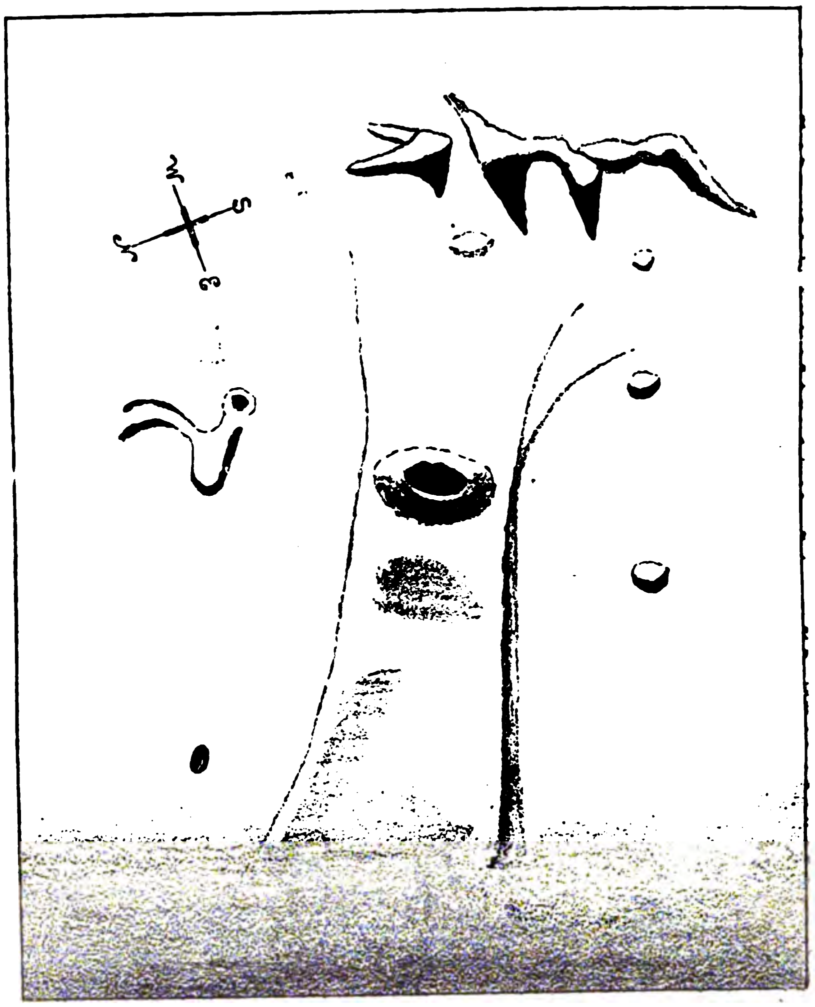
It may interest some of your astronomical readers to observe this peculiarity during the present favourable aspect of the planet.

March 5. **Al Fard.**

VENUS.

[29726.]—In the "Astronomical Notes" ("E.M." March 1, p. 5), it is stated that Venus "may be distinctly seen with the naked eye in the sunlit sky by anyone who knows exactly where to look for her." Venus was easily picked up on Saturday afternoon at 3h. on setting the hour and declination circles by the *Nautical Almanac*. In the fifth edition of Guillemin's "The Heavens," p. 71, it is said that the horns of the crescent, especially the southern one, have "nearly always been observed blunted—truncated, so to speak." From the details given in Webb's "Celestial Objects," one imagines that "nearly always" is a loose way of referring to special observations not perhaps nearly always seen—observations which also comprise some recording a bright point detached from the south horn. Venus, when found in the telescope, could, as stated in the "Notes," be seen with the naked eye.

Hendon, March 11. **P. F. Duke.**



[illegible] Rills near Cauchy. See p. 51.

CLUSTERS AND NEBULÆ.

[29727.]—The most profound interest attaches to the marvellous photograph of the nebula in Andromeda by Mr. Roberts, and I am anxious to bring the subject before your scientific contributors and readers.

Star clusters appear to be divided into two classes. Those which are aggregations of stars in the Milky Way, of which the principal examples may be cited as the double cluster in Perseus, M 35 in Gemini, and M 50 in Monoceros. In these there seems to be a concentration of stars of the greatest grandeur, but with no particular central nucleus, the individuals of which *may be* physically connected as a whole, but which do not appear to be so more than the rest of the Milky Way.

The other class, and apparently quite distinct from everything else, are the independent and isolated clusters, having no connection with the Milky Way, and existing (so to speak) on their own account. The principal of these may be taken to be M 13 in Hercules, M 5 in Libræ (in Serpens in Proctor's Atlas), and M 3 in Canes Venatici. Here we see evidently independent systems with bright stellar nucleus.

The independence of these systems seems to be further proved by the unexpected revelations of the Andromeda photograph, which to all appearance, is one of the same class of clusters in a much less advanced state of development. Here we seem to see, indeed, a star cluster in process of formation, vast multitudes of stars having already condensed from the nebula, and the nebula itself encircling the whole with its still gaseous parts.

The conclusion seems irresistible, that in those vast clusters the first three have passed their nebulous state, and are now sidereal systems, quite independent of our stellar universe, and that Andromeda is in transition, also that our system is but another of the same as the first three, in which the Milky Way, being perhaps the last to leave the nebulous state, encircles the whole, much as the outer ring in Andromeda may possibly do. The great desideratum seems to be to ascertain how far these clusters and nebula are from us. Mr. Proctor of late, I think, considered that the Andromeda neb. was not so far as this independence of each, as a stellar universe, would seem to require.

I trust that "F.R.A.S.," Mr. Sadler, and other of our astronomical experts, will tell us what is really known on this head. Was any parallax ever obtained of the Nova in Andromeda; or has it, of the three clusters named? There is, of course, nothing new in the foregoing theories, but they seem to be confirmed or rendered probable by the discoveries in the neb. in Andromeda.

Fordingbridge. **T. Westlake.**

TRANSITS OF VENUS, AND LOCKYER'S "PRIMER OF ASTRONOMY."

[29728.]—I wonder whether any of the readers of the "E.M." who happen to have a copy of that otherwise excellent little work, "Primer of Astronomy," by Prof. Lockyer, have noticed that there exists in the same a decided inaccuracy with respect to the Transits of Venus. The defect occurs on p. 90, in the edition of 1884 (I am not aware of any subsequent editions having appeared). The intervals between the Transits of Venus are alternately 8 and 105½ years, and 8 and 121½ years. The first Transit of Venus ever seen by man occurred in 1639; but one had taken place unobserved eight years before—viz., in 1631. The interval between 1639 and 1761 (during which no Transit occurred) was 121½ years; therefore, to agree with the above alternate intervals, the dates since 1761 must be 1769, 1874, 1882, 2004, 2012, &c. But the "Primer" would seem to imply that a Transit of Venus will occur 105½ years after 1882—i.e., in 1988, which obviously cannot be the case, compatible with the intervals above specified. The interval of 105½ years has been the last to occur, now that of 121½ years will take place—in fact, has already commenced—and the date of the next Transit in consequence will be—not 1988—but (June 4th) 2004.

Perhaps some reader of "Ours" can say what lunar crater the frontispiece of the "Primer" is intended to represent. I have compared it with several very good maps of the moon's surface, and although it bears as much resemblance to "Copernicus" as to any other, I should like the opinion of others on the subject. Maybe "F.R.A.S." could obtain the explanation from the distinguished author himself, which would perhaps be the most satisfactory course to pursue. **Autolycus.**

CLOCK TRAINS.

[29729.]—The picture given with my letter (29679) on p. 13, is such an indistinct reproduction of a tolerably good photograph, that I am not much surprised that Fred. Carre has some difficulty in making it out. I have, therefore, sent him a print of the photo, and a few lines in explanation, and have called his attention to a previous drawing, in Vol. XII. p. 277, of my old wheel-cutting attachment, where every detail is given, and which is nearly identical with this one; also to Vol. XII. p. 185, in which is shown the same headstock with large pulley on the rear end of the mandrel; also to Vol. X. p. 365, for the method of originating prime wheels. The missing letter E should have appeared above the spindle of the worm-screw, and nearly vertically over the carrier which holds the work. I beg to say that the "hospital" is a private one, accessible only by private introduction. The patient, in the form of a worm-wheel, whom, as I said I expected, arrived duly and was discharged at the end of about eight days. I have not yet heard whether I effected a perfect cure. It would have been really less trouble to make a new one. **J. K. P.**

CATS AND MUSIC.

[29730.]—"R. W. E. W.," in letter 29703, says he was "amused." I don't mind amusing, if I can do it without making myself ridiculous; but I really had no notion of saying that the air, or tune, had anything to do with it. In fact, I intimated the contrary in letter 29663, notwithstanding that my word "tune" was printed "time." I should not have written at all had I not had some vague idea that it might possibly have been my own experience that somehow had got reported to the compiler of the "Musical Anecdotes." Anyhow, it was eight or nine years earlier than the "Science Gossip" that "F. R. A. S." is kind enough to refer me to. **J. K. P.**

AUTOMATIC MACHINES.

[29731.]—I am preparing a short history of automatic machines, their origin and development, in England and abroad, and should thank your readers very much if they would help me by informing me of the existence of any coin-freed apparatus other than the clockwork models at exhibitions, &c., prior to 1886.

I know of several automatic sale and delivery machines without any definite check to prevent fraud, but none perfect enough to place in positions where the public would have free access to them. I should be very glad of any information in regard to electrically worked machines or those for giving a current of electricity upon the insertion of a coin, as I believe they never existed before about three years ago. **E. Broquant.**

Northgate House, Highgate, N., Feb. 5.

DARWIN v. LAMARCK.

[29732.]—An instance came some years ago under my special notice as follows:—A number of breeding sows were kept in a yard adjoining the highway; at the time of conception of a small-breed Berkshire sow, an elephant, being *en route* to the town, stopped for a few minutes at the gate of this pigyard. This sow—a sensitive subject, as pigs go—being much astonished at the elephant, and being then chased away from the gate by a ferocious companion having very wild, large red eyes, during the birth of her litter became in great suffering, and after much delay gave birth to an enormous creature having an elephant's perfect trunk, elephant's ears, skin, and feet; but minus a mouth, anus, and urinary organs, while in the centre of its forehead was one vast red awful-looking eye. Of course, the creature ceased to breathe in a few hours.

Now probably some such an occurrence gave that arch-robber, the patriarch Jacob, his cue whereby he succeeded in "besting" his respected father-in-law Laban over the sheep business; but Laban, perhaps, knew his customer: hence the Leah retaliation artifice. **The Lydney Dispenser.**

WEIR'S NEW BATTERY.

[29733.]—In reply to Mr. G. Weir's letter, No. 29690, I am sorry to say that the mistake was mine. It should have read ½, and not ¾. Of course, the measurements made on my instruments could not have been so accurate as those made by you, as the instruments you have access to must necessarily be more delicate than mine. As soon as your batteries are in the market I shall be very pleased to have one, when I will give my report upon it.

F. W. Mason, Consulting Electrician.

A NEW BATTERY.

[29734.]—Many thanks to "Farad" for his kind explanation respecting the action of the solution on the rubber bands. I may state that I was acquainted with the answer; but I have attributed the phenomena, I may state, to another cause, though I am not in possession of sufficient experimental data to prove this yet; when I do possess it, I will immediately make it public. I also fully coincide with "Farad's" opinion—viz., that it is a mistake to connect plates underneath a solution; but this was made in this case as an experiment. The permanganate of potash solution employed by me was made with very great care, all substances employed being chemically pure, and water used being redistilled. Of course, as "Farad" must be aware, this would make a slight difference in the result of that obtained by using the ordinary commercial materials. I will give "Farad" the proportions that I have found from practical experience the best to use in ordinary cases, but if he would like to know the full details and description of the more delicate method of preparation, if he will advertise his address I will send it him with great pleasure.

Permanganate solutions.—For single cell: Permanganate of potash, 602; sulphuric acid, 202; water, 1 pint. For double-fluid cell (inner with zinc): Permanganate of potash, 802; sulphuric acid, 302; water, 1 pint. Outer with carbon: Water, 1 pint; sulphuric acid, ½oz.

F. W. Mason, Consulting Electrician.

GAS BATTERIES.

[29735.]—Alfred Treeby's theory regarding the action of the plate in contact with hydrogen may be perfectly correct as far as it goes. Up to a certain critical point the gas consumed, and the current in ampères, will vary with the pressure; after which no amount of pressure will cause an increase in either. This critical point will be found to vary with the temperature, the metal used, the porosity of the carbon, and the active surface of occluding metal per square inch of carbon plate. If the supply of gas to the occluding metal be unlimited, palladium will act better than platinum, without a doubt. The employment of wire cloth is a most decided improvement on the carbon plates; the drawback to this is, that the porosity which Alfred Treeby rightly advocates is destroyed to a certain extent by the copper plating.

Alfred Treeby says his experiment with the wire mesh proves that gold and platinum act equally well in a gas battery, though their power of occlusion is different. Why, then, does he use platinum at all and not lead or some cheap metal? Surely the result of the experiment is a mistake. I am perfectly well aware that the plate connected to the + pole of a battery in charging an accumulator becomes the − plate (or element), and the + pole of the accumulator in discharging. The current does not flow from − to + in any case. This subject is hardly worthy of discussion side by side with "the invention of the age."

I have not heard of the carbon mentioned; but I know that *very* porous carbon plates, soaked in animal blood and heated to redness in a retort, will answer the purpose very well. They cannot be used in contact with the hydrogen, but absorb and condense oxygen and chlorine freely.

Regarding works on the subject, a paper by Dr. C. W. Siemens was read at the meeting of the British Association held at York in September, 1881. The patent specification of G. E. Dering, No. 4,019, 1881 A.D., certainly is worth reading. The former I have not seen. An account was, I am told, at the time published of a very good but expensive gas battery (altogether of platinum), exhibited in the Inventions Exhibition, in the *Electrical Review*. Some reader will perhaps kindly quote the date of the issue. Several patents have lately been taken out for gas batteries. I think, on the whole, Alfred Treeby will find his own knowledge on the subject a good bit ahead of any of the above. Some students of the City and Guilds Central Institute were some time ago experimenting on gas batteries under Prof. Ayrton; their experience may be of value, if they would kindly give it.

I should be much obliged to Alfred Treeby if he would kindly publish his address, as I have some improvements which I should like to communicate to him before, in due course, giving them to the public. **Gilbert B. Luckhoff.**

SILVERING SPECULUM.

[29736.]—A few nights ago I silvered a 6½in. speculum by Brashear's process. The thermometer was 54° Fahr. The vessels, &c., were kept at same temperature for more than 24 hours; but I could not get distilled water, and had to use pure country rain-water filtered. From previous experience of silvering, I thought it would require 1½ hour to silver; but when I looked at disc in 1½ hour the silver film was gone from surface of solution, and on taking out speculum it was covered over with transparent spots like rain drops. What was the cause? "Reducing solution" about two months old.

After adding the potash solution to the silver, I found by adding ammonia drop by drop the solution cleared, but had black particles—very many—floating in it. In one book I read that ammonia should be added until no precipitate remains. Does that mean that it should be added until the black particles are dissolved, or merely until the solution clears?

I stopped adding ammonia when the liquid cleared, and filtered out the black particles. Which is the proper course? I used triple re-crystallised nitrate of silver.

The spots are transparent by transmitted light. **T. M. C.**

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67500.]—**Telegraph Lines (U.Q.)**—Going on the basis that wire used is 7½ gauge, having 13w. resistance per mile; that each needle instrument gives 200w. resistance, and that 20 milli-ampères of current should be sent out, the battery power should be:—(1) 100 Leclanché cells; (2) 134 Daniell cells, P.O. pattern. T. P.

[67559.]—**Bisulphate of Potash in a Leclanche Cell.**—I will send "F.R.Met.Soc.," in one or two weeks, a full description of this; but at present I am trying an experiment with it, and would rather wait till I obtain the result. I may state that it is, in my opinion, an advantage to use the bisulphate, as it rather prolongs the life and action of the cell; but, as I said before, in a few weeks I will with great pleasure send "F.R.Met.Soc." full details. F. W. Mason.

[67620.]—**Equation of Time.**—In reply to "Viator," Le Verrier's equation of the centre for 1850 is—

$$\begin{aligned}&(6918{\cdot}310'' - 0{\cdot}1751''t - 0{\cdot}00000564''t^2)\ \sin.\ z\\ &+ (72{\cdot}508'' - 0{\cdot}00375t)\ \sin.\ 2z\\ &+ (1{\cdot}054 - 0{\cdot}00008t)\ \sin.\ 3z\\ &+ 0{\cdot}018''\ \sin.\ 4z\end{aligned}$$

and in 1890, Jan. 1, Paris noon—

$$\begin{array}{lrcr} & L = 281^\circ\ 5'\ 10{\cdot}64'' & + & 3548{\cdot}3204'' \\ & w = 281^\circ\ 2'\ 29{\cdot}5'' & + & 0{\cdot}169'' \\ \hline & z = 0^\circ\ 2'\ 41{\cdot}1'' & + & 3548{\cdot}161'' \\ \text{Add—} & 23{\cdot}0'' & & \\ \hline & z = 0^\circ\ 3'\ 4{\cdot}1'' & & \text{Greenwich mean noon.} \end{array}$$

Let us calculate the place of the sun for Jan. 1, 1890, we find—

$$\begin{array}{lcr} \text{L.} & = & 281^\circ\ 5'\ 33{\cdot}68'' \\ \text{E. of C.} & = & +\ 6{\cdot}30'' \\ \text{Lunar pert.} & = & +\ 6{\cdot}35'' \\ \text{Planetary pert.} & = & +\ 2{\cdot}50'' \\ \text{Nutation} & = & -\ 16{\cdot}79'' \\ \text{Part of abern.} & = & -\ {\cdot}35'' \\ \hline & & 281^\circ\ 5'\ 30{\cdot}69'' \end{array}$$

agreeing with the *Nautical Almanac*. The mass of the moon used in the *N.A.* is $\frac{1}{81{\cdot}84}$ (Le Verrier's). The greatest equation of the centre takes place whenever z is about 88° 48′, when it amounts to $+\ 1^\circ\ 55'\ 18{\cdot}78'' - 17{\cdot}51''t$. t is equal to the number of years since 1850. Tria.

[67633.]—**Cylinder Boring (U.Q.)**—You must get a half-round or D bit for each size; there is nothing else to do. Polish the cylinders after boring with pumice-stone powder. I recommend you to get a slide-rest: a lathe without one is only good for whittling a stick. A. F. Shakespear.

Lüttichaustr. 14, Dresden.

[67649.]—**Chemicals for Mimic Sea-Fight Effects.**—To "Principia."—In my reply I did not refer to the mixture of chlorate and sugar, as such a mixture is perfectly safe, but to the spirit and chlorate with H_2SO_4. The danger in this would be in using, say, 5 grammes or so of chlorate, and a couple of c.c. of acid, which an uninstructed person would probably do. It is quite safe to explode a large test-tube full of Cl_2O_4, but a quantity such as named above would, if exploded, perhaps drive the contents of the pan all ways at once, and having spirit in it would increase the "effect." Principia.

[67650.]—**Core Box.**—I have just cast a cylinder such as you want. I made port cores of Belfast sand and flour, one part of the latter to five of the former. Bend a piece of wire (same as birdcage wire) to shape of port core, put two in each core, one on each side, a small piece of string (such as groc use) in centre of core, to be drawn out after c made before taking out of core-box, to take a after core is made put box and core to the fi few minutes to harden it, then gently tap and and turn out into your hand; then put ffee, dge on again until dry; be sure and not burn it, or it will be useless. If you have box for main core, make it of same sand as above; then draw off prints and scratch with point of nail to required depth, into which insert port, then the print on face will hold other end. Make all your cores of this mixture, and you will have no blow-holes, and they will surprise you in the taking out of castings. CAST IRON.

[67650.]—**Core Box.**—Fig. 1 shows a core-box for steam passages. Fig. 2, one-half open in the joint of the box for exhaust passage. In this case, as there is no deep steam-chest, the cores are best made separately in their separate boxes. When the steam-chest is deep, and cast with the cylinder, it is advantageous to make its core in one with the passages. The trouble of making joints is thereby saved, and the vents are safer. There is not the slightest need to make a box for the cylindrical core. The passage cores simply abut against it without joints, and their vents are carried away through the steam-chest face. J. H.

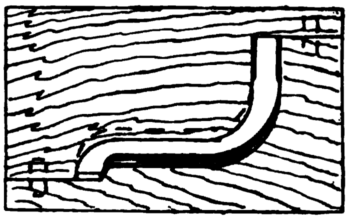


FIG. 1.

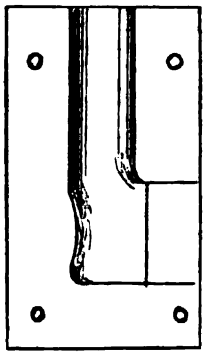


FIG. 2.

[67677.]—**Mineral Oil Lamps.**—I think the suggestions referred to by "F. A. M." were issued as a report to the Board of Trade, and if so, it is sold by the Queen's Printers; but "F. A. M." can find the substance in a lecture delivered by Sir F. Abel before the Royal Institution on Friday, March 13, 1885, an abstract of which appears in No. 1043. S. R.

[67680.] — **Colouring Wax.** — Has "Wax" tried the addition of pigments or aniline colours? Would they be objectionable? It seems to me that the same methods as are adopted for colouring wax candles ought to answer. G. M.

[67692.]—**Girder Drawing.**—Bindon Stoney's work on "The Theory of Stresses" is the text-book; but I think Mr. Adams, of the City of London College, has issued some small works which would suit. E. G.

[67702.]—**Slicing Oranges.**—This query asks for a machine for slicing oranges to make marmalade. I do not think there is any machine of the kind in existence. E. C. S.

[67704.]—**Lantern Light.**—The Clamond light might be applied to a magic-lantern, and so might the Welsbach, but I do not think it can surpass the limelight; but some of our lantern-makers ought to be able to answer the question. M. T.

[67711.]—**Ink for Boots.**—Any of the usual recipes (to be found in back volumes) will do, but here is a cheap ink. Boil 2lb. of logwood chips in two gallons of water for, say, a quarter of an hour (the chips to be added by degrees as the water boils); then stir in a quarter of an ounce of bichromate of potash, and boil for another quarter of an hour. When cold, add a pound of common gum, which has been dissolved ready. A red ink could be made of a decoction of Brazil-wood, steeping it in weak vinegar, and diluting it with a watery solution of gum. C. G.

715.]—**Vulcanite.**—If this querist cannot to back volumes for information about vulg as applied to dentists' work, he should procure Hunter's "Mechanical Dentistry" from Crosby Lockwood and Son, Stationers' Hall-court, E.C. A. M.

[67716.]—**The Amphitrite.**—Any position, so long as the person lying on the table is strongly lighted up. A reflector could be so fitted as to throw the light direct on the figure. S. P.

[67717.]—**Smoke Pipe.**—Let W, X, Y, Z = 9in. pipe, ·A ·A, G ·G = 4in. pipe at 45°; draw a line at right angle A to ·G at any point, then draw a semicircle and divide into any number of equal parts, and draw indefinite lines; from W X let fall an indefinite perpendicular V, then from ·A ·B ·C ·D draw horizontal lines bisecting V W, at 1, 1, 1 from V W let 1, b = ·B ·b, 1 c = ·C ·c, 1 d = ·D ·d, then join a, b, c, d by an unbroken curved line, then let fall perpendiculars b 2, c 2, d 2 and carry them at right angles through 9in. pipe. Take your plate and set off distances ·A ·B, ·B ·C, ·C ·D, &c., equal respectively, ·A ·b, ·b ·c, ·c ·d, &c., on Fig. 1, then draw perpendiculars equal in length to ·A A, ·B B, ·C C, &c., Fig. 1, then draw an unbroken curved line through A, B, C, D, E, F, G, and your pattern is completed.

East Cowes. J. S.

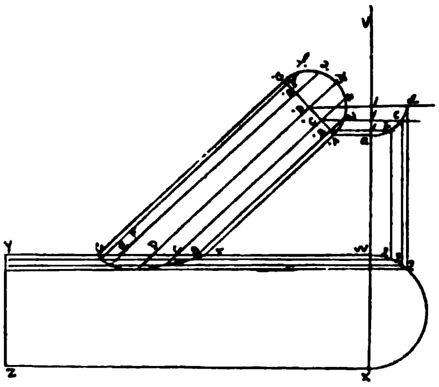


FIG. 1.

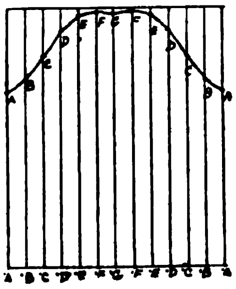


FIG. 2.

[67749.] — **Telegraphic.** — The deflections of needles were probably due to earth currents, which frequently flow from one portion of the earth to another. These deflections are always observed during a display of the aurora borealis, and are also supposed to have some connection with the sun's spots. T. P.

[67762.]—**Furnace.**—In claying a furnace, if the glaze of the slag is left on, and clay put on the top of it, clay soft and hole deep, and no chips of brick put in, the furnace lighted, it will be sure to peel off. I don't think much of your mixture for standing heat; but I think it has been too soft when blast was put on, and the steam caused it to peel off; your blast would not do it. I think you should take my last advice, and you will find it profitable. CAST IRON.

[67768.] — **Telephone Annunciator.** — These annunciators, or drop indicators as they are called, do not act in the manner described. The polarised indicators used are of two kinds, one wound to 100w., and the other to a resistance of 1,000w. The telephones are arranged to send a permanent current to the Exchange when tubes are in rests; this current holds up shutter at exchange, and deflects the small needle fixed on indicator. When renter calls, by repeatedly pressing button, the current is disconnected, shutter falls at Exchange, and needle commences to vibrate, calling the attention of switch clerk. When two renters are put through for speaking, the permanent current is off while tubes are out. The conversation finished, the restoring of tubes to rests automatically puts on permanent current, which, deflecting needles at Exchange, informs switch clerk the communication is no longer required. Two renters through to one another cannot ring their respective bells, unless specially arranged; all the ringing is performed by the Exchange. The black button alluded to is used at a down office, where more than one telephone is in circuit, for calling the intermediate office, the white button being used to call the Exchange. T. P.

[67804.] — **Thermo - Electric.** — The answer should read 3·3 volts. If full details are required, with Editor's permission, I will give them. F. W. MASON.

[67831.]—**Cart-Wheels.**—I beg to thank Mr. Walter J. Parker for his sketch of platform on March 8, which is quite plain so far. If Mr. Parker would show by what means this is to be raised and lowered in tank he would further help "Young Spud," as I want it fixed as soon as possible. A rough sketch of same would very much oblige YOUNG SPUD.

[67845.]—**Foghorn for Bicycle.**—You ask an impossibility. A pressure of about 80lb. per sq.in. would have to be maintained, which would make the exertion of driving the machine unbearable, to say nothing of the weight such an arrangement would add. Compressing air requires considerable power. A. F. SHAKESPEAR.

Lüttichaustr. 14, Dresden.

[67849.]—**Mechanical Drawing.**—I trust that the great importance a knowledge of descriptive geometry is to practical draughtsmen will be a sufficient excuse for my recommending to their notice "The Elements of Descriptive Geometry," by J. B. Millar, published by Macmillan, price 6s. The date of the last edition is 1887. Had I had an opportunity of seeing and examining this work before writing my last letter ("E. M.," March 1), I should have mentioned it in place of any other modern treatise on the subject. It is a well-written book, clear throughout, and admirably adapted for self-instruction.

Charing. J. R. C.

[67880.]—**Lantern Pinions.**—The statement that solid pinions give better results than lantern pinions is contrary to theory. See the article in the "Encyclopædia Britannica," by Sir E. Beckett, now Lord Grimthorpe, who strongly declares in favour of the use of lantern pinions, but says the revolving pins are an unnecessary refinement. SCHLOSS SCHWERIN.

[67880.]—**Lantern Pinions.**—The reply to the above query given by "Welsh Horologist" in last week's issue surely does very scanty justice to this form of pinion. Though unsuited for driving-wheel work, they possess some very substantial good qualities when driven by the wheels, as they are in a clock movement. In order that a wheel and pinion may work smoothly together, it is important that the pressure of the tooth of the wheel on the leaf of the pinion should not begin until the two have reached the line drawn from the centre of the wheel to the centre of the pinion. A little reflection will show that any action which takes place before this position is reached must entail much friction, and that any roughness on either surface will tend to "plough" and groove that with which it is in contact. Now when the pinion is of the solid form it is not possible to avoid some action before the line of centres unless the pinion has at least eleven leaves. With a lantern pinion, on the contrary, there is never any action at all until the line of centres is reached, however low the number of pins may be, so that it will work well and smoothly with, say, six pins. It follows that we can get a higher velocity-ratio with reduced friction by using the latter form, and the advantages of this are weighty and obvious. It is incidentally a point of some importance that the hollow space inside a lantern pinion forms a harmless receptacle for a quantity of dirt which would be much more than sufficient to bring a solid pinion to a complete standstill. F. E. C.

[67880.]—**Lantern Pinions.**—"Welsh Horologist" tells us that the above are never seen in well-finished clocks; also that a solid English pinion always gives the best results. Now, the exact reverse of this extraordinary statement is nearer the truth. The highest class of clocks are usually made with lantern pinions with fixed pins. The clock described by Denison (made for Mr. Salt, of Saltaire, by Moore, of Leeds), as the finest he ever saw, contained lantern pinions. Denison, writing on the subject of these pinions, says:—"They work with much less friction than common leaved pinions of low numbers when driven, the run upon them being less, and the action wholly after the line of centres and the shape of the wheel teeth requiring less accuracy to drive them smoothly." He also states: "I have no doubt a lantern of eight runs as easily as a leaved pinion of twelve, and of course it requires only two-thirds the number of teeth in the wheel, and is also itself stronger and much less liable to break both in hardening and working afterwards. These pinions are used in all the American clocks, and also in the cheap German or Dutch clocks, both of which it is well known will go with an amount of dust in their insides, which would stop a clock with leaved pinions completely." I am now making a large gravity escapement regulator with lantern pinions, and with these, because experiments have shown me that for smoothness of running, solid pinions are not to be compared. Your readers must choose between the two authorities—the one I give, and "Welsh Horologist"—and there should not be much hesitation about that. Tuebor.

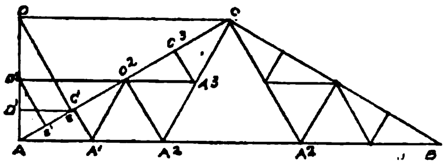
[67884.]—**Model Ship.**—To provide plans on the elaborate scale desired apparently by "Mechanic" for an 18in. model would obviously be absurd. Length of 1,850-ton ship, 265ft.; beam, 40ft.; depth, 24ft. "Mechanic" can work out the proportions. Main-yard 90ft. long, fore-yard that or less, top-mast steps in the top, and is lashed to mast-head by iron cap. Standing yards (i.e., lower yards) and lower topsail yards slung by prong-shaped iron; prongs welded into hoops round yard, and other end to band on mast; by chain tie at bunt and slings at yard-arms shackled to lizard with the braces, &c. Cross-trees are T-irons splayed out aft from the mast and acting as fair-leads for backstays and royal clew lines. About curves: the fewer curves put in the more like the actual vessel. J. C. Q.

[67905.]—**Electric Magnet.**—I fear this query (Feb. 22, p. 528) shows considerable unacquaintance with the subject, and will feel very much obliged if Mr. Bottone or other correspondent will kindly reply with a little information. X. Y. Z.

[67906.]—**Dynamo and Storage Cell for Bicycle.**—To "Fauteil" and "A Cycling Mechanic."—The switch may conveniently be placed on the handle-bar, the same as a bell. The dynamo should be fastened to the backbone, just under the saddle. The accumulator, which must be a V-shaped one, hangs on the backbone, between the back and front wheels. A 5c.p. dynamo would absorb $\frac{1}{10}$H.P. S. Bottone.

[67910.]—**Hammock.**—A hammock is simply an oblong piece of canvas with ends rounded almost to a semi-circle. Canvas is roped round, and ends are eyeletted with brass or galvanised iron thimbles. The clews of small line are rove through thimbles. "A Greenhorn" will find a "cot" the more comfortable resting-place. This is of canvas, just after the fashion of the paper boxes which children are so fond of making. The overhanging flaps are eyeletted and clews attached as in the ordinary hammock. It makes a capital bedstead. J. C. Q.

[67929.]—**Strains on Roof Principal.**—If equally loaded, Fairbairn gives the following graphic method:—Let the whole load = W. Draw the diagram and let A D represent ¼ W, D.C being



parallel to A B, also join D² C² and D¹ C¹, and make D E and D² E¹ parallel to C¹ A¹ and C² A². Using same scale, the strain on tie-rod will be from—

$$A \text{ to } A^1 = D\,C + D^2C^2 + D^1C^1$$
$$A^1 \text{ to } A^2 = D^2C^2 + D^1C^1$$
$$A^2 \text{ to } A^2 = D\,C$$
$$\text{and on } C^2 \text{ to } A^3 = D^1C^1$$
$$A^3 \text{ to } C = D^2C^2$$

D E is thrust on struts C^2A^2

D^2E^1 is thrust on struts C^1A^1 and C^3A^3

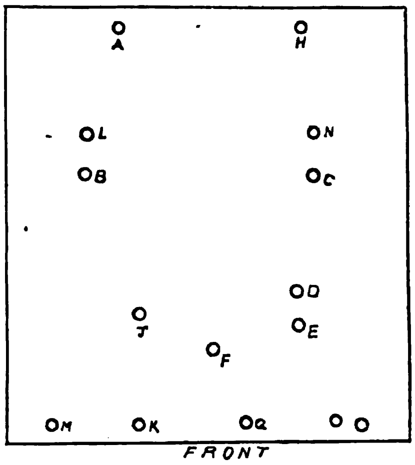
Rafters usually of uniform section, and maximum thrust is about ¾ of the total load on truss.

Bristol. T. C.

[67931.]—**Granule Battery.**—Try the following solution: Inner cell with zinc; permangate of potash, 2oz.; sulphuric acid, 1oz.; water, one pint. Outer solution: Water, one pint; sulphuric acid, 2oz. By adding about 120 grains of chloride of mercury to the solution, the zincs could be left in solution. I do not recommend a weaker solution for battery than this. This solution will not need replenishing for a time. F. Mason.

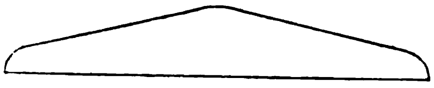
[67938.]—**Turbine v. Waterwheel.**—A Victor turbine will give you quite 25 per cent. more power than the ordinary waterwheel under the same conditions. One I recently saw put in a flour-mill, was only 18in. in diameter, yet drove two pairs of stones with 15ft. head of water; it fairly astonished the owner of the mill. W. J. Hunter.

[67937.]—**Electric Coil.**—I think "Amateur" will, by the aid of the following rough sketch and instructions, be able to connect up his coil. He will require four terminals (where he now has two) in the front of base-board—two for primary, and two for secondary currents. He must also arrange so that one primary and one secondary wire end are



at each side of reel. A is terminal connected to primary wire B; C is the other end of same wire connected to magnet D; E is magnet connected to contact-breaker F (or, as "Amateur" calls it, "pillar carrying platinum-tipped screw"; if there are two pillars, only one need be connected); F is connected to terminal G; H is terminal connected to armature J (pillar carrying spring), thence to terminal K. This completes your primary connections, and you have now only to connect end of secondary wire L to terminal M, and the other end of secondary wire N to terminal O. A. Barnes.

[67946.]—**Straight Edge.**—Steel of 16th gauge would be quite stout enough for 4ft. straightedge, if made as sketch, and 17th gauge for one of 2ft.;



but with care, if your saw is not crippled, one of 4ft. may be made from the back of your saw that will answer your purpose.

Scorrier Saw Mills. A. R.

[67950.]—**Berthon's Equatorial Stand.**—In the *Monthly Notices* of the R.A.S. for last month I read—"The mean error in R.A. of Hansen's lunar tables with Professor Newcomb's corrections as deduced from 79 observations in 1888, is + 0·079s., showing a slight increase on the mean for 1887, + 0·068s., which was itself an advance on the steady value of + 0·03s., found from 1883-6." This is, I understand, what "Luna" wants. Tria.

[67952.] — **Electro - Magnets.** — An "Old Reader" can work his electro-magnets from one circuit either with a battery, or with a current from a dynamo machine. Before his question can be fully answered, it would be necessary to know if more than one magnet would be put in circuit at the same time; if the current is to be kept on any length of time on certain magnets, or if, before contact is made with a second magnet, the first is released. J. H.

[67956.]—**Polishing Machine.**—"Flywheel" will not be able to do any polishing without power to drive at a good speed—say from 5,000 to 6,000ft. per minute, for which his 20in. flywheel with treadle motion is totally inadequate. More speed requires more power, and every ounce of resistance applied to the polisher in the shape of pressure upon it is multiplied at every connection where the speed is increased back to the initial power used to drive it. The polisher used for soft metal—such as brass, copper, zinc, &c.—is what is called mop, which is a disc of calico, say, 8in. diameter, from 50 to 100 thicknesses clamped together at the centre, and which, though unable to bear its own weight when at rest, as soon as the necessary speed is put upon it, is, by the centrifugal force from its centre, thrown out until it is quite stiff, and sufficient to bear upon its outer edge without upsetting it. It would be as well to remark that zinc will not take the high polish of either copper or brass. G. G.

[67959.]—**Engine Query.**—For a single-crank compound engine to develop 200I.H.P. you will require the cylinders to be—h.p. 13in. diam., l.p. 26in. diam. The ratio in this class of engine is generally 4 to 1, as there is no necessity to divide the work as in the double-crank compound. Ratio of expansion 5. The cut-off in h.p. cyl., to effect this rate of expansion, will be ⅘ = ·8 of the stroke; cut-off in l.p. cyl. $\frac{3}{10}$; steam cut-off at ⅑ and ratio of cyl. 3 to 1 would be nine expansions. The weight of the wheel should be at least six tons; width of belting 18 to 20in. To find weight of rim of a fly-wheel—Let d = mean diam. in feet, p = total average pressure on piston in pounds, s = stroke in feet $\frac{p \times s}{45 \times d}$ = weight in cwts.

Longsight. J. Stokes.

[67960.]—**Starting Compound Condensing Engine.**—Many thanks to McGill and J. Stokes for their kind replies on the above; but I am puzzled yet as regards the injection tap—being ordered shut in one reply, and being opened in the other. I hope you will explain the difference; also the cause of the engine losing her water. Are the air-pumps at fault, or the foot of delivery valves? Young Fireman.

[67962.]—**Bluing Solution for Steel.**—Thanks to "Sm." (p. 37); but what I want to know is whether the thin film of sulphide would be produced, and whether it would give a blue colour—not what the object of the recipe may be (I have my own views about that). Of course, I can try it myself; but as my views already agree with Mr. Mason's experience (p. 37)—for which I thank him,—I am afraid I should waste my time. I fancy the recipe is another "sell." I do not believe there is any method of bluing steel except by heat—that is, any permanent way; but, of course, I can coat with blue lacquer. W. T. E.

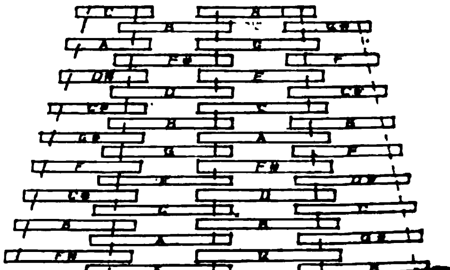
[67964.] — **Dressing Threshing - Machine Cloths.**—Take one pint of linseed and boil in a gallon of water for an hour, or simmer it to get the mucilage; now take an ounce of good yellow soap (I like Cleaver's terebene soap or carbolic); strain off your linseed, and first mix your soap with a quart of boiling water, then mix with the linseed. Dress or size your cloth with this; it is much better than animal size or starch. When very near dry, go over it with boiled linseed oil, just stained with lamp-black that you may see where you are working. Put this on as dry as you can; this is to be done by keeping the brush as dry as you can. See that it covers. Let dry for a day or two, then give it another coat; then take half a pint of boiled oil and work up a piece of soft soap about as large as a filbert in it; when well mixed take two parts of boiled oil and one of good Brunswick black and mix all together, put some lamp-black ground in oil, about ¼lb. to quart, and mix; this is the finishing—you can give one or two coats of this. If you follow this, I think you will say it is the best dressed cloth you ever had. Jack of All Trades.

[67966.]—**Varnishing Maps.**—The fact of it is you have been churning your size and varnish up into a lot of air-bubbles. Your size should be of just such a consistency as you can use like oil when cold, and use a hog-hair fitch for the job; and don't work your brush backwards and forwards, but go over it one way and back again, and the same with your varnish. That answer by "Miles, Bournemouth," is a masterpiece: it is a pity we could not have it framed and glazed, and put up in a conspicuous place for reference.

Jack of All Trades.

[67970.] — **Music from Wood.** — This is a Tyrolese instrument, and must be made of Swiss pine for a really good tone. The following is a sketch and sizes of highest and lowest notes, which is taken from my own instrument received direct from Switzerland:—

Fig. 1.



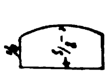


Fig. 2.

Lowest C, 13⅜in. long; top C, 5⅛in. long; section of all notes as shown in Fig. 2; rounded top, ⅜in. thick in centre, ¼in. thick at top, and 1in. (full) wide. The dotted lines show the strings runnin through each note so as to keep them in place, a the centre notes have a small turned button thread between them to keep them slightly apart. Inst ment is laid on five rolled bundles of straw a

1in. diameter, and struck with small wooden hammers.

Bournemouth. MILES.

[67968.]—**Back-geared Lathe.**—Please refer to Vol. XLIV., where full instructions are given for making a 4in. self-acting lathe, from which you can reduce dimensions. J. H.

[67974.] — **Soluble Paraffin Wax.**—Soluble paraffin wax would be of great service in the laundry trade. It could be put into the washing machine. The ordinary wax can only be put into the boiling copper. Will "Working-Man" correspond? See my address in the proper Column.

A. T. RICHARDS.

[67974.]—**Soluble Paraffin Wax.**—In reply to "Working-Man," it is probable his results will not be permanent; but, if so, he has accomplished what has, I believe, commercial value. I have been working on somewhat similar lines myself, and shall be glad if he will communicate his address, with a view of comparing notes. My address will be found in the usual Column. J. B.

[67982.]—**Moulding.**—Use common moulding sand, such as Belfast, not too wet; don't use clay.

CAST IRON.

[67983.]—**Wood-carving or Shaping Machine.**—"Ignoramus" could get shaping and recessing machine from A. Ransome and Co. He had better hunt up their address. I saw an advt. of theirs years ago in the BUILDING NEWS, but don't know if they are still in existence.

SCORRIER SAW MILLS.

[67983.]—**Wood-Carving or Shaping Machine.**—Such machines are made by the manufacturers of wood-working machinery. An arm endowed with a universal motion in the horizontal direction is furnished with rapidly-revolving cutters. The vertical spindle that carries the cutters has a plain end which is traced around the profiles of a "former" or "copy," which the work cut exactly resembles. Builders use them largely. J. H.

[67991.]—**Electrical Contacts.**—Will "Handy Amateur" please advertise his address? I think I shall be able to help him. F. W. MASON.

[67992.]—**To Mr. Bottone.**—The current set up of a battery depends *cæteris paribus*, upon the internal resistance of that battery, and upon nothing else. Suppose we immerse zinc in chromic-acid solution, and pit it against carbon as a negative or conducting plate, we shall get an E.M.F. of about two volts, however small or however large the surface the zinc exposes to the acid. But the current will vary conversely as the distance there is between the zinc and the carbon, and also directly as the size of this latter. The chief advantage that is to be derived from the use of a large zinc surface is that it does not consume so quickly—i.e., does not require renewing so frequently. Suppose we are using acid of such a strength that it dissolves the zinc at the rate of 120gr. per hour, then it is evident that if we expose a zinc surface weighing only two grains, it will be all consumed in one minute, when, of course, all action will cease; but while that action is going on two volts E.M.F. and x current (dependent on size and proximity of carbon), will be passing through the circuit, just as much as though a pound of zinc were in the cell. There is another advantage in using large zincs, though not so great as might at first sight appear, and that is that as zinc is a better conductor than the acid, the larger zinc surface diminishes somewhat the resistance of the battery; but the same result can be obtained more cheaply by surrounding the zinc rod with large surfaces of carbon. S. BOTTONE.

[67993.]—**Dual Arithmetic.**—"Olaf," by contrasting dual with decimal, seems to understand the former in the sense of "binary" arithmetic, or that which uses but two figures, 1 and 0. The "dual" arithmetic of Oliver Byrne is quite another art, and as completely decimal in its notation as our ordinary arithmetic. It is a mode of working logarithmetically, but without the printed tables, certain other kinds of logarithms, with other bases than 10, being made by the calculator himself as he proceeds. I much doubt whether it has advantages for any computations we often have to deal with.

E. L. G.

[67997.]—**Lamps.**—Since voltage cannot pass through a lamp, I am puzzled to know how a high voltage can have burst your lamp. Too much current has passed through your lamp, that is what has burst it. Another time put a few inches of No. 30 German-silver wire between one of the terminals of your dynamo and your lamp; then you will light your lamp without accident. S. BOTTONE.

[67997.]—**Incandescent Lamps.** — "Experimenter" has certainly been rewarded by discovering something that is new to electrical science? Since the amount of heat developed in the filament of a lamp is due to the quantity of current that passes along it—which is proportional to the voltage,—if you used an excessive voltage, there must have been an excessive current sent through the lamp—hence its failure; or if the lamp failed before it was properly lighted, it was a very bad one. If you must run a lamp of lower voltage than the dynamo, put a resistance of iron wire in series with the lamp, or drive the dynamo slower.

W. A. WALTON.

[67999.]—**Condensation.**—Cover it with one of the non-conducting boiler compositions. Cost, for such a small affair, about 6d. per square foot.

Bristol. T. C.

[68001.]—**Motor.**—I could not make such a small Griscom to work a sewing-machine with so little battery power. I cannot give drawings or dimensions of wire so to do. S. BOTTONE.

[68002.]—**Bearing Rod.**—If the rod is to hang vertically, with a strain of 84cwt., a steel rod 1in. dia. at smallest part will carry the weight safely.

Bristol. T. C.

[68003.]—**To Mr. Bottone.**—Yes; a Judson corrugated carbon cell, if fitted with inner porous cell, would do. See my advertisement last week. See also my reply to 67931 (granule battery) as to mode of rigging-up a Fuller for lighting.

S. BOTTONE.

[68005.]—**Power of Engine.**—Nominal horsepower simply supposes that an area of piston equal to 10 circular inches is 1 horse-power, and consequently is merely a trade term to indicate the size. Your engine will give 5H.P., with ¾ cut-off.

Bristol. T. C.

[68005.]—**Power of Engine.**—The N.H.P. is generally taken at ¼ of I.H.P. in land engines, and ⅙ in marine engines. By cutting off at ¾ of stroke the I.H.P. would = 4¼; if ports were large, you might get 4½. McGILL.

[68005.]—**Power of Engine.**—All the rules for the nominal H.P. of an engine are no good, as the difference between the nominal H.P. and I.H.P. is so great that it is no guide whatever to the capabilities of an engine. The Admiralty rule is—

$$\frac{\text{area of piston} \times \text{speed of piston} \times 7}{33{,}000.}$$

Another rule—

$$\frac{\text{diameter of cylinder in inches squared}}{30}$$

And for compound engines $\frac{d^2 + D^2}{33}$, d being diam. of small cylinder, and D diam. of large cylinder. According to your figures, your engine would develop 3½H.P. actual.

Longsight. J. STOKES.

[68006.]—**Armature.**—Yes; the Siemens Alteneck armature is wound in many sections. (This armature has been described and figured several times in "Ours.") One section of wire is wound lengthwise round the drum, the beginning above, the ending below; then the beginning of next coil is connected to the same commutation bar at the end of the last coil, and so on until the drum has been entirely coiled with wire longitudinally. You might wind your 8 by 2½ armature with about 2lb. No. 18, and the field-magnets with 10lb. or 12lb. No. 20. Connect up in shunt. S. BOTTONE.

[68009.]—**Kitchen Boiler.**—The cistern should be so fixed that the water level in boiler and cistern are the same—siphon being constructed according to their relative positions. The probable cause of the back flow is in a blocked-up outlet, preventing a free outlet of the generated steam into flue. Boiler would do for circulating purposes if it is fitted with proper manholes and covers, insuring its being steam and watertight under pressure. It ought to be wrought, welded or riveted, not cast iron.

FRIDAY.

[68009.]—**Kitchen Boiler.**—I scarcely understand the arrangement as "Cook" gives it; but if he wants hot water to ascend to a room 30ft. above the boiler, he can easily have it. The boiler must be a close one, and the flow-pipe must be annexed to the top of boiler, and the return to near the bottom. The cistern must be placed higher than any part of pipe, and the supply may be introduced there. If he wants to supply his bath, he has only to open his stop-cock, and the hot water will flow out. This will be made up again by the water flowing from the cistern into the return-pipe and thence into the boiler. The size of boiler must be regulated by the amount of hot water he wants to use at any one time. ECNAL.

[68010.]—**To Mr. Bottone.**—Don't use a wire core; you can only mount it on a hub, and that is bad. Get 75 7in. Pacinotti punchings; wind these with about 6lb. No. 12, and wind the four field-magnet cores with 18lb. No. 10. Connect up the two sets of F.M. wires in parallel, and couple up the machine as a series machine for arc lighting. This should give you 50 ampères at 20 to 25 volts.

S. BOTTONE.

[68012.]—**Portable Battery.**—Use equal proportions of manganese and carbon dust in cell. Thoroughly saturate this mixture with a strong solution of chlorate of ammonia (salammoniac). You could use same for your other cell, or any other single-fluid cell solution. F. W. MASON.

[68012.]—**Portable Battery.**—As the result of my own experience with these batteries, the best advice I could give you would be to throw the insulite cells away, and get ordinary Leclanché; but if you must have something portable, try medical Leclanché. B. R. W.

[68014.] — **Telescopic Eyepieces.** — On an object-glass of 40in. focus, with eyepieces, of which the—

Field Lens.	Eye Lens.	Distance apart.	Powers will be
3 inches....	1 inch	2inch....	26·6
1·5 „	0·5 „	1 „	53
1·125 „	0·375 „	¾ „	70·16
0·5625 „	0·1875 „	⅜ „	142·2
0·375 „	0·125 „	¼ „	213·3

ECNAL.

[68015.]—**Telescope.**—When the focal lengths of the o.g. and the eyepiece are known, the magnifying power is found by dividing the focus of the o.g. by that of the eyepiece. J. C. LINSCOTT.

[68015.]—**Telescope.**—Divide the focal length of the object-glass by that of the eyepiece. Supposing that your object-glass is 40in. focal length, and the eyepiece is 1in., then the power of telescope will be 40, and so on. ECNAL.

[68016.]—**Carbon.**—If potassium or sodium be caused to burn in dry carbon dioxide (carbonic-acid gas), the oxygen is absorbed by the metal, and carbon is liberated. S. BOTTONE.

[68016.]—**Carbon.**—A knowledge of chemistry is essential for this, as method is rather complicated. If "Leeds" possesses sufficient experience I shall be pleased to help him. F. W. MASON.

[68016.] — **Carbon.**—The gas is first passed through a solution of lead acetate, and then through sulphuric acid; the first removes traces of sulphuretted hydrogen, &c., and the second dries it. It is then passed through a quantity of sodium (or potassium), heated in a tube which breaks up the CO_2 into the carbonic radical and carbon thus—

$$Na_4 + 3CO_2 = 2Na_2CO_3 + C.$$

The carbonic radical is absorbed by the sodium, and carbon deposited as a fine, black powder. Some time ago some scientists, requiring carbon free from all hydrogen compounds, obtained it by heating chalk with sodium in alternate layers. I forget the names of the men, but remember that they required it to determine a disputed point in organic analysis—i.e., as to whether a certain substance contained hydrogen or not. PRINCIPIA.

[68017.]—**Cones.**—To set out cones, draw a base line equal to the diam. of required cone. Bisect this line, and erect a perpendicular. On this perpendicular set off the height of cone, and from this point as a centre decribe a circle cutting the base line at the extreme ends. On this circumference from any point mark off 3¼ times the diameter of the cone. Draw lines from the centre to the two points in the circumference, and cut out segment of the circle. Should you require a lap-joint, allow as much beyond the lines drawn. To set out the frustum of a cone, set out your base line and perpendicular as above, then from the centre of the base line mark off the height of your frustum, and through this point draw a line parallel to base line, equal to the top diameter, bisected by the perpendicular. Join the ends of base line and ends of top diameter, and extend them till they meet. From this point as a centre describe two circles, one cutting the ends of top diameter, the other the ends of base. On this latter mark off the same as for a cone. Join up to the centre, but cut out along the two circles. If you want to be very accurate, the proper factor to multiply the diameter by is 3·1416, commonly called π (pi). DYNAMITE.

[68020.]—**Reversed Brass Letters.**—These are made for the casting of letters for brands, &c.

JACK OF ALL TRADES.

[68023.]—**Watch Repairs.**—If "Amateur" would procure the illustrated price-list of Morris Cohen, 132, Kirkgate, Leeds (four stamps), so frequently advertised in these pages, he would see illustrations not only of the Jacot pivoting turns, but also of all watchmakers' tools and materials.

SCHLOSS SCHWERIN.

[68024.]—**To "T. C., Bristol."**—"Amateur" will notice that his query reads very confusing, and if he will send full particulars again (and not refer me back for information), I will try and meet his requirements.

Bristol. T. C.

[68025.] — **Air Motor.**—Cannot "Wat" see that the object he wishes to attain is "perpetual motion," which is impossible? B. R. W.

[68025.]—**Air Motor.**—I hope "Wat" will really excuse me for declining to assist him in obtaining perpetual motion—for that is what his query amounts to.

Bristol. T. C.

[68026.]—**Incandescent Lamps.**—To MR. BOTTONE.—These vary in price from 1s. to 5s., according-ing to the make and quality. The former are platinum filaments, the latter Edison-Swans, with carbon filaments. (See my advertisement.) The power required to drive a well-made 20c.p. dynamo is about 60 watts, or $\frac{1}{12}$th of a horse-power.

S. Bottone.

[68028.]—**Steam.**—At 308° Fahr. the total heat is $1,082 + (308 \times \cdot305) = 1,175°$, of which $1,175 - 75 = 1,100$, has been added to feed water $= 24 \times 2 \times \cdot609 \times 1,100°$ per minute, or a total of 32,155lb. raised 1° F., in addition to $24 \times 2 \times \cdot025 \times (308 - 75) = 280$lb., raised 1° F. in the priming, equivalent to 32,435lb. raised 1°. As each pound raised 1° represents 772ft.-lb., we have $32,435 \times 772 = 25,039,820$ft.-lb. The engine develops $125 \times 33,000 = 4,125,000$ft.-lb., so the efficiency is $\frac{4,125,000}{25,039,820} = 0{\cdot}16$ about.

Bristol. T. C.

[68029.]—**Boiler.**—If the engine is 3in. by 5in., it is quite large enough. Yes, it would be called 1H.P. nominal. Have a boiler (vertical), say, 30in. by 16in., and firebox 15in. by 12in.

Bristol. T. C.

[68030.]—**Electric.**—Wind the armature with No. 22; get on 3oz. if you can. Now put eleven layers of the same wire on fields. Connect up in shunt machine. This should give you two or three ampéres at 12 volts pressure, enough to light well two or three 6-volt lamps, if driven at 3,000 revs. per minute. S. Bottone.

[68032.]—**Propulsion of Boat.**—Your scheme is perfectly practicable. You will need a motor of the Immisch type, giving from 1 to 2H.P., with a dynamo capable of giving from 60 to 80 ampères at 4 or 5 volts pressure. Such a dynamo would occupy about 12in. square floor-space, stand about 9in. high, require about ¼-horse to drive. Shall be pleased to furnish drawings and castings.

S. Bottone.

[68033.]—**Drilling Small Holes.**—Assuming that you can temper steel properly, it may be that the difficulty arises from not having the drills of the requisite form. There should be no difficulty in obtaining the right quality of steel, as dealers in watch materials supply not only ready-made drills, but also a particular kind of wire for making them. There is a small drill frequently sold of the form of a needle, with a brass sheaf at the end; but this is not adapted for drilling into hard metal, it not being sufficiently rigid. Rigidity is, in fact, very essential for small drills, and on that account the shank should be exceedingly thicker than the boring part, and this latter no longer than what is necessary. A drill of the form of a shaft and pivot is then the right kind of small drill for boring into hard metal, and it would be well also to use a more cutting file than a steel one for cutting it into form.

Schloss Schwerin.

[68037.]—**Transfer Papers.**—Two parts of prepared chalk or any pigment, and one of very finely powdered rosin. Mix with linseed mucilage, weak gum-water, or well-boiled starch. This I gave some years ago. Jack of All Trades.

[68043.]—**Preserving Smith's Bellows.**—Get some pure dubbing from a currier, and apply it over the surface of the leather, say, ⅛in. thick, and let it dry in; or, if you want to make your dubbing, melt some good tallow, take it off the fire, and add, say, one quarter the weight of cod-liver oil; stir well until thoroughly mixed. In cold weather more oil is required; in hot less. Currier.

[68043.]—**Smith's Bellows.**—If "Novice's" bellows are new, do not oil or grease them at all, only keep them clean by brushing the dust off. One pair of new ones that I had lasted nearly 30 years, and never had anything in the shape of dressing put on, and only two patches where iron had run into them. These bellows were 36's, and worked on an average 12 hours a day. If "Novice's" bellows are old, stretch them with a weight hanging on to them, wash them well with warm water with a little grease in, and then dress them well with the best neatsfoot oil. After they are at work again, keep the dust well brushed off, or this cakes on with the heat and makes the leather crack.

F. G. F.

[68044.]—**Flux for Compo. Gas-Pipe.**—The best is compo. candle. Jack of All Trades.

[68046.]—**Micro-photography.**—Procure large common engraving; pin it out quite flat on a well-lighted wall. In the centre of this place the photograph you wish to reduce. Place your camera at such a distance from the engraving that the photograph itself makes an image the size you wish your reduced picture to be—say $\frac{1}{16}$in. diameter. Now focus the engraving very carefully. By this means the central photograph will also be in focus. Expose and develop for the engraving; the small picture will also be right. You will have to print (by contact with a dry collodion or gelatino-bromide plate) from this. If you have a negative, of course you can reduce, as in the copying camera, using a small, short-focus lens, and a long blackened body to carry the negative in. In this case you get a direct positive, so no printing is needed.

S. Bottone.

[68047.]—**Steam Launch.**—A vertical boiler would take less room if it can be got low in section. Stay the furnace to shell, and work at 100lb. Could be bought cheaper. Diameter of screw 20in., pitch 24in., revolutions 250. McGill.

[68050.]—**French Polishing.**—What did you want to give it two coats of shellac for or use the pumice? I don't wonder at its turning grey. Take a rubber and use nothing but methylated spirit, and do your best to rub it off; and you will learn something by that—no fiddling, mind.

Jack of All Trades.

[68051.]—**Japanese Tumblers (Magic Toy).**—These are very simple; the rods are hollow cylinders of pasteboard with a globule of mercury in each, so that when the mercury runs down it jerks one man over the other's head, and so on. The details will be found in Tissandier's "Scientific Recreations." Principia.

[68055.]—**Compressed Air.**—If the lower tank is closed (like a boiler), and strong enough to stand a pressure of 10lb. per square inch, you can do what you wish; but I do not feel anxious to work the air-pump for you. I would much prefer to pump the water up, or even carry it upstairs in buckets.

Bristol. T. C.

[68057.]—**Electric Bells.**—You can get the result you desire if you put another gong on the other side of the clapper, so that it strikes this second gong when it flies back from the first. See my book, "Electric Bells," as to details of construction. It will be better to use a Leclanché battery for the bell, and a separate and stronger battery for the coil. The interruptions of current which take place in the bell circuit would interfere with the proper working of coil. S. Bottone.

[68058.]—**Screw-Cutting.**—If your leading-screw has 2 threads to the inch, put a 20-wheel on mandrel; if 3, then 30; or if 4, then 40. Now put 110 on lead-screw, and an idle wheel, any number, to connect up.

Bristol. T. C.

[68059.]—**Sparking of Dynamos, &c.**—To Mr. Bottone.—The causes of above are various. 1st. The brushes do not press equally on the commutator; 2nd, the brushes do not touch at the right points; 3rd, the coils of the armature are not all alike as to quantity of wire; 4th, the magnetic field is not even, but has two or even three maxima as in the Houston machine, which is a "rare sparker"; 5th, the commutator has worn uneven, and into grooves. S. Bottone.

[68059.]—**Sparking of Dynamos.**—This is due to many causes—bad design being the most hopeless to remedy. If mechanical arrangements are right in a well-designed machine (that is, the commutator runs true, and the brushes are held firm), it is probably because they do not press on the commutator at the "neutral point," and should be adjusted by experiment; or they may not be diametrically opposite each other. Having a large number of sections for the armature conductor, and each of as few turns as possible, will reduce sparking troubles to a minimum, with due attention to adjustment. W. A. Walton.

Steering Apparatus.—At a recent meeting of the Junior Engineering Society a paper on "The Steering Apparatus of Modern Warships," was read by Mr. S. H. Wells, Wh.Sc., Stud.Inst.C.E., Chairman of the Society. The author first considered the action of the streams of water around a ship's stern due to the ship's motion, or caused by its propelling agent, and their steering effects upon rudders, special notice being given to the screw race, with single or twin screws, and the desirability of arranging the rudder to take full advantage of the energy of these race streams. Mention was made of the varying pressure due to the water from top or bottom blades, and of the difficulties met with in sudden reversal of the screw, and consequent change of direction of pressure on the rudder. Different forms of simple, balanced, and divided rudders were then described, including Thorneycroft's double rudders, Thomson's sternway manœuvrer, White's turnabout system, and the Kunstadter steering screw; the results of steering trials of boats fitted with these arrangements being given. Attention was next directed to the size, area, and pressure upon rudders, rules and formulæ for the determination of which were quoted. The investigations of Rayleigh, Froude, and others on these points were referred to, and from them it was shown how the theoretical power of the steering gear could be determined. It was also pointed out that since the pressure on the rudder varied approximately directly as the square of the speed, it was manifestly of little use comparing the time elements in steering trials of different ships unless they had been carried out at a uniform speed.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "T. P." has replied to 67500, A. F. Shakespear 67633.

67397. Gas-engine, p. 385.
67407. Alkaline Substances injected into Steam Boilers Travelling with the Steam, 386.
67416. Spectroscope, 386.
67441. Gas-engine, 387.

67655. To Mount-cutlers, &c., p. 468.
67664. Circular Saw, 468.
67667. Winding Motor and Coil, 468.
67668. German Silver Balls, 468.
67670. Railway Goods Rates, 468.
77699. Water Motor Percussion Floats, 469.
67706. Paper Condensers, 469.

QUERIES.

[68062.]—**Wheel Cutting.**—Would some reader inform me the way to calculate the change wheels of a screw-cutting lathe that I might be able to cut wheels to almost any number of teeth? The change wheels rise from 20 by 5 to 120.—J. Wheelwright.

[68063.]—**Organ Pipes.**—What would be difference in tone in a stopped diapason between a CC pipe made of ¾in. and 1in. wood respectively? Does an oblong section give a different tone to a square, and if so, what is the best proportion? Do different woods produce different tones?—M. H.

[68064.]—**Dyeing Wicker Work.**—Please inform me the best way to dye wicker work. Is it possible to do so by dipping in a water-white liquid? What is it? Also how is copperas and logwood applied for the purpose? I have tried and failed.—Jingo.

[68065.]—**Enamelling Small Articles.**—Would anyone kindly inform me how I can enamel small articles, such as letters? Many things I have about 2in. long I want to enamel either in iron or copper.—D. L.

[68066.]—**Measuring Pendulums.**—Will some of your correspondents kindly say whether the length of a pendulum is measured to the centre of the bob or to the bottom of same?—Bob.

[68067.]—**Brazing Tricycle Parts.**—I am making a tricycle, and would any kind reader tell me how to braze the parts together?—A Constant Reader.

[68068.]—**Boiler.**—Suppose a circular boiler measures 12in. diam. outside and 14in. deep, what will be the required thickness to withstand a steam pressure of 100lb. to the square inch to be in cast iron?—Constant Reader.

[68069.]—**Division Plate and Index for Lathe.**—Would some reader kindly tell me the best way to drill a brass division plate *in situ*, using a paper division plate as a guide? Also mention the best shape of hole, and the best shape for point of index.—A. H. S.

[68070.]—**Gas Blowpipe for Hardening Small Tools.**—What is the best arrangement for heating small tool with gas to the right temperature for hardening, either with or without a blast of air?—A. H. S.

[68071.]—**Power.**—Would a water-wheel 8in. diam., with simple projections for the water to strike against, and with inlet tube at top, ¾in. diam. and at lower end ⅜in. diam., drive a 20c.p. dynamo, and if I made small hole smaller, should I get more or less power?—Experimenter.

[68072.]—**Lamps.**—How are the parts that are heated in Edison's incandescent lamps made, as I have a small glass-blower plant and thought I could make my own lamps?—Experimenter.

[68073.]—**Commutator.**—What is a good test for when the commutator is at its best position, so as to get as much power out of it as possible? Is the Pacinotti ring dynamo any use for continuous lighting? I should only have it for a 20c.p. one. I mean does the armature heat like a Siemens H one?—Experimenter.

[68074.]—**Coppers.**—Will some one who has had experience inform me of the best method to set boiling coppers? Is it possible to make one fire answer for two coppers? I have reason to think that a great portion of the heat generated in my two fireplaces passes up the flues. Instead of setting the coppers in brickwork, can I place them close together in an iron frame, and use sheet iron for casing?—Laundryman, Cambrian Laundry, Lewisham.

[68075.]—**Dynamo for Water-Wheel.**—Could I obtain a 2H.P. dynamo to charge a storage battery, and which, standing in the same place, could be converted into a motor to discharge at the rate of two men-power, and what might be the cost of the number of cells to provide sufficient storage to run the motor three half-hours daily for ten days? I have a 6H.P. water-wheel for doing heavier work, but is unsuited for lighter implements, and I am in search of some method of driving these light gear, which would be at once ready to hand, economical, and cleanly. I have thought of employing a dynamo worked from my water-wheel; but unless I can find one that is convertible into a motor and reconvertible to a dynamo, I am afraid the expense of two machines would interfere with the undertaking. There would be no charge for cable. The dynamo and battery and the implements for which the power is needed would all stand in one room, which is connected with the water-wheel by a wire rope?—Unskilled Electrician.

[68076.]—**Unidirection Current Machine.**—To Mr. Bottone.—I have made the machine described in your book, but cannot get it to work either as dynamo or motor. Armature cheeks made of half-round iron well annealed; flat piece riveted between to form channel for wire; silk put on as directed and wound with nearly 3oz. of No. 22 s.c. wire; magnet very good and of size stated; armature spindle made to work in centres; commutator fixed so that slits are in line with cheeks of armature. I can drive armature at terrific speed, but can get no current from it. If you would kindly suggest where the fault may be, so that I can get it to work, I shall be very pleased. I have made the motor you described last and it works well. Will you please say what c.p. lamp the uni-direction current machine should light, and what battery power to drive it as a motor?—E. Ward.

[68077.]—**Water-Wheel.**—What speed should an undershot water-wheel run to give best results? The wheel is 17ft. diam. and 8ft. 6in. wide, with a 6ft. head of water. Also what power would the above give. The above is at present a breast-shoot wheel and runs 5 revs. per min., but it only gives about 14H.P., and I think it ought to give more.—Millwright.

[68078.]—**Recharging Medical Battery.**—Will Mr. Bottone kindly inform me how to recharge medical battery of the following description? Outside is a carbon cell, 7¾in. high, 3½in. diam., the interior of which is corrugated. A porous pot of 2in. diam. stands in middle, in centre of which is a zinc rod surrounded with cotton wool, which also fills the space between carbon cell and porous pot. The whole is hermetically sealed, and when opened it smelled slightly of ammonia.—J. H. C.

[68079.]—**Trigonometry.**—Let $x = m + b \sin. m + d \cos m$, and $y = x + p \sin. x + q \sin. 2x +$ &c. I want to find y as a function of sines and cosines of m thus:

$$\begin{aligned} y = m &+ s \sin. m + t \cos m \\ &+ w \sin. 2 + y\, m \cos 2m \\ &+ \text{\&c.} \end{aligned}$$

It can be done, but I do not see how to do it at present.—Tria.

[68080.]—**Frame Saw.**—I am trying to make a frame saw to cut a plank up to 1ft. in width. I have a lively little hot-air engine, nominally two-man power, but it would take two strong men to hold it. The frame is about 2ft. 6in. high. The crank, however, is only 2in., so that the stroke is only 4in. The platform is on rollers, and is dragged forward by a weight attached to a cord. There is a flywheel on the engine about 40lb., and another on the crank axle about 28lb. The engine makes about 300 revs. per min. The saw, therefore, works very quickly, but the shortness of the stroke makes the progress slow. What I should like to know is (1) would the saw cut faster if it did not move so quickly? 2. Could I venture to have a crank 3in. in depth, and so have a stroke of 6in. 3. What would be the best description of saw to use, one like the ordinary fret saw, or one with the teeth not larger than a carpenter's hand-saw? I find the saw with the large teeth does not cut so fast as I could wish. The saw-dust is very fine and looks more as though it was filed off. What is the best way of feeding? The weights drag the platform, but the pressure is equally great in the up-stroke, and the work is continually pushed back and drawn forward—does not stand to its work, in fact.—Asoulus.

[68081.]—**Dynamo—40 to 50 Lighter.**—To Mr. Bottone.—Would it be too much to ask you to supplement the sketch, &c. (you so kindly gave in the "E. M." of Feb. 22nd, in answer to a query of mine) with sketches and particulars of the various other parts? Also the distance from the base of the dynamo to the centre of the F.M.'s and the distance from the centre of the F.M.'s to centre of the main or armature shaft. What form of armature do you recommend? I have read with interest the letters in Vol. XLI. that you referred me to; but being not very well acquainted with the minor details of a dynamo, hence this letter.—Royal Mail.

[68082.]—**Shocking Coil.**—Will Mr. Bottone or other friend oblige us with an answer? We have made a shocking coil, 8in. long, 1in. core, with two layers No. 16 c.c. primary, and 1½ to 2lb. No. 28 c.c. secondary, every layer paraffined. Using it generally for charitable bazaars, we want it very powerful, but find occasionally some able to withstand its full power. This is objectionable. What is the best way of strengthening the same, utilising the present secondary? We use two 1pt. double-fluid bichromate batteries (chloride).—Unshocked.

[68083.]—**Fletcher's Bath Heater.**—One of these has just been fitted to a house I am going to take; and the British workman, with his customary cussedness, has gone flat against the maker's instructions in every particular, and consequently the thing is useless. It will cost a good bit to pull the whole to pieces, and I should be glad to know if I carry up a 3in. pipe from the orifice of the flue, which is flush with the external wall, up to the roof and cap it with a windguard, if I shall get draught enough. Of course, I shall have to put a bigger gas supply pipe than the ½in. composition one the genius aforesaid has run up the external wall.—Kappa.

[68084.]—**Induction Coil.**—I have just completed a coil, using for secondary 2lb. No. 40 s.c. wire, carefully wound and insulated, with central division, which gave, with a six-cell bichromate (pints), 3in. sparks; but now I can only get 1½in. sparks with the same battery, and I am at a loss to know how to localise the cause of this falling off. Will some one please help me? Does it require a very sensitive galvanometer to test the continuity of the above secondary, as I can get no indication of a current through it with the six-cell battery and a fine wire galvanometer? How do you ascertain the maximum amount of battery power that can be used with a coil safely, and what would be the effect of using too much power? If the secondary had become severed at some of the joints made during winding, would that seriously affect the length of spark, as the ends would be still held very close together by the paraffined paper insulation? How is the condenser proportioned to length of spark, and what is the most approved form of rheotome for a 3in. spark coil? Lastly, and which is a great puzzle to me, what becomes of the induced current when the secondary terminals are separated beyond spark striking distance, and would doing so be likely to injure a coil, and where?—T. Heath.

[68085.]—**Accumulators.**—Will any reader suggest a remedy for leaking cells (Plante)? I have tried wood cells dipped in pitch without success. I have now earthenware, well glazed, and standing on strong jars; but the acid gets through, even when coated inside with paraffin wax. Would dipping them in hot paraffin wax be a cure?—Volt Ampere.

[68086.]—**Organ Blowing.**—Will Mr. Bottone kindly advise me in the construction and probable cost of an electro-motor, about half-man power, to blow a small organ? I intended using a small gas-engine, but have been advised to use an electro-motor instead, it being cheaper and not so noisy. Also what might be the average cost of keeping the batteries in working order (per month), supposing the motor to be used about one hour daily, or less, and the batteries to have lifting elements? Could the electro-motor, described by you in the "E. M." a few weeks ago, be enlarged to half-man power to do the work mentioned, or would it require to be a different kind of motor entirely?—Motor.

[68087.]—**Petroleum Engine.**—Have any of "ours" made a petroleum engine from Mr. Stoke's designs and found them work well? I do not quite understand how the charge is ignited.—Member Camera Club.

[68088.]—**Preserving Vegetable Colourings.**—I desire to preserve in bottles some green vegetables for the table. They have to be cooked before being bottled. How may the green colour be preserved without deleterious additions, and without imparting a colour to the liquor in which the vegetables lie? They turn out at present a dull yellow colour, though by my recipe the flavour is preserved perfectly.—Chlorophyll.

[68089.]—**Japanning.**—Would some reader oblige a new subscriber with information relative to the japanning of polished iron, such as fenders, stating what japan is used and how applied, and if stoved, at what temperature? I have a gas-heated stoving oven, and have tried several enamels and japans, but without any good results. I want a good hard glossy surface.—Niger.

[68090.]—**Aluminium Palmitate.**—Would any of our chemical contributors kindly say how this compound is manufactured? I could easily obtain the fatty acid, but do not know how it is combined with the metal. As I cannot find out where to buy this compound, I am anxious to try if I can make it. I understand it is used in America by wall-paper manufacturers for giving gloss to their goods.—Maxos.

[68091.]—**Water Pipes.**—How much ought to be depreciated for 2,730yds. of water pipes, that have been laid in a main street for eight years as follows?—1,920yds. 4in. bore, 675yds. 3in. bore, 135yds. 2½in. bore.—W. C. L.

[68092.]—**Regulating Gas Burners.**—Can any reader inform me whether there is a regulating gas burner in the market suitable for an incubator? I find the one in use very unsteady, the pressure on meter at night not being the same as in daytime. I want one to give a steady flame whatever pressure there be on the meter.—Incubator.

[68093.]—**Colouring Benzoline.**—I shall be much obliged to any reader who can inform me of any colour that will dissolve in benzoline—black, &c.? Will aniline? I may mention that I have tried pitch, Brunswick black, but I prefer something more like aniline, as the above will not dissolve enough without becoming thick.—Flywheel.

[68094.]—**Water-Motor.**—Will any correspondent tell me which is the most effective motor to use having a jet of water ¾in. or 3-16in. diam. at 40lb. pressure? I should like to know the best for speed and small power, and most power and slow.—T. F.

[68095.]—**Launch Engines.**—I have a launch, 52ft. by 9ft., and a draught of 5ft., a fairly good model. What sizes of cylinders (compound condensing) and boiler would it require to drive it 12 miles per hour, and what power would such engines indicate? Also what size of propeller would be necessary?—W. C. S.

[68096.]—**Electro-Magnets.**—To produce the greatest strength in a small electro-magnet, what size wire should be used for winding, and length of same? Also what strength of battery power would be used to work several of these with certainty? I am wishing to get a small magnet to lift a weight equal to ¼lb., with the armature ¼in. from the poles. If several electro-magnets are placed together, would the current through one have any effect on its neighbours? Any hints on this subject will be very welcome.—W. F.

[68097.]—**Boring Holes in Granite.**—Will some kind reader help me in the following? I have a number of holes to bore through granite, the thickness of which is 12in., diam. of hole ¾in. What I most particularly want is, can they be drilled through? If so, with what kind of drill?—Sonny.

[68098.]—**Throttle Valve.**—Will "T. C., Bristol," kindly let me know what kind of valve is best for governors you described in last week's issue, No. 67982, and details for making same?—S.

[68099.]—**Boiler Stress.**—Will some one give me the stress in tons of a boiler that is 7ft. diam., 28ft. long, at 70lb. pressure per square inch? Also the way of calculating it.—Boiler.

[68100.]—**Tabular Pneumatics.**—Will any reader please say what the general action is of above in organs?—Oboe.

[68101.]—**Engine Query.**—Can any reader please inform me the diameter and stroke of gas-engine cylinder for ½H.P., and about the weight and size of flywheel?—W. S.

[68102.]—**Toy Soldiers.**—Will some one kindly inform me how the small lead toy soldiers, &c., are cast? I have somewhat similar castings to make and find a difficulty.—S. B.

[68103.]—**Lantern Slides.**—Can anyone inform me how to prepare the colours for painting lantern slides, so as not to appear thin and streaky? Are they varnish colours or enamels? Will aniline colours do?—One in a Fix.

[68104.]—**Catering.**—What is the best way of making tea for 200 people, and what are best proportions of tea, sugar, and milk for 200 pints? Are there measuring taps made, that will measure and let pass, say, one pint for each turn or movement, and who makes them? What is the best recipe book for cooking for numbers of working people, soups, stews, &c.?—Aci.

[68105.]—**Bath.**—What kind of bath would best stand rough use (the house being often let furnished), and what would be the relative prices of zinc, enamelled iron, slate, fireclay, or anything else?—Duck.

[68106.]—**Clock and Watch Springs.**—How is the steel cut to narrow strips? How is it heated and coiled, and the beautiful colour obtained, and are the springs tested? If so, how?—Bouclières.

[68107.]—**Electrolysis.**—Kindly tell me how to make (and use) the electric instrument for destroying superfluous hairs. I think it is called the electric needle.—Electrolysis.

[68108.]—**Sulphide of Tin.**—Will any reader kindly tell me the best way to reduce sulphide of tin to a metallic state?—George.

[68109.]—**Creaky Boots.**—What is a good remedy for this extremely disagreeable noise?—A. Lloyd.

[68110.]—**Painting Greenhouse Pipe.**—What is the best material with which to coat the outside of the hot-water pipes in a greenhouse? It should be such as will prevent the pipes from rusting when watering the plants, and at the same time should stand the heat of boiling water within the pipes, and not emit any fumes or peel off.—A. Lloyd.

[68111.]—**Phonograph.**—Can any of your readers inform me what shape the needles should be (using a wax cylinder), and also the method of attaching same to the diaphragms, which, I believe, consist of glass for recording and silk for interpreting?—P. C.

[68112.]—**Incubator Regulator.**—Will some one kindly tell me if I can obtain a wire coil of any kind, 3in. or 4in. in length by 2in. or 3in. diam., that will expand under the influence of 110 per cent. of heat and return to its original position as the heat decreases, or tell me of any other way to construct a moderately reliable regulator for incubator?—R. H. J.

[68113].—**Basting Meat.**—Can anyone suggest a good mechanical contrivance for continuously basting meat while being roasted? It should be automatic, and at the same time practicable. The usual method of having to perform the operation by manual labour renders it liable to be neglected, with the result of causing the joint to be burnt outside, and dry and insipid within, as though baked in an oven, instead of being juicy and succulent as when properly roasted. Might not something similar to the oil lubricators of engines be contrived?—A. Lloyd.

[68114.]—**Problems.**—I shall be obliged if any of your mathematical readers will transpose the following:—

$$X = \sqrt{\frac{H \times F}{n \times A \times R \times S}}$$

I want the values of H, A, R, and S respectively.—J. Stokes.

[68115.]—**Electric Motor.**—Would some kind reader give me dimensions of a ½H.P. motor? I want as flat a machine as possible. Please give of size armature and field magnets; also size and quantity of wire; also the kind of battery and accumulator to keep it in work for 4 or 5 hours, and what size plates they would require? Please state the best way to connect wires. This must not have any dead points.—H. Harcourt.

[68116.]—**Dynamic.**—Will any kind reader of "Ours" assist me by solving the following? What power will it take to throw a body, one pound weight, 25ft., sliding along a horizontal plane 6ft. long, and 19ft. through the air, until brought to the ground by the force of gravity? This is no idle question, but one which involves most important and practical results.—Dynamic.

[68117.]—**Derrick.**—Will any of your readers kindly give me a rule for calculating the safe load that a derrick pole (pitch pine and red deal) will carry in lifting bridge girders, the pole being held in a vertical position by guy ropes, the weight acting at the edge?—H. B. Jones.

[68118.]—**Holland.**—Can anyone tell me what sort of country Holland is for a cycle business? What places are best suited; preferably near the German frontier, and not over-damp. Whether at any places German is spoken.—A. F. Shakespear, Dresden.

[68119.]—**Gassner's Dry Battery.**—To Mr. Bottone.—Will you kindly inform me if the outer element of this battery must take the shape of a jar? Would it not be equally effective if an earthenware pot were used, with a roll of zinc inside? In what proportions should the exciting compound be mixed?

[68120.]—**Cupola.**—Would some reader give me sketch, with dimensions? To run about two cwt. of iron at each tapping, and how to charge it? Also the best lining, size of fan, and revolutions per minute?—W. J. B. Wholey.

[68121.]—**Screw-Cutting.**—How does a lathe double the error of its lead-screw? Thus a lathe with 4 threads per in., lead-screw has 40·1 threads on 10in.; but when set to cut the same rate, 40·2 threads appear. Can a lathe be constructed that will absolutely reproduce its own screw?—A. F. Shakespeare, Dresden.

[68122.]—**Nickel-Plating.**—I have made a small vat of nickel solution, holding about six gallons, with double salts of nickel, working it with an American patent battery. I have tried it with iron, which turns out very scaly. Will some reader kindly tell me if my solution is in fault, or too much battery power.—W. McPherson.

[68123.]—**Bronzing Tin-Plate.**—How can I produce a bronze or dark bluish-grey steel colour on tin-plate to be permanent? I wish to darken the exterior of lantern body of enlarging apparatus, as I do not like the appearance of the bright tin with polished wood. I do not wish to use any form of japan or varnish, which sooner or later chips and scratches.—Indian.

[68124.]—**Dynamo.**—To Mr. Bottone.—I have a set of castings, 7in. high, 5in. wide, ⅜in. thick. Laminated armature, 5in. by 2in. What size and quantity of wire would it take to light two 20c.p. lamps in parallel?—Henry.

[68125.]—**Dynamo.**—To S. Bottone.—In reply to 66774, October 26, 1888, you give amount of wire for dynamo to light 4-volt lamp. Would the same wire on a Siemens H armature and same F.M.'s light 6 or 8-volt lamp? If not, please state quantity. Also be pleased to give directions for peg-board to give inter-communication, as in telephone exchanges, to twelve lines or more.—A Subscriber.

[68126.]—**Paris Exhibition.**—I hope to visit Paris in the course of the season, and should like, instead of stopping at an hotel, to have a bedroom from which I could sally out and get my meals where convenient. As many might wish a similar arrangement, a little information as to combining respectable locality with moderate price from one acquainted with Paris would, I am sure, prove acceptable.—Tourist.

[68127.]—**Soldering Zinc Bath.**—I have tried spirits of salts killed with zinc and salammoniac, as well as other fluxes that have appeared in the "E. M.," and it is that greasy I cannot get solder to take after cleaning. I have tried Baker's Preparation. Would some of "ours" assist me a little? I use tin solder and a well-tinned bit. —Dark Zinc.

[68128.]—**Watch Timing.**—I have a watch that has had a new verge fitted, and it gains about 2 hours in 24. Regulator is put right to "slow." Could I alter the hair spring to get it to keep time? And how done?—Clock Cleaner.

[68129.]—**Clay.**—I have a bed of clay, which I think is oxide of iron and clay. It is dark red, soft to the touch, quickly runs to a kind of black cinder when in the kiln. If any of the readers of the "E. M." can say of what use it is, I shall be obliged.—Bricks.

[68130.]—**Alcohol and Fermentation.**—Can any reader tell me what is the least percentage of proof spirit that will absolutely prevent fermentation taking place in, say, grape juice, even if yeast were added under circumstances most favourable to fermentation, as regards temperature, &c.; or, to put it another way, what percentage of proof spirit would be developed in, say, grape juice, supposing sugar to be in plenty, under similar circumstances? I ask because I have seen several conflicting statements, and have not the means of accurately testing for myself. Perhaps Mr. F. Davis would oblige.—Tren.

[68131.]—**Voltage of Leclanche and Fuller's Cells.**—Will any of your readers be good enough to inform me what is the computed voltage of the Leclanché cell and Fuller's bichromate cell, relating to the standard Daniell.—74 M.

[68132.]—**Factory Spindles.**—Can any subscriber tell me how to soften steel factory spindles, so as to turn them? I have tried the usual method for annealing steel, viz:—inclosing in an iron box with sand, heating to redness for half-an-hour, and cooling slowly. Can soften ordinary steel by this process, but it seems to have no effect upon spindles. Have been told that there is a special method of doing it; and should be very glad to know what it is.—Yokel.

[68133.]—**Grey Parrot.**—A fortnight ago I bought one of these, freshly imported, from a large dealer in the east of London. The bird seems quite well so far. I am given to understand that these birds when imported in quantities almost invariably die within 8 weeks at latest. Can any one kindly recommend best food and treatment to insure health? What is the average length of time in which these birds learn to say a word or two at the very commencement of their training?—Indian.

[68134].—**Gramme Dynamo.**—Field-magnets 3¼in. long, 1½in. diam., wound with 10lb. No. 22 d.c.c. wire. Armature ring 5in. by 2in. in 10 sections, wound with 3lb. No. 18 d.c.c. wire. How many volts and ampères should it give; also what speed? How many 16c.p. lamps should it light and what voltage should the lamps be? Apart from the question above, is there any advantage in using high volt lamps over low voltage?—Amateur.

Dr. Dallinger on Evolution.—On Monday evening, the 11th inst., at the Birmingham and Midland Institute, the Rev. W. H. Dallinger, LL.D., F.R.S., delivered a lecture to a large audience, on "Recent Researches in the Vast and the Minute Indicating Evolution." The lecturer said that since the human mind had given itself fearlessly and without bias to the study of phenomena, evolution was no longer a bugbear, and might be looked upon, even by the most timid theologian, as the actual method of creation. Dr. Dallinger dealt with the aid that had been rendered to the study of the heavens by the telescope and microscope, and pointed out that even these instruments, valuable as they were in the researches, could not realise the same results that followed the use of the art of photography. By exposing sensitised plates for a period of time, ranging from a number of hours, stars and nebulæ that were invisible to human sight were revealed. A most remarkable case in point was furnished by the photographic operations of Mr. Isaac Roberts, in connection with the constellation of Cygnus, which comprised 170 millions of solar systems as important as our own. Another photograph, taken only three months ago, represented the nebulæ in the constellation of Andromeda, which brought them face to face with worlds in process of formation—a system of visible evolution. Doubtless within the next hundred years changes would take place in that solar system so great as to furnish absolute proof of the changing process. From astronomy the lecturer went to minute organisms, and detailed experiments which he had made, showing that organisms living normally in 60° of heat became so changed in constitution and formation as to thrive and multiply in a temperature of 165°. The doctrine of Darwinism, he pointed out, did not suggest changes where there was no alteration of environment, but transformation to meet altered circumstances.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 13, and unacknowledged elsewhere:—

Edward Hines.—J. McG.—H. Hancox.—J. and H. Grace. —A. Marson.—H. Gilbert.—Harrold.—Paraffin.—Tyke. —Proselyte.—New Subscriber.—T. Robinson.—Libra.—Photus.—Puzzled.—H. Ward.—Sm.—W. P. Maycock. —Thirteen Years' Subscriber.—An Amateur.—W. W. B. —A Fellow of the Royal Astronomical Society.—Alfred Treeby.—Gilbert B. Lückhoff.—J. H. King.—J. C. Linscott.

Walton, Baltimore, U.S.A. (The "puzzle" is a rather old one—much older than the Sepoy rebellion—and it has lately been revived by a well-known firm of soap makers. In yours the two pieces of wood help to deceive, and the key "completes" the deception; but the answer is the same. The wood is softened by boiling or steaming, and is then pinched in a vice until it will pass through the hole. The grain of the long pieces runs with their length, because it would not be so easy to do the puzzle otherwise, and, as you note, it offers proof that they must have been passed through the hole.)—G. H. P (There is a much better way of silvering a concave piece of glass than by the use of mercury, and full directions for depositing a film of pure silver have been given many times. See, for instance, the index issued with this number, and p. 471, No. 1164, together with the indices of many back volumes.)—R. (We do not keep queries, and have only a dim recollection of yours. The planisphere has been described in back numbers, and as to what you want about Mercator's projection, that was not specified. The queries are of little or no interest to other readers.)—Essayist. (We have given the composition for making copying pads hundreds of times, and if you had studied the "rudiments" you would not have tried "size and glue" mixed or separate. Take one part of good glue and soak until soft; pour off the water and melt. Then mix well into it four parts of glycerine and sufficient whiting or barytes to make the whole cream colour. Pour out into a shallow tray and skim bubbles from the surface with the edge of a bit of card or stiff paper.)—Edwin Gates. (The numbers are out of print, and as to the best "practical book," it depends on what you want to do—slop work or artistic bookbinding. Zaehnsdorf's "Art of Bookbinding," Bell and Sons, is a good work. Nicholson's "Manual of the Art of Bookbinding," E. and F. N. Spon, 125, Strand, W.C., may suit.)—W. F., Bury. (You can advertise yourself as an "electrician" or a "consulting electrician," and so put C.E. after your name, without "fear of any society." (2) We do not know, but it may be Greek in incorrectly copied Roman or Italian characters.)—J. A. Hamber. (See index published with this number.)—A. L. (See previous answer, and refer to the indices of back volumes.)—F. Jenn. (Surely you can "burn" it by putting the borax on a hot plate or in a crucible. How would you think of doing it? Not necessary for brazing.) —E. H. T., Dover. (Mr. Wimshurst has himself given in this paper full instructions for making various sizes of his machines, and they are also published in a little book by Pewtress and Co., Little Queen-street, Holborn, W.C. See the indices of recent back volumes, and especially No. 1127, p. 192, No. 1025, p. 242, No. 1073, p. 142, and No. 1076, p. 201.)—Montague Hankey. (The Nos. containing such information generally run out of print; but if you could see the back volumes you would find explicit directions for making all kinds of organ pipes.)—Gortschakoff. (Try David Nutt, Strand, W.C., for Reiff's Grammar, or Trübner and Co., Ludgate-hill, for Riola's "How to Learn Russian.")—Member Camera Club. (Tastes differ; but the Musette is scarcely a drawing-room instrument, except in houses where the bagpipes would be appreciated. 2. Yes. 3. Recently answered.)—A New Reader. (No. 752 is out of print. Back numbers, when in stock, are sent post-free from this office for five halfpenny stamps.)—W. P. Jones. (There are several works on telegraph instruments—for instance, Bond's "Handbook of the Telegraph," Crosby Lockwood and Son; Culley's "Handbook of Practical Telegraphy," Longmans. The first-named will probably suit you, but the last-named is the textbook for telegraph engineers and operators.)—J. G. Rust. (See any of the textbooks if you cannot refer to back volumes. The pump on the engine compresses air into a reservoir which is conveyed to cylinders beneath the coaches. Those cylinders contain a piston which, acting on levers, applies the brake-blocks. An illustration of the new quick-acting brake cylinders was given in No. 1204.)—T. N. Cox. (The Whitworth method of making true planes is given in nearly all the manuals and textbooks of tools and machinery; and a description can also be had from the works, or "any bookseller.")—Lux. (If gas is available, use the Wenham lamp.)—C. W. E. (See the index issued herewith under "Cameras, home-manufacture of.")—Mars. (See the index of the last volume issued with the present number, and the previously-published indices.)—Mexican. (By drawing a magnet over it from end to end. See the indices or any textbook.)

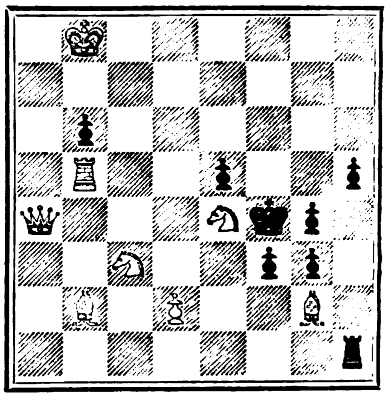
Thousands of People have tried the effect of wearing HARNESS' ELECTROPATHIC BATTERY BELT for the prevention or cure of disease, and in every case the result has been most satisfactory. All in search of health should wear this, the only *bona-fide* reliable galvanic belt recommended by thousands (see testimonials) for the immediate relief and speedy cure of all rheumatic and nervous affections, impaired vitality, liver and kidney diseases, ladies' ailments, &c. Pamphlet and advice free on application to Mr. C. B. HARNESS, Consulting Medical Electrician, the Medical Battery Company (Limited), 52, Oxford-street, London, W. (corner of Rathbone-place. Note only address.

CHESS.

All communications for this department must be addressed "Chess Editor, English Mechanic, 332, Strand."

PROBLEM MCXLI.—By Victor Gorgias.

Black.



White. [8 + 8

White to play and mate in four moves.

Solution to 1,138.

White.	*Black.*
1. B-R 6.	1. Kt takes B (a).
2. Q-Q 4 (ch).	2. R takes Q mate.
2. Kt-Q Kt 4 (ch).	(a) 1. Kt-Q B 3 (b).
2. Q-K 4 (ch).	(b) 1. B takes R (c).
2. R-B 3 (ch).	(c) 1. B takes Q (d).
2. Q-Q 4 (ch).	(d) 1. R-R 5.

There should be a B-P at Q R 6 to prevent
1. Kt Q Kt 2, &c.

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,138 by E. Sanders, F. C. Cook, Formosa, J. W. Read, and G. A. Macbeth; to 1,137 by G. A. Macbeth.

F. Fernando.—If in 1,138, 1. $\frac{\text{R-K B sq}}{\text{B takes R (ch)}}$ 2. $\frac{\text{Q-K 4 (ch)}}{\text{B takes Q}}$, 3. K-Q 7.

J. Kistruck.—How do you proceed in 1,138, if 1. $\frac{\quad}{\text{P takes P (ch)}}$, 2. $\frac{\text{K-K 6.}}{\quad}$

Names entered for Tourney:—Hensing (A), J. A. Miles (A), G. Keeble (A), Othello (C), G. A. Macbeth (C), Fr. Fernando (C), J. Harrop (A). We have now thirteen entered in A and thirteen in C. We are willing to relax the rule that competitors may only enter in one section, so far as to allow any competitor in C to enter A, on payment of additional entrance fee.

F. C. Cook.—Your solution is sound; but it is not the author's. We suspect a B. P at Q R 6 has been accidentally omitted. This makes it all right.

H. Planck.—Thanks for the problem, which shall appear in due course if correct.

J. J. Jones.—We are obliged to you for the copy of the game, as also for the magazine, which has plenty of good chess to recommend it, apart from its other features. We have pleasure in complying with your request.

The following are the rules as to marking in the Solution Tourney which will commence next week:—

1. Five points allowed for each correct key move, in three movers, provided all the variations are given in Black's first move. (None need be given in the second).
2. Two points allowed for each correct key move in two-movers.
3. Two points allowed for each additional solution discovered to a three-mover; one point to that in a two-mover.
4. In three-movers, one point allowed for each dual continuation on White's second move, should such occur in author's solution.
5. In the event of a problem having more than one solution, the key moves only of additional solutions need be sent in.
6. A competitor proving a problem to be unsolvable or impossible will receive two points.
7. One point to be forfeited for each incorrect claim; also for the omission of any variation in Black's first move.
8. Solutions must be received not later than a fortnight after publication of the respective problems.
9. Solutions once received cannot be recalled, corrected, or cancelled; but in the event of a second key move being discovered and sent in within the time limit, points will be allowed.
10. A problem in each section will be published each alternate week.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 22, 1889.

PRACTICAL ELECTRICAL TESTING.—III.

By E. J. Wade and F. C. Allsop.

FIGS. 5 and 6 show side and front elevations one-quarter real size, of a simple form of scale and lamp for use with reflecting galvanometers, or other apparatus employing the same principle.

The base *a* is a rectangular piece of ¾in. stuff, 12in. long by 8in. wide, From this rise the two uprights *b b*, 6in. apart. They are 5in. high by 3in. wide, and ½in. thick. A strip 1in. wide is cut out of the centre of each to within 1in. of the base *a*; the tongue pieces *d* fit into the gaps thus left. Four brass strips, *c c*, screwed to each upright, two on either side, hold the tongues in their places, and a set-screw in the upper strips enables them to be clamped at any desired height.

The board *g* is 18in. long by 3in. wide, and fixed to it at right angles is the scale-board *l*, 18in. long by 2½in. wide. Another board, *n*, of the same length and about 3in. wide, is attached to the upper edge of *l* by hinges, so that it can be bent over at about an angle of 60°.

The lamp *h* burns paraffin oil, and has a flat wick. Any ordinary paraffin lamp may be employed, provided the centre of its flame does not stand more than about 4in. high; but if this cannot be obtained, a rectangular oil reservoir, 6in. long by 5in. wide, by 1¼in. high, should be made from sheet tin, and the wick and chimney holder fitted to the top about 1½in. from one end. This is best done by soldering on a brass collar, into which the holder either slides or screws.

Outside the glass chimney *p* is a metal cylinder *o*. This may be made from sheet copper, zinc, or tin; but copper is to be preferred, as it keeps its shape better. It should be large enough in diameter to just clear the sides of the chimney, and about 8in. in height. No solder must be used in its construction, as the heat from the lamp would soon melt this; but when bent into shape the two edges should overlap by about ⅛in., and some small rivets be put through. Paper fasteners do very well for this purpose.

The object of the cylinder is to shut in all the light from the lamp except that which passes out through the hole *r*. This is cut out at such a height as to just come opposite the brightest part of the flame, and may be either a ½in. circle or a rectangular slot ½in. long by ⅛in. wide. A slit is also cut in the cylinder to enable it to pass over the handle that regulates the height of the wick, and a number of holes are bored all round near the bottom to allow the air to pass up to the lamp. (These latter are not shown in the drawing.) It may be found that the draught up the cylinder between it and the chimney interferes with the draught up the chimney itself, and causes the lamp to smoke; in which case it will be best to have a top to the cylinder with a hole in it just large enough for the lamp-glass to pass through. Across the hole or slot *r* is stretched a fine wire, about No. 32 B.W.G. It is fastened by threading it through two small holes just above and below the slot.

The scale is of paper, and fixed in position with a little thin glue. It is usually divided into millimètres, and numbered from the centre to each end as shown. Scales may be bought specially numbered for this purpose, or an ordinary half-mètre scale may be procured and the numbering rearranged. All the woodwork of the above apparatus should be sized and varnished to diminish its tendency to warp, and for the same reason a fairly hard and well-seasoned wood should be employed. Mahogany or teak is the usual practice; but this is purely a matter of taste.

The scale should also be sized with a little isinglass dissolved in water, and then varnished with the best pale varnish.

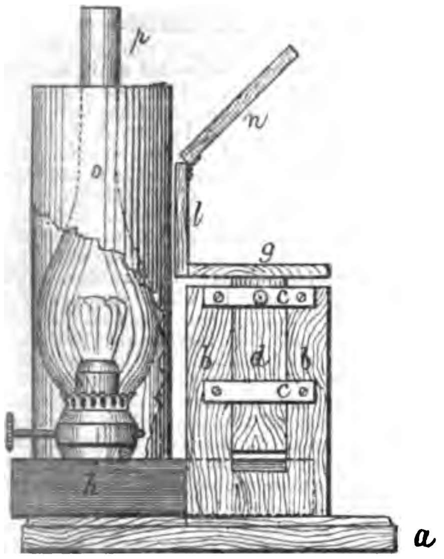


Fig. 5.

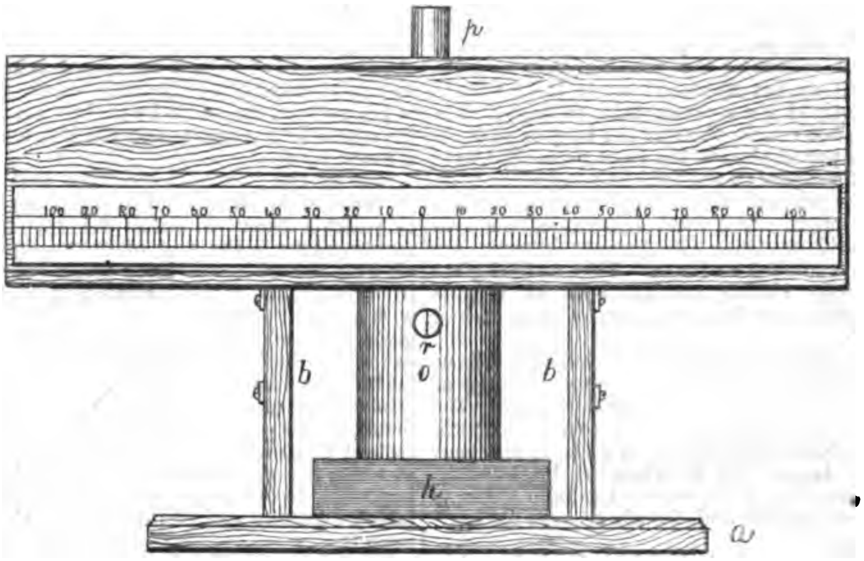


Fig. 6.

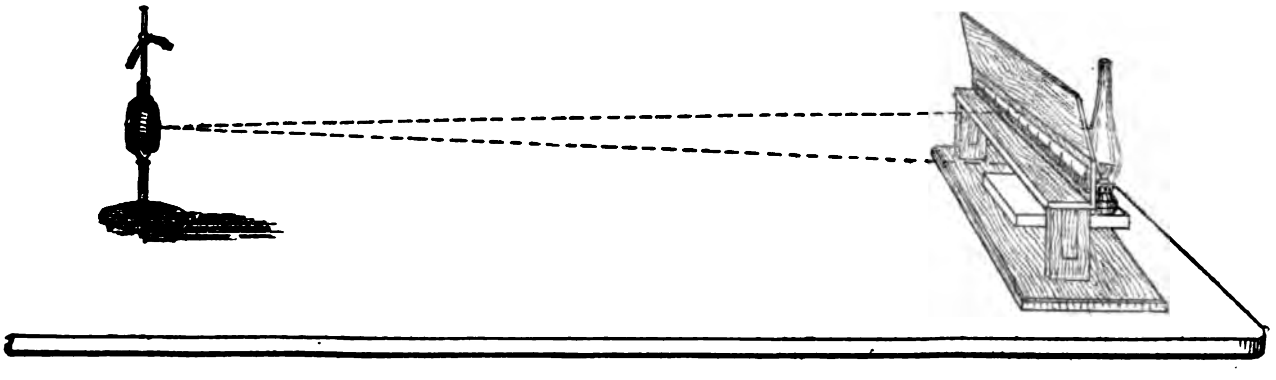


Fig. 7.

Fig. 7 gives a perspective view of the galvanometer, lamp, and scale in position ready for use. The lamp is shown without the inclosing cylinder. If a plain mirror is used in the galvanometer and no lens interposed between it and the slot, the diverging rays from the lamp will be reflected on to the scale as a dull and confused blur of light, quite useless for any purpose. There are at least five or six different methods by which a distinct image of the slot and wire may be produced on the scale, and we will deal with these in detail.

1. A double convex lens of short focus is interposed in front of the slot. This collects the diverging rays of light on their way to the mirror, and after reflection refocuses them on the scale. The lens should be from

4in. to 6in. focus, and placed about the same distance from the slot. The image obtained by this method is necessarily several times larger than the object, with the result that the whole of it cannot be reproduced on the scale, the brightness is considerably diminished, and the wire more or less thickened and blurred.

2. A concave mirror is used instead of a plain one. The "principal focus" of the mirror should be one-half the distance between the galvanometer and scale. The image produced will be the same size as the object, and of equal brilliancy. Most of the best makers fit their instruments with concave mirrors; but these are expensive to buy separately, and the same results can be obtained by the next method at much less expense.

3. A double convex lens of long focus is placed close in front of the mirror. The closer this is to the mirror the better, and it may very well be permanently fixed to the front bobbin of the galvanometer, so as to close up the aperture; or, if the mirror is contained in a separate tube, as described in our last article, the lens can be ground down and put in place of the front glass. The rays of light pass through the lens twice—once on their way to the mirror, and again after reflection. The focal distance of the lens should be twice the distance between the galvanometer and scale. This method gives exactly similar results, both as regards brightness and size of image as the preceding one.

4. This is a combination of the short-focus lens used in No. 1 with the concave mirror or long-focus lens used in Nos. 2 and 3. The distance of the former lens from the slot will be about 2in. to 3in. with a 4in. to 6in. lens. The image will be about as bright as the object, but from one-and-a-half times to twice the size, and, therefore, easier for reading.

5. In this method, which is due to Mr. Mudford, the same combination is employed as in No. 4, but the short-focus lens is placed at about its focal distance in front of the slot—that is, 4in. to 6in. The image obtained is not that of the slot, but of the lens, and the wire must, therefore, be removed from the former and stretched across the face of the lens nearest to the galvanometer. The image will be the same size as the lens, and about as bright as in No. 1. Of the above Nos. 4 and 5 are undoubtedly the best, and there is not much to choose between these two, but on the whole we prefer No. 5 for general purposes, and No. 4 for the finest work.

The "principal focus," or "focal distance," of a convex lens is that distance from the lens at which parallel rays of light will be brought to a point or "focus." These distances measured in inches give the numbers by which opticians distinguish various lenses; for example, a lens with a focal distance of 48in. would be called a "48in. lens," and so on. These remarks apply similarly to concave mirrors.

The "focal distance" of a convex lens may be easily found as follows:—Hold the lens in front of a candle or other source of light, and on the side furthest from the light hold a sheet of white paper. Now shift the lens and paper until an image of the light is obtained on the paper of the same size as the light itself. The distance between the paper and the light divided by four will give the focal distance. 4in. to 6in. lenses are used for magnifying glasses, and 48in. to 60in. lenses for weak long-sight spectacles. Both kinds may be obtained from any spectacle-maker for a few pence. The former will need to be mounted on a stand so that they can be shifted about when focussing. They may either be fitted up the same as the condenser lenses used with microscopes, or a simple wooden frame may be made to answer the same purpose.

The galvanometer, lamp, and scale are set up ready for working, as follows:—Raise or lower the suspension-pin to bring the mirror centrally within the coils, adjust the levelling screws until it swings quite freely, and then bring it round parallel to the faces of the bobbins by turning the controlling magnet. The lamp having been lighted and the metal cylinder placed in position, see that the edge of the wick is towards the slot, and also that the flame is at the right height to bring its brightest portion in a line with the slot. Place the scale and lamp directly facing the galvanometer, and advance or retreat them until a distinct image of the slot and wire is obtained on the scale, raising or lowering the latter as may be required to bring it to the right height. If a second lens is used, introduce this in front of the slot, and move it backwards and forwards until an image either of the slot or of the lens (according as methods No. 4 or 5 are used. Of course, if No. 1 is employed, no focus can be obtained until the lens is interposed) is again obtained. Now bring the image of the wire to the zero on the scale by slightly turning the controlling magnet, and the instrument is ready for use.

It is of the greatest importance that the galvanometer should stand in a place as free as possible from vibration, for the least movement sends the spot of light swinging all over the scale. A brick pillar built up from the ground without coming in contact with any portion of the surrounding building gives the best results; but, of course, this can seldom be done except in places specially built for testing purposes. It is often preferable to place the instrument on a bracket firmly fixed to one of the walls of the room, instead of standing it on the table or bench at which the operator works, for it is almost impossible to avoid occasionally shaking the table by leaning against it or placing things upon it.

Vibration may also be very considerably diminished by standing the galvanometer on a wooden platform, suspended at its four corners by means of long strips of indiarubber which act as springs. A simpler way of obtaining the same result is to place an indiarubber cork, such as may be procured from any dealer in chemical apparatus, under each of the levelling screws, and if this is not sufficient, heavy lead weights may be cast, and attached to the base of the instrument. These, by bringing its centre of gravity very low down, steady it considerably.

Another point to be considered in choosing a place for setting up the galvanometer is the light. If there is too strong a light upon the scale, the reflected image will hardly be visible, no matter how intense the flame. On the other hand, if the instrument is put in total darkness, although the spot of light will stand out well upon the scale, it is very difficult to avoid mistakes with the other apparatus one may be using at the same time. A subdued light will therefore be the best, and it also follows that the light from the lamp should be as brilliant as possible. A small flame does equally as well as a large one, for it is intensity, and not size, that is to be desired. An incandescent lamp makes a very good source of light, the filament itself being focussed on the scale.

The distance between the galvanometer and scale is determined by the focal distances of the lenses or mirrors used, and these, again, depend, to some extent, on the nature of the work one has in view. The usual distance is from 2ft. to 4ft.; but there is no limit, and in some of the large cable works, where very delicate measurements have to be made, the galvanometer is placed at one end of the room, and the scale marked on the wall at the other end. The size and length of the scale is in proportion to its distance from the galvanometer. An 18in. scale, such as we have described, would be used 2ft. or 3ft. away, and a 2ft. to 3ft. scale for longer distances.

When the whole apparatus is once placed in position and in working order, it should not be shifted more often than can be helped, for it takes some considerable time and trouble to make the various adjustments satisfactorily. If, however, they have to be moved, marks should be made to show the relative positions of galvanometer, lens, scale, &c., so that they may be replaced in their original positions in the shortest possible time.

Further details and directions with regard to the use of the mirror galvanometer will be given as occasion for them arises in connection with the various tests for which it is employed.

IMPROVEMENTS IN VULCANISED COMPOUNDS.

THE utility of vulcanised rubber in the arts is well known; but useful as it is, it might be of more value if it could be made more durable. An improved rubber compound has been recently patented in this country by Mr. A. J. Boult, on behalf of Mr. W. Kiel, of Butler, New Jersey, which is especially adapted to the manufacture of vessels, receptacles, or other articles used for chemical or electrical purposes, and also of articles now made of rubber or other plastic materials. The composition consists of the following ingredients: Indiarubber, sulphur, and pumice-stone, to which are usually and preferably added oil and beeswax. The exact proportions of the ingredients used in the manufacture of the composition are not invariable, for the reason that the proportions and quantities vary with the quality of greater or less elasticity of the material to be produced. It is preferable to use crude rubber which has been washed only, as it is better adapted to the purpose than rubber which has been passed between hot rollers. The quantity of pumice-stone to be used varies in weight from one to five times the weight of the crude rubber. It is found that it is not practical to use less than even parts of pumice-stone and crude rubber, or more than five times as much pumice-stone as rubber. The quantity of the other ingredients varies according to the quantity of pumice-stone and the quality of the rubber. Less sulphur is needed with inferior rubber. A quantity of sulphur is used equal to one-half of the weight of pumice-stone when the minimum quantity of pumice-stone is used; oil equal to one-fifth, beeswax equal to one-twentieth of the weight of the minimum quantity of pumice-stone; thus, for example, with 10lb. of pumice-stone to 10lb. of crude rubber of ordinary fair grade, the best results obtainable are by using 5lb. of sulphur with 2lb. of oil and ½lb. of beeswax. The quantity of sulphur used increases with the quantity of pumice-stone, and at the rate of one-tenth of the quantity of sulphur for each additional part of pumice-stone; but it is preferable, when using the maximum proportion of pumice-stone, to use twice the proportionate weight of sulphur used with the minimum quantity of pumice-stone. The quantity of oil (in weight) used is equal to one-fifth of that of pumice-stone; the quantity of beeswax in weight varies from 0·006 of the quantity of pumice-stone, when the minimum quantity of pumice-stone is used, to 0·01 of the quantity of pumice-stone when the maximum quantity is used. It is found useful to mix powdered hard rubber with the other ingredients in quantity equal or less to the quantity of sulphur used; but this is not necessary. The solid ingredients other than the crude indiarubber are to be finely powdered and mixed together with the liquids. They are then with the rubber to be rolled between heated rollers until the various ingredients are thoroughly incorporated with each other in a manner similar to that employed in the manufacture of hard rubber. The compound is then ready to be put in moulds, or otherwise treated to produce any desired form, and then vulcanised,—the heat in that process varying according to the nature of the article moulded, or the use to which it is to be put.

This compound should have in vulcanisation a pressure of from 50lb. to 60lb. during a space of from ten to fourteen hours, according to the quantity of pumice-stone used. It is preferable to gradually increase the pressure instead of using

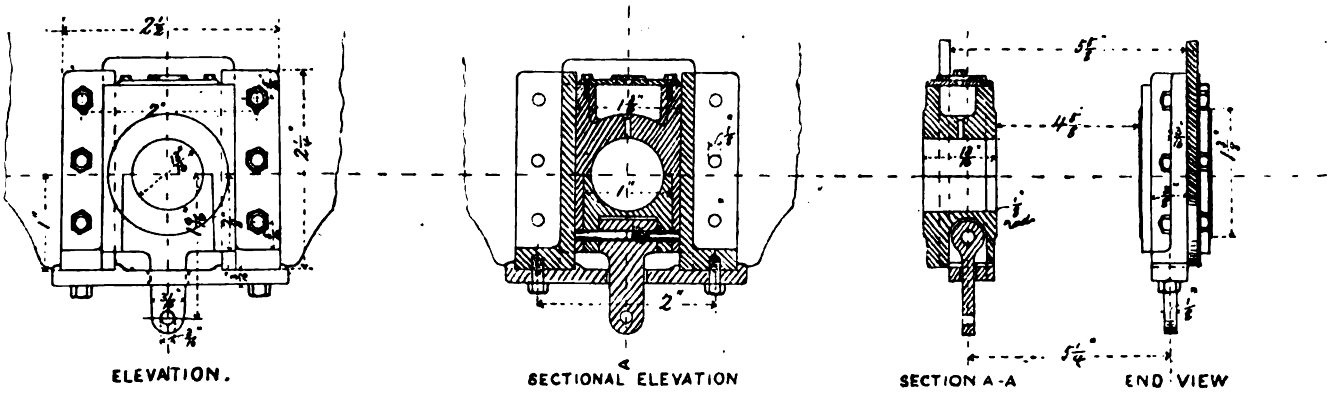


Fig. 8.

the highest pressure immediately. The compound must be kept in the vulcaniser not less than ten or more than fourteen hours. The best results are produced with a lower pressure and longer vulcanisation. It will be understood that other equivalent ingredients may be substituted for the oil and beeswax, or both, or, under certain conditions, such ingredients may be omitted, the principal feature of novelty and value in this composition being the use of pumice-stone in a vulcanisable compound. By mixing pumice-stone with the ingredients constituting hard rubber, a change takes place in the resulting material during the process of vulcanisation, which is different from the change occurring during the vulcanisation of hard rubber and its other compounds, and by it an article is produced which, while it has the same hardness as hard rubber, possesses a superior elasticity and toughness, and resulting greater strength, qualities which no other known ingredient other than pumice-stone imparts to vulcanised plastic compound. In the manufacture of hard rubber it is a well-known fact that hard rubber cannot be vulcanised at one time in thicknesses of over ¾in. By using this invention however it is possible to vulcanise this material of at least 2½in. in thickness at one operation, without difficulty and without failure. The advantages of this invention over ordinary hard rubber and other known vulcanised plastic compounds, are that: It is easier to work than hard rubber or other compounds, and is less likely to ignite during manufacture than hard rubber and its compounds, and generally the process of manufacture is greatly facilitated by the use of pumice-stone. It is not affected by the most intense cold. It will stand a very high temperature, much higher than hard rubber itself. It burns with difficulty. Its ingredients mix faster and more uniformly than those of other compounds or even hard rubber itself. It is a tough, elastic, and hard material capable of resisting blows which would crush, destroy, or fracture articles made of other vulcanised plastic compounds. It is non-porous, and therefore well adapted to be made into vessels or receptacles to be used for holding fluids, and in particular it is adapted to the manufacture of receptacles for holding acids, as it is capable of resisting their attacks and those of other corrosive substances. It is a perfect insulating material and in insulating properties is superior to any other vulcanised plastic compound, and even superior to hard rubber in practical use, and it is more durable than the latter substance. Furthermore it is cheaper, and for that reason articles made of it can be used where hard rubber and other vulcanised plastic compounds as now manufactured cannot be applied by reason of their cost. It can with success be made into nearly every kind of article for which hard rubber is now used. It is not intended to limit the use of this compound to the manufacture of particular articles for electrical or chemical purposes.

A MODEL LOCOMOTIVE.—III.

The Axle Boxes.

THE axle-journals run in axle-boxes, which fit with a certain amount of freedom between the axle-box slides, or "horn-blocks," bolted to, or else formed in the solid with, the frames. The freedom of motion is essential in order to allow the action of the springs to come into play, as the engine runs with more or less of jolting over uneven roads. In spite of this free fitting, the adjustment of the different parts to one another is a task requiring the greatest care and skill, no pains being spared to secure the nicest adjustment by means of the file and scrape. Though free fitting, it is not slop fitting. The stresses of the moving mass are transmitted through the boxes, and inaccuracy here is unpardonable. The fitting of the step to its guides in the direction of the length of the frames is absolute, consistent with ease of vertical motion, but there is no play in that direction. But in the other direction, that of the fitting of the flanges, a definite amount of end-play is allowed. In an ordinary axle-box this will be about ⅛in., and its purpose is to allow freedom of movement of the engine mass relatively to the axles and wheels sideways, as when one side of the engine happens to be momentarily higher than the other, owing to the sudden shocks incidental to travelling on rough roads. But for this play, the flanges of the steps would become jammed, and probably fractured. All this precise fitting must be done with red-lead and oil. For our model the side play will not exceed $\frac{1}{64}$in.

An axle-box consists of two main parts: the step or upper portion, and the keep or lower portion. A part sectional elevation of one of the most general types of locomotive axle-boxes is shown in Fig. 7. In large boxes the body of the step A is sometimes of cast iron or of steel; this carries the actual bearing of gunmetal, and this again is frequently lined to a greater or less extent with a white metal, B, poured into suitable recesses. The brass is prevented from becoming shifted on its seating by means of pins or studs cast with it, and fitting into corresponding recesses in the iron body, or by means of the flanges, as in the generality of cases. Often, notwithstanding its weight, perhaps from 2 to 3cwt., the entire step is made of gunmetal, as in Fig. 7. The metal is always worth its first cost, the labour of fitting is diminished, and it is less liable to fracture than cast iron. Lubrication is variously provided for; usually cotton wicks are used to siphon the oil from the reservoir C, formed in the upper portion of the step, and convey it down through copper tubes to the journal. The oil-boxes may be filled directly by the lifting of their lids, or reservoirs may be fitted against the sides of the wheel-splashers, whence bent copper tubes will convey the supplies down to the journal, and also to the horn-blocks. The keep D has usually a large recess in which the waste oil from the journals collects, so preventing loss. This sometimes also contains a lubricating pad or sponge in contact with the journal, by which lubrication is assisted and prolonged when the upper reservoir becomes temporarily emptied. The keep is variously held in place by means of pins passing through it into the side prolongations of the step, or by means of short stud-bolts, which unite it to the outer casing, and maintain it in position relatively to the lower portion of the journal and to the step. The entire bearing, therefore, oscillates in the vertical direction as a single piece upon the springs.

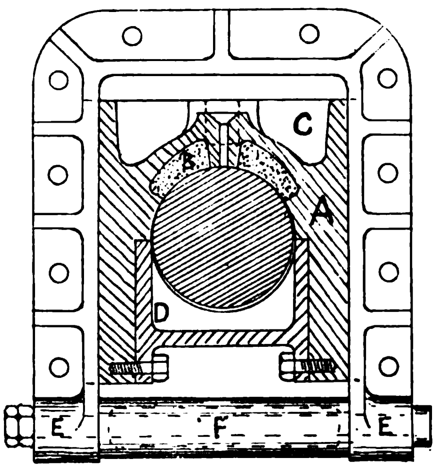
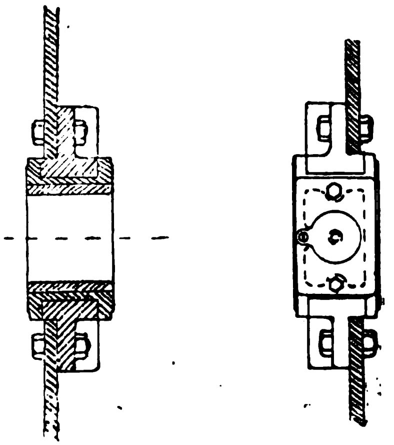


Fig. 7.



In the plan that I illustrate for our model, the construction is necessarily simplified. The step is entirely of gunmetal, saving the fitting of the brass, and no white metal is used. The keep may be of cast iron; but considering its small size and corresponding weakness, it will be better to use gunmetal. It is held in place with a single pin, passing through the keep and the downward projections of the step. There is also a difference in the fitting of the boxes, owing to the difference in the diameters of the wheels. The driving and the trailing-wheels are large—8⅛in. diameter—and their bearings high (see Art. II. Fig. 2, p. 4), and we shall therefore use under-springs for those, because if placed above, they would crowd closely on the boiler. The leading-wheels are small—4⅞in. diameter—and we shall place their springs above. This will therefore modify the forms as well as the dimensions of their axle-boxes. Fig. 8 shows the boxes for the former wheels, Fig. 9 those for the latter. In the first, the link or attachment for the buckle of the springs is pivoted to the lower portion of the keep; in the second the spring thrust bar bears in a socket in the upper part of the step.

Though in some engines the guides for the axle-boxes are forged solid with the frames, horn-blocks or axle guides are, as a rule, made as distinct castings, and either bolted or riveted upon the plates. These are either of cast iron or cast steel, the use of the latter now predominating. They may be either single slides, as in Figs. 8 and 9, or an arched casting reaching over from side to side of the recess in the plate, as in Fig. 7. The latter form is considered to possess the merit of greater stiffness, and to stiffen the frames better than the former. Either type has to be fitted to the frames by careful planing, and the bolts or rivets have to

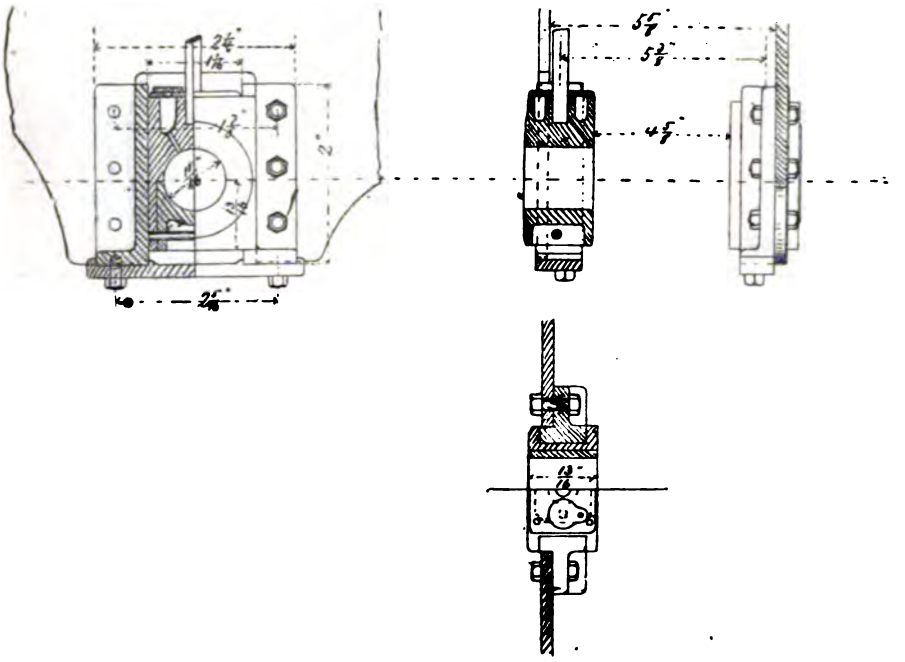


FIG. 9.

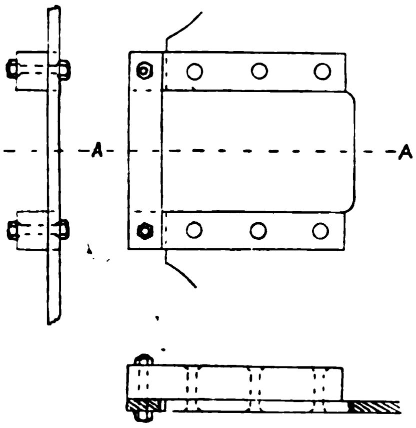
make a driving fit into holes that are first drilled and afterwards broached.

For the model I may suggest choice of three or four methods. Small thin iron castings are very weak, and will not stand much rough usage. We may with care use cast iron for either of the forms shown in Figs. 7, 8, and 9, and bolt the castings to the frames with ⅛in. bolts. Or we may preferably cast strips of gunmetal to Figs. 8 and 9, from patterns, and rivet them on without risk of fracturing them by concussion, as we probably should in the case of cast iron. Or, ignoring typical forms, we can get plain rectangular strips of wrought iron and rivet them on the plates beside the recesses, in which case the openings in the frames would have to be made narrower than the dimensions given in our second article—that is, the recesses would be only cut to the width over the axle-boxes themselves instead of to that over the shoulders of the cast guides (Fig. 10). I will incorporate the plain slides, Fig. 8 and 9, cast in iron, and bolted to the frames, as part of the design.

In order to afford compensation for the weakness caused by the cutting out of the frames for the axle-boxes, the horn-stays, Figs. 7 to 10, are introduced. Of these also there are several forms. The arrangement in Fig. 7 is neat, but that in Figs. 8 and 9 is the one that we will adopt. In the first, Fig. 7, bosses E are formed on the lower ends of the horn-blocks for the reception of stay-bolts. A distance-piece F, of cast iron, is bridged across between the bosses, and the bolt being screwed up, the lost strength of the plate is fully restored, because, before it can fracture, the bolt must be torn asunder. The diameter of these bolts in actual practice is about 1⅜in. If introduced in the model, their size may range from ⅛in. to $\frac{3}{16}$in. as minimum and maximum dimensions. Then, instead of a casting, a bit of stout tube, made by drilling down a bit of ⅜in. rod, will answer the purpose very well.

In our drawings we incorporate the method shown in Figs. 8 and 9. The lower ends of the slides are provided with flanges, to which the flat horn-stays made in wrought iron or steel are attached with studs. In practice, a cottar-pin or a lock-nut might be used to prevent risk of slacking back; but we can dispense with these. The fitting of the shoulders renders the structure very rigid. One other way is to simply bolt a flat bar of iron across the lower faces of the horn-blocks (Fig. 10), in which case the strength depends on the shearing strength of the bolts.

If axles are not perfectly parallel and square, the tires will wear more on one side than on the other in running. The truth of the frames is, therefore, properly checked from the horn-blocks, whose various faces afford a good basis for operations. Properly, as I mentioned in Art. II., these blocks should be fitted in place before the frames are put together. If the recesses prepared for their reception in the frame-plates are true—that is, parallel and square and at correct centres—and if the plates themselves have been levelled, then, if the blocks are planed or filed perfectly parallel and of equal thickness, the whole will be so accurate when bolted up that no adjustment or easing should be required. But now take a fitter's narrow-tongued steel square, not less than a foot long in the blade; place the stock against two inner opposite faces of, say, the driving-wheel horn-blocks, and try the blade along against the faces of the leading wheel horn-blocks, and note the direction and amount of inaccuracy, if any exists. Then reverse the square, and try the faces of the trailing blocks in like manner. In this way it is easy to ascertain whether the blocks are all parallel and at right angles, or otherwise.



SECTION A-A

FIG. 10.

The patterns of the step, and of the keep, may be made precisely like their castings, cutting them out of a piece of hard, close-grained mahogany, in which material the short grain which occurs in places will yet be sufficiently strong. The patterns will be strongest, on the whole, if the grain runs in the vertical direction as the castings stand in place. Keeps are sometimes cored out, or they are made of several pieces of stuff, the grain being arranged to run in different directions as best adapted for strength. In this case, by cutting out the inner portions with care before finishing the outside faces, there will be sufficient strength of grain to prevent risk of fracture by the slight pressure of gouge and chisel on the edges. If the job is too delicate for clumsy fingers, then core out the oil-boxes and the hollow space beneath the keep. But if the core-boxes are not precisely correct, the castings will be thicker or thinner than they ought to be. To save trouble in this small work, I have not shown the hollow form of keep with [illegible] pad. Have the castings in good hard gunmetal, not soft yellow brass.

The faces of the steps and keep, after [illegible] and pinning together, will be turned in a lathe chuck, being adjusted until the inner edges of the flanges are parallel with the face-plate, and the centres of the holes central with the lathe. A second chucking will be required for the turning of the opposite face. Note the rounding of the edges of the step to a ⅛in. radius. This is important, as conducing to the strength of the axle. Note also the shallow facings for the contact of the wheel bosses, and for the shoulders of the crank.

The fitting of the step to the journal requires to be most carefully done. It is not properly a tight fit, because then the least expansion of the journal due to heat would cause the step to grip, or seize, and to become abraded. The step and keep are therefore bored out a very trifle larger than the journal—perhaps $\frac{1}{32}$in. in practice, and afterwards the scrape is brought into requisition to give a somewhat more extended area of bearing surface (Fig. 7) than would be afforded by the bored hole. Great care is exercised in this operation of scraping, and by its means the risk of heating of the journals is diminished.

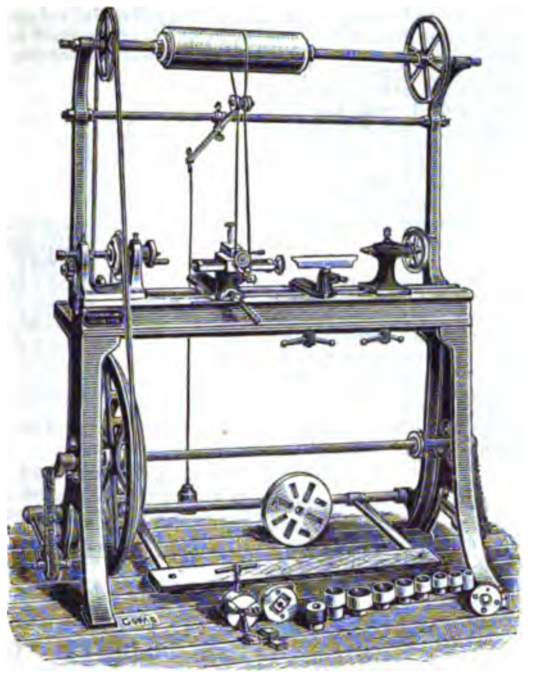
These boxes are so small that it is impossible to carry out all details with strict adherence to the methods of the originals. We cannot use cotton wicks for siphoning the oil, neither can we use hinged lids over the steps, nor fit lubricating reservoirs against the splashers, with their paraphernalia of tubing and taps. The neatest plan, I think, in this case, will be to fit covers over the oil-boxes, fastening them down with $\frac{1}{16}$in. stud-bolts, that can be removed should the oil-holes become choked at any time. The oil can be introduced through a hole drilled in each cover, which will be protected from dust at other times by means of a small circular plate hinged upon a pivot. The Figs. 8, 9 show this arrangement, the hole and cover being central in Figs. 8, but placed out of centre in Figs. 9, because of the presence of the spring bar.

All necessary dimensions are introduced, and minor dimensions can be scaled, the drawings being strictly proportioned.

The springs and their attachments will form the sbuject of the next article. J. H.

THE "LUKIN" LATHE.

IN the annexed engraving we illustrate a lathe made to the design of the Rev. J. Lukin by the Britannia Co., of Colchester. As will be seen, it is adapted for plain and ornamental turning, within such limits as can be done with 5in. centres and a 4ft. bed. The fast headstock is made with steel traversing mandrel running in hardened steel collars, and fitted with six screw guides or "formers" of different pitches, one being that of the mandrel nose, and others selected at pleasure. These work in a segment plate adjustable into and out of gear with the former by eccentric motion, and enable short screws in brass, wood, or ivory, such as fittings for optical or electric work, or wood boxes, ivory ornaments, &c., to be cut with great facility and accuracy. A plain sleeve is provided, to be used in place of the screw "former" when plain turning is to be done; or when screw cutting is only temporarily interrupted, a simple device is provided to avoid taking off and putting on screw guide and sleeve. The cone pulley is made of gunmetal with three or four speeds, and its front is fitted with a division plate having three or more circles of holes of any selected numbers, and a spring index point. A driver chuck and face-plate are fitted. The loose head, or poppet, is fitted with a steel tubular mandrel, coned at front end for centres, and screwed at back end and fitted with a left-hand square thread traversing screw, bright turned hand wheel, and secured to the bed by a through bolt and bow nut and plate beneath. A plain hand-rest, with tees for wood and metal, is fitted. The bed is of cast iron of strong section, without cross ribs to impede the free passage of poppet and rest from end to end, and with double flat face, truly planed. It is mounted on strong cast-iron standards. The treadle is fitted with bright turned rocking-shaft and cast-iron arms. The bright turned wheel shaft runs on friction rollers, and is coupled to the rocking shaft by chain and roller gearing. The heavy-rimmed driving wheel has three quick speeds, and two smaller for slow



motion. It can be fitted with dip crank shaft running on centres and hooks or chains if desired. The lathe is also fitted with a polished mahogany tool board at back. The overhead is constructed with strong rigid cast iron vertical supports, carrying the bright turned shafts, and has a turned and polished mahogany drum to slide along the grooved shaft, and driving wheels with tension rod and pulleys for adjusting the driving gut. The ornamental slide-rest is of good construction, and a plain ordinary compound slide-rest for heavier metal turning can also be fitted. Other chucks and fittings can be adapted or added at pleasure. Dimensions:—Height of centres 5in., length of bed (which may be varied) 4ft., across face of bed 4⅝in., depth of bed 4½in., diameter of nose of mandrel 1in., pitch of screw 8 per inch, diameter of driving wheel 27in. The bed can be had with a gap if desired.

PROPOSED INTERNATIONAL STANDARDS TO CONTROL THE ANALYSIS OF IRON AND STEEL.

By Prof. JOHN W. LANGLEY, University of Michigan, U.S.A.

IT is well known that the results of chemical analysis will differ slightly with the methods employed and with the personal peculiarities of the operator. This latter has been called the "personal equation" of the analyst. These causes of variation are of great importance in all investigations where minute quantities of foreign bodies have to be sought in large amounts of a compound or mixture such as all samples of commercial iron and steel. In this class of analysis, the percentages of carbon and phosphorus are often as low as 0·15 per cent. and 0·01 per cent. respectively, and yet these small amounts will have quite marked effects in the steel which contains them. In order to bring about a greater uniformity of analyses in the countries which are the principal producers and users of iron and steel, it is proposed to prepare a quantity of samples which shall be absolutely identical, and to distribute them to properly qualified analysts in those countries, who will then analyse them and will interchange reports of their results with each other. By the above plan, there will be in each country participating in the work a quantity of metal identical with that in the other countries, and which has been analysed with the utmost care by a considerable body of chemists, so that its composition may be said to be known authoritatively and beyond dispute, and which will thus constitute international standards.

The standards so obtained should serve two important purposes. First, they would show, in the course of their preparation, the relative agreement in the processes and results habitually arrived at by the chemists of different countries, and it may be that, in addition to determining the "personal equations" above referred to, national differences, or differences due to the teaching in different chemical schools, may in this way be noticed. Secondly, these standards being distributed to certain custodians, it may be possible to furnish small portions of them to chemists who may make the necessary application, for the purpose of checking their individual work, and obtaining a measure of their accuracy. Also as new analytical methods are constantly being invented, it will be of great advantage to have a standard metal on which to test them.

The details of the best methods of securing the above ends should be the work of a committee, whose recommendations would form a preliminary standard set of processes; but it is not proposed to fix any definite methods of analysis. Prof. Hermann Wedding, of Berlin, Prof. Richard Akerman, of Stockholm, and Prof. Langley, of the United States, have already considered the general plan, and have given provisional assent to it and to the following suggestions:—

(1) The analysis shall be made for the total carbon and for the phosphorus. This is all which it is advisable to demand; but other elements may be added at the wish of any of the analysts for the samples in their hands only.

(2) The samples shall be of the following composition (or temper) in carbon, as nearly as is practicable: Carbon = 1·3 per cent., 0·8 per cent., 0·4 per cent., 0·15 per cent.; and all the other elements shall be kept down to the customary proportions for steel of medium quality.

(3) The samples shall be in the form of drillings, uniformly and carefully mixed, and quantities not less than 10 kilo. for each temper; this would mean not less than 40 kilo. for the whole.

(4) These samples shall be equally divided, and sent under seal to properly accredited persons in Sweden, Germany, England, and the United States.

(5) The analysis shall be made in each country independently, and the report of the results obtained shall be sent to each of the proper representatives of the other countries participating in the proposed plan.

(6) If there should be important disagreement between these reports, it shall then be the duty of the parties to this agreement to appoint an international committee, to whom the whole subject shall be referred. If, however, the reports differ only slightly, then the average of all the reports shall be deemed the true composition of the international iron and steel standards.

It is stated that a committee of the British Association, consisting of Prof. Roberts-Austen, F.R.S., Mr. Thomas Turner, and Prof. Langley, has been appointed to make the necessary arrangements and communications with other nations for bringing the proposed scheme to their consideration, with a view to its final adoption.

SIMPLE EXPERIMENTS IN PHYSICS.*

IN some experiments described in a former article (p. 515, Vol. XLVIII.), it was shown that hydrostatic pressure is equally distributed on all sides of the containing vessel. Fig. 1 illustrates an experiment in which are shown the effects of removing pressure from a portion of one side of the vessel, thus allowing the pressure to act upon the opposite side of the vessel in such a manner as to cause it to move. This experiment is arranged to show this action in two ways, one so as to propel the vessel forward, the other so as to cause it to turn.

The apparatus consists of a tall tin can—such as is used by fancy bakers for wafers or fine crackers—mounted upon a wooden float provided with a lead ballast to keep it in an upright position. In one side of the can at the bottom is inserted a short tube, *a*, and in diametrically opposite sides of the can, also at the bottom, are inserted longer tubes, *b*, which reach over the wooden block and have their ends turned in opposite directions. All of the tubes are stopped, and the float is placed in a large vessel of water, when the can is filled with water and the stopper of the tube *a* is withdrawn, thereby allowing water to escape from the can, thus relieving the pressure over so much of the area of the can as is represented by the bore of the tube. This disturbs the equilibrium of the lateral pressure in the can, and allows the pressure on the side opposite the opening to preponderate and press the can forward, as shown in the right-hand figure.

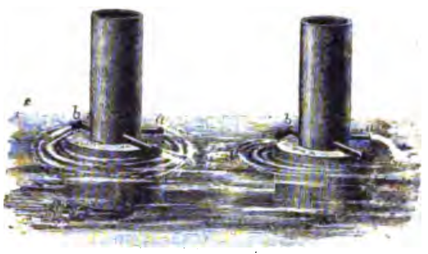


FIG. 1.—Reactionary Apparatus.

When the straight tube, *a*, remains closed, and the bent tubes, *b*, are opened, the relief of the pressure results in the rotary movement of the apparatus. In this case the bent tubes are virtually extensions of the containing vessel, and the relief of pressure at one side of one tube causes that tube to move forward, while the relief of pressure at the corresponding side of the other tube causes that tube to move rearward, the resultant of the two motions being a rotation of the two bent tubes, and the parts to which they are attached, around a vertical axis. The apparatus arranged in this way illustrates the principle of Barker's mill.

The hydraulic ram, a simple form of which is illustrated in Fig. 2, depends for its action on the momentum of the water column and upon the elasticity of air. The reservoir in the present case consists of an inverted glass bottle having no bottom, and provided with a perforated stopper in which is inserted one end of a tube, preferably lead, on account of the facility with which it may be cut and bent. The other end of the tube is branched, one branch extending through a stopper inserted in an inverted bottle which serves as an air chamber. The other branch of the tube extends to the overflow valve. In the stopper of the air chamber is inserted a second tube, which is bent upward and curved over, forming the riser.

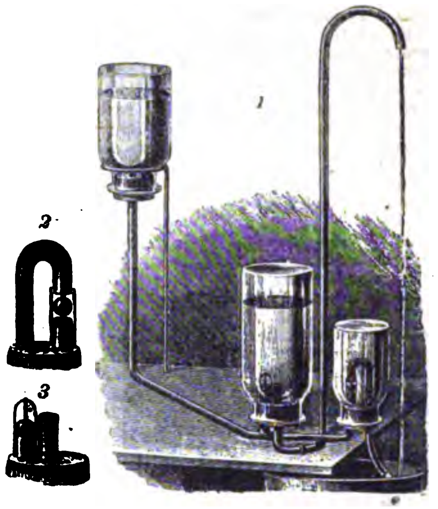


FIG. 2.—Hydraulic Ram.

The smaller bottle, which serves as a valve-chamber, is provided with a stopper which receives the branch of the supply tube and an overflow tube. The arrangement of these tubes is shown in detail at Fig. 2, the curved tube being the overflow, the straight one the inlet. To the inlet and overflow tubes is fitted a valve consisting of a metal ball or a marble. The fitting is accomplished by simply driving the ball against the end of each tube, so as to form valve seats. Four wires are inserted in the stopper around the inlet tube to prevent the escape of the valve. The distance which should separate these tubes as well as the weight of the ball-valve is determined by experiment. In the air-chamber above the branch of the supply tube is confined a ball-valve by a cage formed of wires inserted in the stopper as shown at 3. This valve is fitted in the manner already described. The discharge tube extends above the level of the reservoir. The reservoir and the tubes are supported by wire loops and standards inserted in a base board.

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* By GEO. M. HOPKINS, in the *Scientific American*.

Water flows from the reservoir through the valve chamber, and out at the overflow. When the velocity of the flow is sufficient to carry the valve in the valve chamber up against the end of the curved overflow tube, the overflow is immediately checked, and the momentum acquired by the water causes it to continue to flow for an instant into the air-chamber, compressing the air in the chamber, and causing the water to rise in the discharge tube. As soon as equilibrium is established, the valve in the air-chamber closes, and the valve in the valve-chamber falls away from its seat on the overflow tube, allowing the water to discharge again, and so on, this intermittent action continuing so long as there is water in the reservoir. The water discharged by the riser is only a fraction of that flowing out of the reservoir.

HOW GAS IS MISAPPLIED.*

THE great misapplication of gas is, however, caused by the consumer, either by employing imperfect burners or globes, or allowing it to pass uselessly away, for which so many facilities exist. We may observe that the Argand has been often regarded as superior to all other burners in preventing loss, on account of any tendency to waste being made evident by the flame smoking, thus causing the attention of the consumer to be directed to remedy the evil. But against this advantage this burner possesses the great defect that, on reducing the quantity of gas consumed below the maximum for which it is made, the light evolved per cubic foot is materially diminished. For instance, if a burner consume 5ft. per hour, and give the light of sixteen candles, then we would imagine that 2½ft. from the same burner would yield the light of eight candles, whereas it gives only three or four candles. If we now reduce it to one foot an hour, then we have a blue flame devoid of light. Thus the Argand, only when consuming the full quantity for which it is made, that is when on the point of smoking, yields the maximum light per cubic foot, and any reduction therefrom diminishes it materially, until we find that the gas may be burned without yielding any light whatever.

This arises from an excess of air passing through the chimney which prevents the carbon of the gas attaining the required high temperature to produce light. To prove this statement, if we place a piece of talc on the top of the chimney, with a hole in the centre proportionately with the quantity of gas consumed, then a degree of light will be evolved corresponding with the maximum—that is, 2½ft. will give the light of eight candles, and in the same proportion for any other quantity, which arises from the air being heated before combining with the gas.

Other difficulties with the Argand are that a chimney longer than the proper length will diminish the light. The same defect occurs when the flame is irregular, either by having some of the holes larger than others or stopped. In the days of "contract burning" in order to economise the gas, companies had the Argand so made that the quantity intended to be supplied could only issue at a pressure of 5-10ths or 6-10ths, by which the illuminating power of the gas *was actually reduced one-half.* Of course, at the period this fact was unknown, but at the present it is well confirmed. Again, if the holes of a burner were drilled so small that about 30-10ths pressure would be required to supply 5ft. per hour, then the gas will give only a blue lightless flame. A good Argand delivers the quantity for which it is made at a pressure of 1-10th at the point of ignition.

The flat-flamed burners have one advantage over the Argand—that is, with ordinary pressure, the light emitted, in candles per cubic foot, is about the same whether consuming 5ft. or 1 foot per hour. But against this they offer great facilities for waste by increase of pressure; and particularly the fish tail, which in every-day practice often yields only half the available light to be derived from it, and which only a practised eye is able to understand. This is particularly the case when the burner is enclosed in a globe with a narrow orifice at the bottom and a wide opening at the top, and is due to the current of air cooling the flame, as already described with the Argand. But by adopting the means suggested—that is, by covering the top opening, with a piece of talc with an orifice in the centre of about 1in. in diameter, then the gas will be burned economically, and the flame, which before was smokeless, will, until the supply is diminished, yield smoke in abundance.

With the flat-flamed burner and excessive pressure the gas is wasted as positively as with the Argand, but in a different manner, as instead of smoking they assume a very irregular form, accompanied with a roaring noise, at the same time yielding very little light indeed, and that not serviceable. Thus we learn how gas may be misapplied by improper burners and glasses and excessive pressure, and this is supplemented by the negligence of consumers; and exaggerated as the statement may appear, the loss from this source—that is, the waste from the fish-tail burners alone in the United Kingdom, amounts to some hundreds of thousands of pounds per annum.

A certain class of gas fires may be also mentioned as the means of misapplying gas. Of this kind is the stove with the flue which passes direct into the house chimney, by which means only a small portion of the heat is radiated into the apartment, and the rest is wasted. We lately saw a stove of this kind built into a chimney, consuming when full on about 40ft. an hour, and of this at least three-fourths of the heat was carried away uselessly. The extent of this waste can be imagined when it is stated that at the outlet of these stoves wood is charred, and sometimes paper ignited.

Manufacturers have, however, recently introduced the means of avoiding this great loss by adding a chamber to the stove, thus exposing a large surface to the action of the heated air, which at the same time is radiated into the surrounding locality, while the products of combustion are carried away at a temperature a few degrees higher than the surrounding atmosphere. This system is applied only to large stoves, but it is highly desirable that it should also be adapted to the smaller kinds, and so advance the use of gas fires. The "Cheerful" which was in general use a few years ago, like other stoves burning gas without an admixture of air, have the advantage that they can be placed in the midst of an apartment, so that all the heat is radiated where desirable without any more inconvenience as regards odour than is experienced in burning a like quantity of gas for lighting.

As regards cooking and boiling apparatus, manufacturers have achieved that degree of success as to leave little to be desired, for within the last few years means have been applied to prevent the radiation of the heat from the stove, by which an economy of 40 or 50 per cent. is effected in the cost for gas. Therefore, so far as concerns this part of our subject the principal misapplication of gas is in those stoves which are provided with a flue, which is connected to a chimney, and thus allows a large portion of the heat to be lost.

BOWEN'S VELOCIPEDE.

THE velocipede illustrated below has some novel features, which may be of interest to cyclists, as it is provided with means for inclining the wheels at the pleasure of the rider, so that the lower parts of each wheel may be moved inward to run on a narrow path, the machine also having a brake and means for steering. It has been patented by Mr. Richard E. Bowen, of St. James City, Lee County, Florida. The frame has a bow top, with loop brackets extending downwards, from which are converging arms, to a bottom cross-piece on which is attached a straight bar also fixed to the under side of the seat. A rod bent to form a double reverse crank treadle is journaled in the sides of the frame, each end of the rod having a sprocket wheel, with chains for rotating a shaft journaled in a sleeve bearing and sliding block of the frame, and also carrying a friction wheel. The main wheels are fixed on two short shafts connected by a universal joint, and journaled in sliding blocks. The shafts each carry a friction wheel, operated by the friction wheel connected with the crank treadle. By screwing down a threaded rod upon the sliding block, the main wheels are inclined as shown in the section, Fig. 2, the wheels returning to their normal position when the screws are raised. The machine is steered by raising one of the friction wheels out of contact with its companion wheel on one side of the machine.

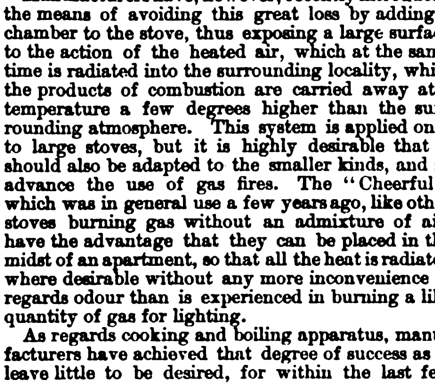

Fig. 1.

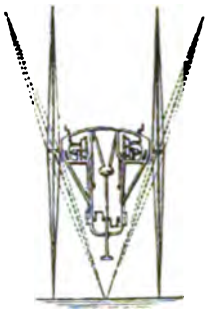

Fig. 2.

SCIENTIFIC SOCIETIES.

THE COUNTY OF MIDDLESEX NATURAL HISTORY AND SCIENCE SOCIETY.

A MEETING of this society was held at their rooms, 11, Chandos-street, Cavendish-square, on March 12, Mr. Sydney T. Klein, F.L.S., in the chair.

Mr. W. Mattieu Williams read a paper on "Silkworm Culture in England," this being in continuation of a paper read by him a few years ago before the Society of Arts. Mr. Williams' exhibited several boughs taken from his mulberry trees, on which were several hundred cocoons of the same species of Bombyx as is cultivated in Italy for the purpose of the silk industry. Mr. Williams gave a full account of his experiments during the last three summers, and showed how it was possible for working men to rear not only a large number of these larvæ, but also vegetables in their back yards, even in the midst of London, by means of a covering of "scrim." This substance not only kept out the soot, but prevented young plants being killed by frost.

An interesting discussion followed, in which the chairman and many other members took part. A good deal of interest was also caused by the presence of a member of the Chinese Legation and a mandarin, who gave an account of the culture of silkworms in China.

Mr. Klein read a paper on "A Sequel to the Discovery of Ephestia Kuhniella in London in 1888," and also exhibited several photographs illustrating the "platinotype," bromide, and other methods of developing prints from photographic negatives.

Mr. Mitchell exhibited numerous fossil shells, including a fine specimen of nautilus, taken from the London clay at an excavation near Hampstead. There were also several objects on view under microscopes.

A Big Enlarging Lantern.—We have recently had an opportunity of examining an enlarging lantern made by Messrs. Watson and Sons, of High Holborn, for an amateur, which must be one of the largest ever made. The condenser is 16in. clear aperture, and the body of the lantern measures 15in. by 18in. and 20in. high, and is adapted for the limelight or a paraffin lamp. The "front" is formed in two portions, each attached to the other by collapsible bellows, and the foremost of these, carrying the lens, has an extension for focussing of 30in. The back portion carries the negative to be enlarged, and is so arranged that it may be placed close to the condenser, or at some little distance in front of it, because when a large plate is being used it is best to have it close to the condenser; but when it is of small size a better result is obtained by placing the negative further from the condenser, so as to concentrate the whole of the rays of light upon it, thus saving time. Messrs. Watson and Sons have had a good deal of experience in constructing lanterns for enlarging purposes, and they have certainly made this one as perfect as possible. It is believed to be the largest lantern that has ever been made for an amateur, and is probably as large as any that has been made for a professional. Carriers are supplied with the lantern, so that it can be used for enlarging any sized picture, from a half-plate up to 12in. by 10in. Messrs. Watson and Sons have made several large lanterns for amateurs, but this with a 16in. condenser is no doubt the largest ever made to a private order.

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* Extracted from an article in the *Gas Engineer's Magazine.*

SCIENTIFIC NEWS.

According to Dun Echt Circular No. 169 Dr. Krueger, of Kiel, has sent out telegrams announcing that Dr. Terby, of Louvain, has noted the appearance of a "white region on Saturn's ring opposite shadow globe."

We have received a reprint from the *Astronomische Nachrichten* of "Double-Star Observations made at the Lick Observatory by S. W. Burnham." We presume it can be had from Dr. Krueger or from Mr. Burnham.

Mr. R. Bryant, F.R.A.S., has published an elaborate calculation of the orbit of small planet Sappho, No. 80, which was discovered by Mr. Pogson, of Madras, on May 3, 1864, and which comes into opposition in the autumn of the present year. The immediate object of the calculation was to provide an accurate ephemeris of the planet, as a series of observations of Sappho will afford means of obtaining another determination of the sun's parallax and distance; but Mr. Bryant, in calculating the perturbing effect of all the principal planets, has arrived at some interesting results as to the value of the mass of Jupiter, and the effects produced by the small planets upon the motions of others which approach them.

Herr O. Jesse, of the Berlin Observatory, directs attention to the importance of studying the luminous night clouds which are visible in Europe during June and July, as he considers they are interesting from an astronomical, as well as from a meteorological, point of view. He thinks that they may throw light on the question whether cosmical space is filled with a resisting medium. He will be glad to receive the results of any observations that may be made.

Mr. R. S. Newall, of Gateshead, has offered his 25in. refractor, with the dome and accessory instruments, to Cambridge University. The Vice-Chancellor, Dr. Routh, Dr. Glaisher, and Profs. Adams, Darwin, Liveing, and Thomson have been appointed a syndicate to consider the arrangements and expenditure necessary to maintain and utilise such an instrument for astronomical and physical research, and to report to the Senate. The telescope is of 25in. aperture, 30ft. focal length, and was made by Cooke and Sons in 1870.

The death is announced of Dr. John Call Dalton, of New York, an eminent physiologist, in his sixty-fifth year.

The subject of the Bakerian lecture this year before the Royal Society by Profs. Rücker and Thorpe is "On a Magnetic Survey of the British Isles for the Epoch Jan. 1, 1886."

At the ordinary meeting of the Society of Arts last week, Mr. W. Anderson, M.I.C.E., of Erith, read a paper on "Aluminium and its Manufacture by the Deville-Castner Process," in the course of which he described in detail the various stages of the process carried on at the Aluminium Company's works at Oldbury, near Birmingham, by which aluminium of 98 per cent. purity is obtained, and referred to the many uses in the arts and manufactures to which it was applicable. The paper was illustrated by specimens of aluminium drawn out to extreme fineness in the form of wire, and extended in the form of sheets of great ductility. It was also shown to be a highly sonorous metal, and one capable of receiving and retaining a high polish, which adapted it for taking the place of silver and electro-plate. Its chief use in the future was, however, considered to be in the manufacture of alloys of iron and copper for constructive purposes. In this respect it was capable of imparting very valuable properties, such alloys of copper giving 45 tons per square inch tensile strength, with 20 per cent. elongation. In reply to a question, Mr. Anderson stated that he was not aware that any aluminium was made of a greater purity than 98 per cent., or at a lower price than 40s. per pound.

At a meeting of the Royal Scottish Society of Arts last week, Mr. H. Adolphe Salvesen read a paper, in which he sketched the early history of steam navigation. The object of the paper was to prove the claims of James Symington to be considered the originator of steam navigation, and Mr. Salvesen showed that although the idea of propelling vessels by steam was much older than Symington's time, and although Symington himself had assisted Miller in the construction of his experimental steamboat on Dalswinton Loch, yet the *Charlotte Dundas*, built by Symington in 1801 for plying on the Forth and Clyde Canal, was the first practical steamer ever built. That was built at Grangemouth, and the first steamer which crossed the Atlantic was, he said, built at Leith. Mr. Carter, speaking on the same subject, remarked how the idea of the mechanical propulsion of vessels had occurred to men's minds as far back as the time of Roger Bacon.

At Toynbee Hall last Saturday, Sir H. E. Roscoe, M.P., F.R.S., lectured on a lucifer match. He described the ancient methods of "getting a light," and stated that no real improvement was effected until Robert Boyle discovered the secret of phosphorus. Sir Henry then proceeded to demonstrate by experiments the extreme inflammability of phosphorus, and went on to state that lucifer matches first came into use about 1833. The old plan of making lucifers was, he said, to prepare a mixture of phosphorus and gum, and put it on to a slip of wood tipped with sulphur, but nowadays matches were tipped with melted paraffin wax, though certain classes of people preferred the former kind even in these times, because they could not be blown out so easily. About the year 1840 it was discovered that phosphorus could be reduced to a substance which was totally different in its properties as regarded its power of burning. This was called red or amorphous phosphorus; and it was a very important discovery, for it led to the making of what were called safety matches, which would strike only on a prepared box. This was because the amorphous phosphorus was put on the box instead of on the head of the match. Wax matches were made in a similar way to others, but instead of wood cotton wick was used.

The following regulation has been adopted by the Royal Agricultural Society with reference to the Exhibition, in their Showyard in Windsor Great Park, next June, of engines in which petroleum, or other inflammable substance, is used as fuel or as working agent:—Engines using petroleum or other inflammable substances as fuel, or as working agent, can only be exhibited in the space set apart for such engines. A special fireproof store will be provided for the petroleum, as close as practicable to the exhibitor's stand. All petroleum must be stored in closed metal vessels, which shall not contain more than three gallons each, and no exhibitor shall be allowed to have more than one gallon of petroleum (stored in a closed metal vessel) on his stand at any one time. While the society reserve to themselves the right of excluding any petroleum or spirit they may deem unsafe, they in no way relieve the exhibitor from responsibility in the event of accident or fire. The exhibitors must conform to the regulations of the local authorities in all that relates to the transport of petroleum and the precautions to be adopted against fire. We may remind intending exhibitors in the Implement Department that the latest date for sending in applications for space is Monday, the first day of April next.

The ninth annual report of the Hemel Hempstead Natural History Society contains some useful information, and an interesting paper on the geology of the district, by Mr. E. Wilmott. The society is a very good example of what can be done by a few enthusiastic lovers of nature.

The American Association for the Advancement of Science will meet this year at Toronto from Aug. 27 to Sept. 3. The president is Prof. Mendenhall, who succeeds Major Powell. The French Association meets at Paris this year from Aug. 8 to 15.

The electrical railroads are increasing in America so fast that it is difficult to obtain correct statistics; but about three weeks ago there were 58 roads in operation and 33 in course of construction. The miles in operation totalled 308, with 424 car motors, and the miles building amounted to 220, which would require 287 motor cars. It should be mentioned that on several of the roads horse traction is still employed for some of the cars; but all of them are either partially or wholly worked by electricity.

The Edison incandescent lamp patent in Canada has been cancelled, on the ground that the lamps are not manufactured in Canada, as required by the statute.

By the provisions of the new Weights and Measures Bill introduced by the President of the Board of Trade, the Board is directed to cause such new denominations of standards for the measurement of electricity, temperature, pressure, or gravities, as appear to them to be required for use in trade, to be made and duly verified.

It is stated that an offer has been made to the Liverpool Tramways Company to instal an electrical system on two miles of their lines without expense, and with a guarantee to restore the line if the electrical system, after trial, is not approved.

A device which may be of considerable value is described by M. Neyreneuf in the *Journal de Physique* as an electric valve, by means of which the current can be sent in one direction, but not in the other. With a voltameter constructed of two aluminium electrodes, dilute acid as electrolyte, and an alternating current, he found that pure hydrogen was evolved at both electrodes; but on making up an arrangement with one electrode of aluminium and one of mercury, using distilled water as electrolyte, the current was found to pass in one direction only.

A French medical paper states that saccharin is a very useful antiseptic for mucilaginous and other solutions apt to develop moulds and fungi, and as three grains can be taken during a day without detriment to the digestion, the use of saccharin will probably develop. Saccharin dissolved in water to the extent of 6 per cent. forms a valuable dentifrice and mouth-wash, as a teaspoonful of the solution added to half a pint of water stops the development of certain microbes.

From investigations carried on by Dr. Rappoport in St. Petersburg, it would seem that the quantity of gastric juice secreted during sleep is much smaller than that secreted during the daytime or active life. The digestive power is also less. Pepsin is found to much the same amount; but chloride of sodium and hydrochloric acid are in smaller proportions.

The Danger of Stoves.—Great sensation has been caused by a declaration made by Dr. Lancereaux at the Academy of Medicine, to the effect that the use of stoves for the heating of rooms is attended with the most disastrous results, either by acute or chronic poisoning of the blood, ending fatally, or causing deterioration of the health as manifested in a variety of ways. Dr. Lancereaux has recently had several cases brought under his observation of intoxication by the oxide of carbon set free by slow combustion in these stoves, which generally have not a sufficient draught, and hence the accumulation of the poisonous gas in the rooms. This danger is not confined to the room in which the stove is heated, but may extend to the neighbouring rooms, either on the same floor or above or below it. It is sufficient to have a fissure in the chimneys to permit the oxide of carbon to pass from one chimney to another, and thus cause intoxication of the neighbours. It has been proved that, even when the apartment in which the stove is heated is well ventilated, the atmosphere of the room always contains a sufficient quantity of the oxide of carbon to exercise a disastrous elective influence on the red globules of the blood. These remarks have been fully corroborated by Dr. Brouardel, who insisted on the danger arising from intoxication by oxide of carbon, even in the open air. Every winter the dead bodies of workmen are brought to the Morgue who had been lying about limekilns, from which escape large quantities of the oxide of carbon with which these men had been poisoned. M. Gautier, the eminent chemist, stated that the smallest quantities of the oxide of carbon contained in the air might prove dangerous. The blood has a special affinity for the oxide of carbon and the reduction of oxyhæmoglobin, which is distinctly seen with the spectroscope. With $\frac{1}{10000}$ of the oxide of carbon there is destruction of the eighth of the total quantity of the blood. He cited several cases of grave accidents due to the oxide of carbon produced by the foot-warmers that are filled with lighted charcoal dust and placed in cabs, &c. There have been this year alone five or six cases of poisoning caused by these appliances.—*Lancet.*

Combustion of Air in Coal-Gas.—In a recent number of the *Chemical News* a lecture apparatus for showing combustion of air in coal-gas is described by G. Craig. The apparatus consists of an inverted flask with a side-tube in the neck and an orifice at bottom lined with asbestos; the mouth is fitted with a cork soaked in vaseline through which passes a glass tube. The flask is filled with coal-gas through the side-tube which is ignited at the orifice, the tube is pushed up through the cork, and the air will soon be seen burning from the tube with its usual feebly luminous flame in the interior of the flask.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions o our correspondents. The Editor respectfully requests that al communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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PHRENOLOGY—THE MOON'S ALBEDO —NEWTON AND NOAH'S FLOOD—POST-OFFICE ACT—TELESCOPE EYE-PIECES—ERRORS IN THE MOON'S PLACE—BAYER AND FLAMSTEED —PARALLAX OF CLUSTERS AND NEBULÆ—TRANSITS OF VENUS AND LOCKYER'S "PRIMER OF ASTRONOMY"—MEASURING PENDULUMS.

[29737.]—The paragraph in your "Scientific News" on p. 29, having reference to Mr. Hollander's attempt "to furnish a basis for a really scientific phrenology," suggests to me to remark how utterly the portraits of the wretched creature who blew his brains out in Madrid the other day, tend to falsify the system of Gall and Spurzheim. Benevolence, veneration, conscientiousness, and all the higher moral qualities (as mapped out on the regulation phrenological model heads) are conspicuous in the sketches of one of the greatest scoundrels who has lately appeared, and of whom the world is so happily rid.

Without entering into any detailed criticism of letter 29684, p. 30, I may just note a few points in it which strike me on a cursory perusal. First, with regard to the darkness of Grimaldi, Zöllner determined the albedo of the Moon, and found that it was just ·1736 of the brightness of a perfectly white substance. Now, admitting, as, of course, I do, that parts of the Moon (not many, but some parts) are equal in whiteness to newly-fallen snow, which reflects, according to Zöllner 0·783 of the incident light, these must shine with 4·5 times the brightness of the average Lunar surface. Hence, plains like Grimaldi must be of greatly inferior brightness; and, as Proctor points out, much darker than dark-grey syenite, which reflects ·078 of the light incident on it. This may not, and is not, blackness in the sense of that the Lunar shadows are black; but we should call such rocks "black" on earth. In the second place, I am wholly unaware that I have ever predicated, here or anywhere else, that "there is no snow on the Moon." I see no more reason why Aristarchus should not have snow upon its highest peaks than I do why the Himalayas should not be similarly covered. But it is a gigantic stride from this admission to the acceptation of Mr. Peal's hypothesis that all the cliffs and mountains on the Moon are "composed of snow"! This, in vulgar parlance, is "rather a large order." As for Mr. Peal's "electrical discharges," brought in to explain (?) the radiatory streaks from Tycho, Copernicus, &c., they are the veriest "Deus ex machinâ." I suppose that your correspondent had a dim recollection of an experiment we used to perform when boys, of drawing the knob of a charged Leyden jar over a sheet of glass, and sifting a mixture of red lead and sulphur over the plate. Now, even if we admit that *one* such electrical discharge as Mr. Peal postulates took place, and drove off the meteoric dust, how long would its radial lines of direction remain electrified—and what would happen the next time a meteoric shower fell over the region they occupy? I strongly urge Mr. Peal to study Nasmyth and Carpenter's "Moon," on the question of these strange light rays. He must forgive me if I say that his argument to show that the rills have their origin in subsidence, fails to convince me. They may—or may not—be, but I cannot see that it proves it. Finally, I do not know whether we are to regard the question in the P.S. from a teleological point of view, or as a species of scientific conundrum.

A very remarkable comment on letter 29686 (p. 31), exists in the library at Leyden, in the shape of a MS. journal of Huyghens, who says therein, under the date of "29th May, 1694" (the year in which Halley's Cometic nonsense was communicated to the Royal Society), "Mr. Colin, a Scotchman, informs me that the illustrious geometer, Isaac Newton, has been insane for the last eighteen months, either from excess of study or from the grief occasioned by the destruction of his chemical laboratory, together with many important MSS. by fire." The most devoted admirers of Newton (among whom I am proud to number myself) know but too well what crazy nonsense the mighty mathematician wrote when he touched theology. I did hope that we had done with this x-times-exploded trash about Noah's flood and a comet, for good and all.

"Olaf" (query 67994, p. 38) will find that 1st Vict. cap. 36 is still law in its entirety, that s. 31 is unrepealed, and that any one "fraudulently retaining or wilfully secreting or detaining . . . . a post letter," &c., is indictable for misdemeanour.

If "A New Subscriber" (query 68014, p. 38) will buy the English Mechanic for February 22nd (No. 1,248), and turn to the paragraph at the bottom of column one, p. 520, he will find the information he requires. Of course, the magnifying power of any telescope, refracting or reflecting, is calculated by dividing the focal length of the object-glass or mirror by that of the eyepiece.

Since writing the concluding paragraph of letter 29682 (p. 30), I am told by one of our leading English astronomers professionally engaged in watching the moon (which it is superfluous to say I am not) that while he concurs in my estimate of the possible discrepancy between the tabular and observed declination of the moon (3″), he thinks I have under-estimated the error which may possibly occur in her predicted Right Ascension, and that this latter may amount, on any one day, to as much as 0·3second. "Luna" may accept this dictum as of the highest authority. [It must be noted that Newcomb's corrections referred to by "Tria," in reply 67950, on p. 58, apply to the *mean* places.]

In reply to Mr. Grant (letter 29723, p. 55), Piccolomini was undoubtedly the first to designate the stars by letters, although Bayer all but invariably gets the credit of it. The story about a star appearing in the Almagest as δ Pegasi certainly requires explanation. With reference to Mr. G.'s concluding paragraph, I am not sure that either the "Encyclopædia Britannica" or Chambers is correct in the numbers given of the stars in Flamsteed's Catalogue. I have an idea that Flamsteed's Catalogue, as originally published, contained 2,866 stars, and that to these Baily added 564 more (from Flamsteed's observations) in the Catalogue which forms part of the "Historia Cœlestis Britannica"—at least, this is what is stated in the English translation of Arago's "Astronomy."

While entirely in accordance with Mr. Westlake (letter 29727, p. 55) as to the absorbing interest attaching to Mr. Isaac Roberts's magnificent photograph of 31 M Andromedæ, I fear that anything more utterly hopeless than a determination of the parallax of that inchoate system it would be difficult to imagine. Prof. Pritchard's recent investigations have shown us how merely *relative* all our estimates of the parallax of individual stars must be; and, *a fortiori*, what chance can we have of detecting the distance of such objects as some of those which he specifies?

"Autolycus" (letter 29728, p. 55) appeals to me in connection with a book which I have never seen in my life. If its compiler does state that a Transit of Venus will happen 105½ years after 1882, he talks nonsense—that's all. There will be Transits on 2004, June 8th; 2012, June 6th; 2117, December 11th; 2125, December 8th; 2247, June 11th; and 2255, June 9th—beyond which I need scarcely carry the list. As for my asking "the distinguished author" of the book what his frontispiece means, I should scarcely like to take the liberty; it being, of course, possible that he doesn't know himself. Besides, I have not the very smallest interest in, or curiosity on, the subject.

"Bob" (query 68066, p. 60) will find that the length of a pendulum is measured from the centre of suspension to the centre of oscillation. In the case of a heavy symmetrical bob this might be taken to be its centre of gravity.

A Fellow of the Royal Astronomical Society.

VISIBILITY OF ENCELADUS IN SMALL TELESCOPES.

[29738.]—I have no doubt that Mr. P. F. Duke (letter 29637, p. 498) supposed that he really saw Enceladus with a 3¾in. achromatic and powers of 55 and 104; but I trust that he will forgive my remarking that his letter contains some rather strange statements. Surely he must have been aware that Saturn had moved considerably between the 1st and the 4th of February, yet he seems to have thought at first that the object seen on these two nights was one and the same star. Then again, I cannot understand how Struve's (not Herschel's) "Debilissima duplex" between ϵ^1 and ϵ^2 Lyræ could have been seen with a 3in. in daylight, "not a trace of them being seen after dark." The close *comites* of such stars as ε Boötis or δ Cygni are often best seen in twilight or daylight; but I am utterly unable to conceive how faint, isolated stars, as the components of the little pair in question are, could be seen in daylight, and not at night, with 3in., and the reference to the idiotic diagram in Chambers's "Cycle" rather complicates matters. I saw Enceladus on several occasions in 1874 with my 6½in. Calver, power 164, but I cannot say that it was a very easy object. Saturn, however, was not in a good position. I have no doubt whatever that Ward, with his phenomenal eyesight, saw Enceladus with a 4in. Wray; but I have been unable to find his original statement. Perhaps some reader can help me to it. When Saturn is in opposition in December the satellites would naturally be seen more easily than at other times. Harding and Schröter saw Enceladus, but with difficulty, with a 9½in. Newtonian of 13ft. focus, and Meyer, at Geneva, found it difficult when he first began to observe the satellites with a 10½in. achromatic. Jacob, in the sky of Madras, found that "a steady view" of Enceladus could rarely be obtained with the 6·3in. Lerebours and Secretan. Sir John Herschel found it very difficult with his 18in. front view reflector at the Cape of Good Hope. Pickering determined the brightness of Enceladus to be 12·3 magnitude in the photometric scale. This is the *minimum visibile* in an absolutely dark sky with a 4½in. refractor. I should have thought that an object like Enceladus would be blotted out by the light of Saturn with so low a power as 55 on a 3¾in. I see that an American gentleman, observing at an altitude of 5,500ft. in Utah, states that he has caught glimpses of the satellites of Uranus (rather a vague expression) with a 3in. refractor. Some one will be seeing Deimos and Phobos with an opera-glass soon!

H. Sadler.

ASTRONOMICAL.

[29739.]—If "Mimas" were a constant reader of the Mechanic, he would know that my letter of Jan. 11th was "taken notice of" long before he honoured it with his attention, and likewise more sympathetically. I am glad that my letter has borne fruit. Since its appearance we have had quite a crop of lunar drawings, astro. letters, &c., the current number containing a particularly rich instalment. No one, comparing the pages of the Mechanic with those of twelve or fifteen years back, can fail to note a falling-off both in the number and the interest of astronomical contributions; but, as I said before, there seems now somewhat of a revival and a turn of the tide. We amateur astronomers may want the Mechanic for our medium again, and I write these words not without book, for the L.A.S. *Journal* is anything but what it was a few months ago, and the past two or three numbers in particular (one or two articles excepted) have been bitterly disappointing. I do earnestly hope the society may be kept up to its old standard; but without an improvement in the *Journal*, I fear that is hopeless.

In reply to "Autolycus" (letter 29728), the plate in Lockyer's "Primer" corresponds with one in Proctor's "Moon," and both seem copies of Nasmyth's beautiful study of "Copernicus."

A halo of extraordinary size was visible round the moon on the night of Saturday, March 9. The circumference at one point passed through the Pleiades, and at others just touched Capella and Castor and Pollux. No particular rainfall succeeded this exhibition—at least, in our neighbourhood.

Sunday, Feb. 24, I looked at the sun through my reflector (8½in.) and a small achromatic, but could see no detail whatever, as a multitude of particles were sweeping downwards across the disc, producing an extraordinary effect, like an aërial snow or hailstorm. What might this be? The day was dull and cold.

Llanelly. **Arthur Mee, F.R.A.S.**

VARIOUS ASTRONOMICAL MATTERS.

[29740.]—I should think if it be once admitted that Mr. Ward ever saw Enceladus with a 4·3in. o.g., it must also be admitted that other members of the human race may be as highly gifted. It is very unlikely Mr. Ward is the only person in existence so endowed. From the ease with which Enceladus has been visible in a 9in. on the few occasions when London air and limited sky room have permitted me to see, I can easily conceive that a much smaller instrument may suffice in a better situation and perfect atmosphere. Is Encaladus variable, for I have seen it at end of ring fully as bright as Tethys?

Would "Al Fard" (29725) say with what aperture he saw the cusps of Venus rounded off? On March 11th, with 9in. × 275 they were thin and fine, and certainly extended further round dark part than the phase would warrant.

L'Astronomie for this month contains an article by M. Flammarion upon Venus, in which he indulges in some speculations hardly warranted by actual knowledge, upon the inhabitants of Mars and Venus respectively; but the article is well worth reading.

In the same periodical a M. Guiot is cited as observing Uranus with the naked eye, and Neptune with a binocular habitually. There is also a continuation of M. Schiaparelli's article upon the planet Mars, towards the conclusion of which are some illustrations and remarks upon the doubling of canals and lakes, which seem to me instructive.

I fear you would not find space for a translation at length, but the result is that where canals intersect, sometimes the one canal is seen double, sometimes the other. In the case of "lakes" seen double, this duplication is sometimes in one azimuth, and at others at right angles to it. The doubling in both directions is never seen at the same time. I fancy those who are accustomed to use high powers on double stars will have no difficulty in placing an interpretation upon these observations which will differ somewhat from the explanation favoured on the other side the Channel.

The February number contained a drawing of H IV 37, as seen with the Lick 36in., which would interest all students of nebulæ. The power employed was 2,000. It is described as a "riband of nebulous matter rolled up under the form of two ellipses entangled with each other. A brilliant star occupies the exact centre of the interior ellipse formed by this combination. The whole is set off upon a vast paler nebulosity." The central star is not bright enough in my copy to justify above description. In fact I saw it more distinctly with 9in. If Mr. Roberts ever takes a photo of this object, I venture to think it will differ considerably from this drawing, and also venture to affirm the central star is not in the centre. In the same number is a marvellous reproduction of a direct photograph of the electric spark.

Edwin Holmes.

THE PROBABLE APPROXIMATE OF EQUAL STAR DISTANCES.

[29741.]—Since last I wrote to the English Mechanic, an engagement and very severe pain in the muscles of my right arm and shoulder have hindered me from concluding the point I touched in letter 29546, page 398. A friend of mine, Mr. Peter Hume, Sheckburn, Bedlington, Northumberland, maintains that I misunderstood Mr. Offord, that we both meant the same, and has pressed me several times to inquire if such was the case. "F.R.A.S.", on page 398, appeared also to favour Mr. Offord's views in a modified way, and pointed out the lamented R.A. Proctor's successful researches in regard to the equal distribution "of stars over a series of shells, as it were, surrounding each other." But I fail to see how anything that has been done by any one can bear out the statement that "it is exceedingly unlikely that any two stars (unless binary ones) are equi-distant from us."

We know very well that the stars are not evenly scattered in space, that they are not all of the same size and brightness, differing only in apparent magnitudes on account of their varied distances; for we know that if a star looks large and brilliant as compared with others, that it does so, either because it really is so, or because it is much nearer; but knowing this irregular scattering, varied distances, and intrinsic differences, we are not thereby furnished with a proof against approximate equal distances of stars except in the case of binary systems. To give an illustration or two. Let us take what is thought to be the nearest star, Alpha Centauri, which is also a physically double star. Now let us suppose a line from our position to reach that star (by our position I mean the centre of the Solar system, not that I regard our position as a kind of universal centre—not at all). Then let us consider such line as a radius of a geometrical sphere, and who can say that our sun is the only star encompassed in that mighty sphere? The probability is that there are others within or about that distance, but in other parts of the heavens—stars whose parallax has escaped detection, and no wonder, in such a difficult matter.

If such, however, should be the case, then such star or stars might possibly approximate the distance of Alpha Centauri. Let us now consider a line from our position to 61 Cygni as a radius of our second sphere, who, then, can be sure that our sun and the above-named star are the only ones bounded by that second circumference. The same method of supposition might be carried to the most remote star whose parallax is known, and with increased probabilities that many other stars approximate the distances of each other. Once more, let us suppose a star 99 times as distant as the first in question, and another 100 times as far away, then the difference in the distances of two such stars would be about 20,000,000,000,000 of miles. If, then, from our position as a centre we imagine two circumferences, one passing through each assumed star, then we know that a vast and extensive area of space would be inclosed outside the inner and inside the outer circumference. We cannot doubt that hundreds of stars would be irregularly scattered in such a space, all whose distances from us would be as near or nearer to that of each other as 99 is to 100. But even if we give our imagination a little more latitude here, and suppose the 95th or 100th distances, might there not be thousands of stars in such a space? we might even conceive of clusters of orbs of light, and the difference in the distances of each luminous point would be within the proportion of 95 to 100. Therefore, I contend that it is reasonable to suppose that there are cases in which thousands of stars are about equal distances from us. I may say that I mentioned in my letter (p. 398) that four stars were the greatest possible number that could be equi-distant from each other. If any of your readers don't know this, but have the curiosity to know, I will explain.

Bedlington. **T. Blacklock.**

ASTRONOMY, AND THE "ENGLISH MECHANIC."

[29742.]—I have read with considerable interest the letter by "Mimas" inserted in your issue of the 15th instant, especially that part of his letter which refers to the value of the astronomical matter contained in your weekly publication.

It is generally conceded, I believe, that a few grains of fact outweigh any quantity of hypothesis; therefore I venture, in as brief manner as possible, to state a case which will confirm—should confirmation be needed—much that "Mimas," I presume, intends to convey.

A person of whom I now write, when a boy, attended a few simply-illustrated lectures on astronomy, given in very elementary form in a schoolroom situated in the neighbourhood where he and his parents resided. The knowledge thus simply conveyed he retained to a very considerable extent, and was the means of kindling a love for astronomy which subsequent years of toil and trouble in the commercial world failed to entirely extinguish, his sole recreation after business hours being the reading of scientific literature. But increase of years brought also increasing business and family responsibilities, so that science reading became a thing of the past, and thus a few years of his life were passed without any prospect of a change, when, on a lucky afternoon during an interval of enforced idleness, waiting the arrival of a train at a railway station, he found himself in front of the bookstall, on which was exposed for sale the English Mechanic. He purchased a copy, and instinctively turned to the astronomical matter contained therein. The dormant fire was re-kindled. The "E. M." once more became his weekly companion, and he again found time for science reading.

I will now simply outline what followed:—Your advertising columns in the course of a few months placed him in possession of an excellent 4in. achromatic by Dollond, followed by the possession of a fairly good 6in. Tulley. He became a member of the Liverpool Astronomical Society, highly valuing its monthly journal. This he followed by the construction of a model designed to convey to the eye knowledge which the mind is slow to grasp when assisted only by astronomical treatises. The model was exhibited at an exhibition held at the technical institute in London known as "The People's Palace," which it will be remembered Her Majesty the Queen opened. At the close of the exhibition a certificate of "highest award" was granted to the designer of the astronomical model.

Finally, the greatest gratification of his life has been recently reached in his election to a Fellowship at the Royal Astronomical, which enables him, through the monthly meetings, to drink in knowledge at the feet of those distinguished men of science of whom he had previously read and heard so much. The enhanced pleasure of living has become so great to him that he believes that if he had granted to him health and strength and the allotted span of fifty lives, he would, at the end of that time, desire to live on.

Well, Sir, all this pleasure and gratification is the outcome of the twopence expended at the bookstall on the English Mechanic.

The narration of the above facts may interest struggling scientific brethren.

Jesse S. Nimkey.

ON POISONING BY COPPER UTENSILS.

[29743.]—The recent death of Dr. Keith, at Poona, surgeon to the Duke of Connaught, recalls to my mind many similar fatalities during my long residence in India. In this case the Duke and Duchess, with many members of the staff, were travelling to and from Hyderabad, the Nizam, or ruler, of which powerful State entertained our Queen's relatives with truly Royal splendour. The whole party were more or less ill; but, with the exception of Dr. K. (who was in weak health) recovered. As usual, their sufferings were attributed to cholera. Subsequent investigations revealed the old story—neglected cooking pots.

India-made dishes are usually flavoured with vegetable acids, tamarinds, tomatoes, lime-juice, or vinegar, which all act briskly on the worn tinning. I have seen a dish of food which had been put away for future consumption, with a green circle on the outer edge of the congealed grease. I suspect many an English traveller has died of so-called cholera, the symptoms of that dire disease and those of copper poisoning being remarkably alike, vomiting, purging, cramps, and collapse are indications of both. Here in England there was a memorable case of cupreous destruction some sixty years ago. A political dinner at Salt Hill, near Windsor, resulted in the deaths of several individuals. As well as I can remember, only one escaped, who long after went by the name of "Old Poison-proof." For a term of years this sudden mortality was a mystery to the public, only ending by the cook on her deathbed confessing to neglect of the copper stew pans. Again, about 40 to 50 years back there was a recruit depot in Lower Bengal, Chinsurah by name, where cholera was said to be endemic. The bad drains and the native liquor reported to be the cause, and the newly-imported soldier was always dying. Eventually some official of chemical qualifications discovered and published the hideous revelation of a contractor pocketing the monthly allowance for tinning the barracks utensils, and their consequent corrosion. Sir Charles Napier, the irascible commander-in-chief, exerted himself to hang the heartless Bengalee if possible. There is another form, too, of "death in the pot." A solder of two parts lead to one of tin is a favourite cheap admixture of the native workman. Itinerant tinners call at the houses of Anglo-Indian residents for the job, and if the solder be not examined previously to employment there is lead-poisoning for the unsuspecting householder. Twice a month I overlooked the operation and examined the solder, telling the workman beforehand that I always did so. I also warned my friends of the lurking danger to be encountered in their *ménage*. Canned provisions of a cheap quality have repeatedly caused serious illness, and occasionally death, in India. They were imported; the solder used in the operation being the only portion of the contents open to suspicion.

Eos.

THE SAVAGE TRIBES OF BURMAH.

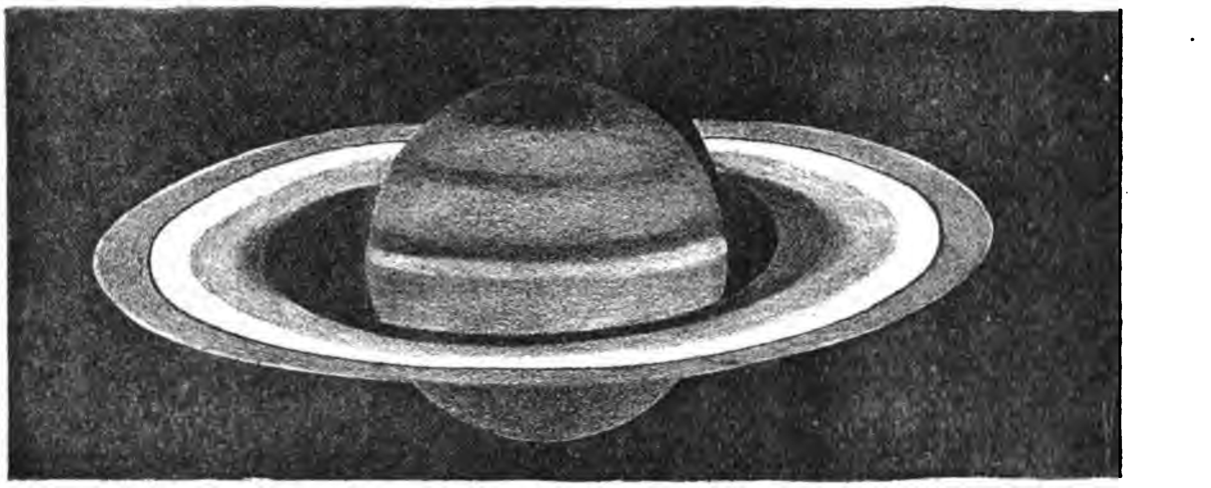
[29744.]—"Our correspondent with the Chin Field Force, in one of his recent telegrams (says the *Pioneer*) gave a pleasant account of a Chin village which the party inspected before committing it to the flames—with its neat garden-plots, its well-arranged water supply, the well-kept interiors, and the ample domestic stores—and our officers have by this time obtained many glimpses of the habits of these barbarous but not uninteresting people. Casual shots fired on the hills at first excited the vigilance of our picquets, but were soon found to be only designed for the dead, the attention of whose spirits they were intended to attract. When a Chin falls in action the best way of appeasing his shade is to kill one of the enemy in return, but if that is not practicable, a buffalo serves as a substitute. When the sacrifice is accomplished the friends go to the spot where the deceased fell, and, summoning his spirit with the firing of a gun, call out that he is avenged, and he can then have rest. Otherwise he must for ever haunt the spot disconsolate. The use of firearms seems to be very general among them, and they escape the ammunition difficulty which besets other jungle people by making their own powder. Saltpetre appears to be common on the Chin hills, and they have the secret of mixing it with charcoal and the seeds of the aunglak, a creeper which grows abundantly in the country. These seeds are split, roasted, and then pounded up and moistened with tobacco-juice or spirit, and the compound makes a powder which is said to be of very fair quality. Those individuals of the tribe whose acquaintance the force has made have shown themselves very intelligent, and, like all savages, immensely inquisitive. The curiosity of one man was especially taken by a pair of boots on trees which he espied in a tent; the reason became plain when it was discovered that he thought the trees were human legs which the English, he supposed, took in preference to heads. Whatever else the annexation of Upper Burmah has accomplished, it has opened up unrivalled opportunities for the ethnologist for half a century to come. Chins, Kachins, and Karens; Lushais, Sylus, and Howlongs—what a field for the student of primitive man!

"A curious practice of the Shans was brought to light the other day by one of the special correspondents of the *Rangoon Gazette* with the Karenni expedition. It appears that when the dacoit Boh Twek Nga Loo was shot in his attempt to escape from his escort, and his body burned, certain Shans from Hopen sent men, had the body exhumed, cut off the head, and sent it on to Mone, the scene of Twek Nga Loo's recent exploits, and there it was exhibited in the bazaars. The body in the mean time was boiled down into a kind of ointment, and this is now being retailed at high rates everywhere, as it is supposed to possess extraordinary virtues, and to endow the persons anointed with high courage and supernatural abilities, such as Twek Nga Loo was said to be possessed of."

Eos.

WHERE DO FLIES COME FROM?

[29745.]—Allow me to add to "J. T. M.'s" remarks. Firstly, the number of eggs laid by the common house-fly in England is generally 60 to 70, and not so many as 100. Secondly, in warm weather



the eggs hatch in the act of deposition; and thirdly, there are three or four different flies generally called "common house-fly," differing in size and mouth organs. **E. Holmes.**

SATURN.

[29746.]—I inclose a drawing of Saturn, made under favourable definition on the 3rd March, with a power of 330 on an 8½in. reflector.

A soft dark shading, too ill-defined to be called a division, was visible in the preceding ansa of ring A, about the centre of the ring. The outer portion of ring B was, as usual, very brilliant for about one quarter the width of the ring, a graduated shading suddenly becoming very dark towards the inner edge covering the remainder.

The yellow equatorial belt appeared to be divided into two zones, of which the southern one was narrower and much brighter than the other. A faint diffused light was visible about half-way between the dark belt adjoining the equatorial zone and the pole. The polar region was very dark, perhaps the darkest part of the globe. The shadow of the ball on the rings appeared to be concave, widening towards the south, and no notch was visible.

The shadow of the rings on the planet, which was a few weeks ago a conspicuous feature, has now completely disappeared. It was last seen about the middle of January as a narrow black line across the planet, adjoining the rings.

I should be glad to see observers follow the example of previous years, and forward observations of Saturn to the English Mechanic.

Didsbury. **Geo. P. H. Hallowes.**

HAYDON'S CUTTER-BAR.

[29747.]—In reply to Fredk. Carre, the analogy drawn by "a young man trying his health" does not apply in this case. Fredk. Carre has a "very wretched lathe, with a slide-rest badly designed, and not over-well fitted," and by this he condemns a cutter-bar tested upon it. As well might a railway company condemn a Westinghouse brake, because the valves and pipes by which it was supplied with air were leaky and out of order. Would they think it a fair trial? or by such a trial condemn the brake as useless, because it failed to act with certainty, or through such a trial, adhere to the old hand-brakes?

It is much more reasonable to suppose the owner of such a trumpery lathe has an equally poorly-constructed cutter-bar.

However, let that be what it may, he may rely that a "wretchedly-fitted slide-rest," &c., is not by any means a fair trial. Regarding the overhang of the Haydon bar, which is, or should be, 2in. or 2⅛in. from edge of rest to point of tool, I would ask how often is it that a tool has to extend 3in. or even 4in. away from the rest to accomplish the work in hand? so that the question of overhang in a Haydon bar is hardly the point of discussion.

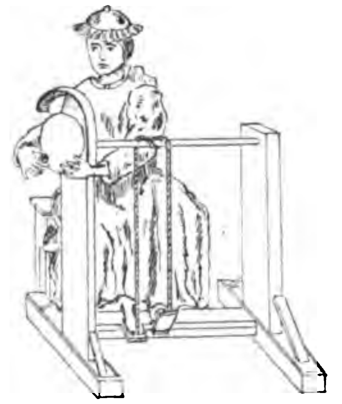
It is quite true, however, for general metal work in a 5in. centre lathe, and especially in a geared lathe, that $\frac{3}{16}$in. is too small a section for the cutting tool, and ¼in. would be better; such a tool accurately sharpened in a well-made cutter-bar, is fully equal in power and capacity to any solid forged tool, with the advantage that no forging is required, and no packing after repeated grinding.

March 12. **Edward Hines.**

CHINESE DIAMOND-CUTTING MACHINE.

[29748.]—Like many others of your readers, no doubt, I was very much interested in letter 29643, on the Chinese screw-cutting lathe, with which I was unacquainted. It had frequently been a matter of curiosity and speculation with me as to how screw-threads were cut by these curious and interesting people. It reminded me of a Chinese machine for cutting diamonds, in which treadle motion is similar, described by the Jesuit, Louis le Comte, in his work, "Nouveaux Mémoires sur l'Etat de la Chine," published at Amsterdam in 1697.

Taking it for granted that all true mechanics and mechanicians are interested in primitive contrivances, an extract from the above work, in the French of the period, which I have somewhat curtailed, together with a rough tracing of the original engraving, may be acceptable to your readers. It is scarcely necessary to point out the interesting comparison which may be made between this primitive machine and the modern appliances for the same purpose, which were so freely illustrated in a practical manner at the Inventions Exhibition at South Kensington in 1885.



" . . . . Au reste ils ont une facilité fort grande à les tailler; car en France, quoique nous leur donnions toutes sortes de figures, ce n'est pas sans travail et sans dépense. On a coupé à *Nankin* la mienne en moins de deux heures. La machine dont ils se servirent pour cela est simple; et si nos ouvriers veulent en user, ils abregeront beaucoup leur travail. . . . A l'une des extrémités du cylindre [that is, the axle] on a mastiqué par son centre une plaque de fer fort mince, fort ronde, and bien aiguisée en tout son contour, qui a environ huit pouces de diametre, et qui se meut avec une grande vitesse tantost en dessus and tantost en dessous, selon qu'on éleve ou qu'on abat les marches. L'Ouvrier cependant presente d'une main l'aiman, et de l'autre de la boué fait d'un sable tres-fin, qui rafraîchit le fer, et qui sert à couper la pierre; mais parce que le fer en passant au travers du sable le jette et le pousse tout au tour avec violence, ce qui pourroit aveugler celui qui travaille. On a soin de placer précisement au-dessus un petite latte tournée en demi-cercle, qui reçoit et qui en défend l'ouvrier."

A. Marson.

POSITION OF THE DYNAMICAL HIGH TIDE.

[29749.]—There is no complete statement on this subject, as far as I know, in any elementary or popular book or article. We are often told, without qualification, that if there were no friction, low water of the dynamical lunar tide must be under the moon. Newton himself tells us this in *Principia*, I. lxvi. Cor. 19. Airy leaves us under this impression in his elementary geometrical treatment of the subject in *Monthly Notices*, R.A.S., Vol. XXVI., 1866, p. 229, as also Abbott in *his* geometrical treatment of the same in *Phil. Mag.*, Jan. 1870. The reason being that the tidal wave's own forward swing is neglected, as may be done for shallow, or comparatively shallow, depths of water—i.e., not too much greater than the actual depths of our own oceans. Airy himself, however, supplies elsewhere the needed qualification, which is generally overlooked.

The following is taken from Airy's article "Tides and Waves," in *Encyl. Metrop.* Vol. V. (here referred to by *A*), and G. H. Darwin's art., "Tides," in *Encyl. Brit.*, last ed. (here referred to by *D*). For simlplicity we shall, with Airy, confine our attention to the water in a canal of uniform depth and width running round the Equator and returning into itself; and we shall begin with the lunar tide separately.

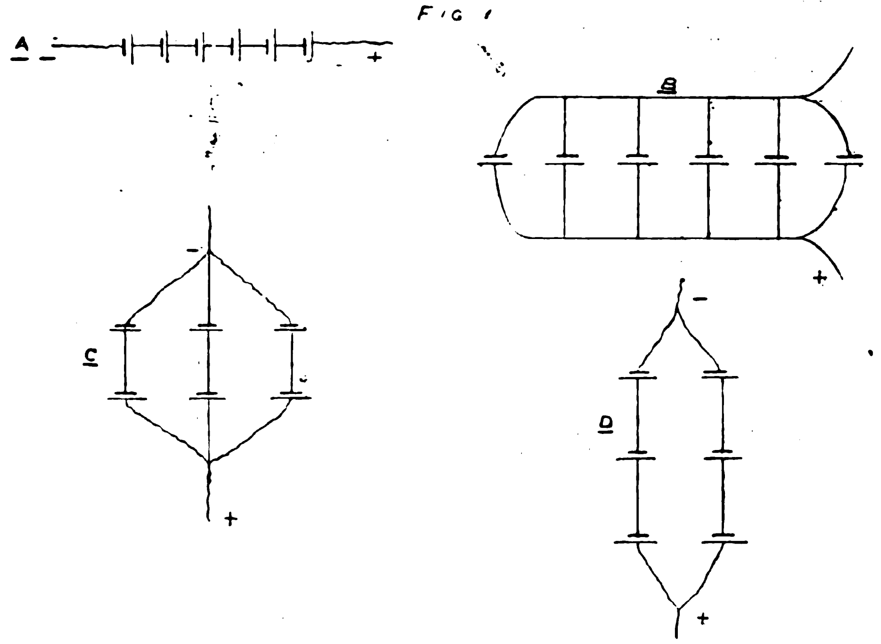
First, let there be no friction. The velocity with which a free, frictionless, bodily undulation of the water would travel of its own accord is $\sqrt{gd}$; g being gravity, and d the depth of the water. In order that such undulation should so travel with the velocity of the forced lunar tidal wave—viz., about 1003·5 miles per hour, the depth of the water should be about 12·78 miles; this we shall call the critical depth for the lunar tide. (*a*) Now let the depth of the water be less than this, so that a free bodily wave would travel of itself less fast than the forced lunar tidal wave; in this case *low* water of the dynamical tide will be under the moon—i.e., high water will be 90° behind, or east of, the moon. (*b*) Now let the depth of the water be greater than the critical depth, so that the free wave would travel of itself faster than the forced lunar tidal wave; in this case *high* water of the dynamical tide will be under the moon (*A*, pp. 323* and 357*; *D*, pp. 354 and 374-5). Airy, p. 323*, emphasises this by the following illustration:—If there were two canals extending right round the Equator side by side, one being more, and the other less, deep than the critical depth, then, with frictionless dynamical tides, high water in one canal and low water in the other, would run abreast.

Now let there be friction. In case *a*, paradoxical as it may seem at first sight, friction will accelerate the high tide, or make it to be ahead of the position that it would occupy without friction (*A*, p. 332*; *D*, p. 375; also Airy, *M. Nots.*, *ubi supra*, and Abbott, *ubi supra*). But the oscillatory motion of the water itself and the magnitude of the tide will be diminished by the friction. In case *b*, on the contrary, friction will retard the high tide, or make it to be behind the position that it would occupy without friction (*D*, p. 374); the shift in each instance being greater or less, according as the friction is greater or less. Therefore, whatever the depth of the water, the dynamical high tide with friction (belonging to the moon, as in contradistinction to that belonging to the "anti-moon"), will be somewhere within the first quadrant behind, or east of the moon. We may add that one depth of water greater, and another less, than the critical depth, would give the same amount of hanging of high tide behind the moon, if they were combined with suitable respective frictions.

Similarly, of course, with the solar dynamical tide, except that for this tide, whose velocity would be about 1037·4 miles per hour, the critical depth would be about 13·66 miles.

We may now add an interesting conclusion from the above (see *A*, p. 323*), viz., that if the depth of the Equatorial canal were between the two critical depths, and there were no friction, spring-tides would occur at the quadratures, and neap-tides at the syzygies, of sun and moon. With friction, spring-tides would occur shortly after quadratures, and neap-tides shortly after syzygies.

Dunelmensis.



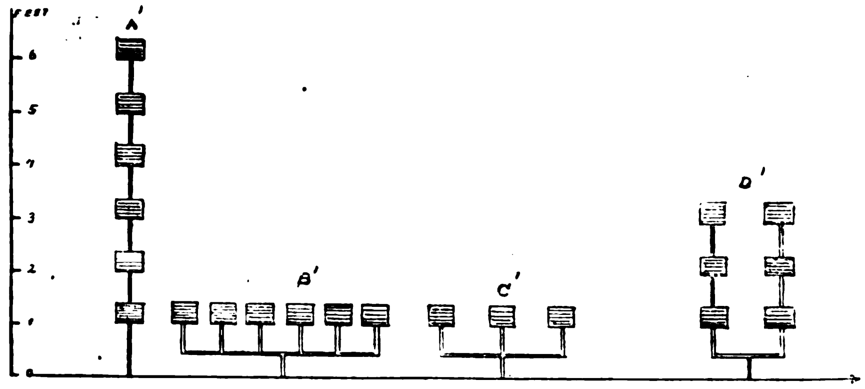


FIG. 2.

CELLS IN SERIES AND PARALLEL.

[29750.]—IN series, parallel, or series-parallel arrangements of cells, the *raison d'être* of the resultant E.M.F., Int. R., and Quantity is not always clear to the tyro.

Take the four typical examples, A, B, C, D, and their hydraulic analogies A', B', C', D', which I will use for the sake of comparative argument.

Imprimis.—In each cell let E.M.F. = 1 volt.
Internal R. = 1 ohm = ω.

Quantity (Q) or capacity = 1,000 coulombs = 1 kilo-coulomb = k.c.

Let each cistern have a capacity of 1 gallon.

1st case, A.—Six cells in series. Total E.M.F. = 6 volts; total Int. R. = 6ω; total capacity = 1 k.c.

A'.—Six cisterns, each being 1ft. higher than the other, communicating through lengths of tube. (These lengths of tube represent the internal resistance of the cells in A.)

Now, the total pressure or head of the combination is 6', corresponding to 6 volts in A. The total R. to flow is the sum of the six lengths of tube = 6, corresponding to 6ω in A. The total capacity is 1 gallon, corresponding to 1 k.c. in A.

NOTA BENE.—One may argue, as the six cisterns together hold six gallons, surely that represents the capacity of the system? No; because as soon as the one gallon has been drawn off, the top cistern is empty, and the original pressure is gone, being reduced to 5'. True, we may get six gallons out, but at constantly diminishing pressure. Similarly, we might be able to draw off more than 1 k.c. from A, but not at 6 v. E.M.F.

2nd case, B.—Six cells in parallel, E.M.F. = 1 v. Int. R. = $\frac{1}{6}\omega$ Q = 6 k.c.

B'.—The level of this whole system is 1', corresponding to 1 volt in B. There being six tubes in a row, the total R. to flow is $\frac{1}{6}$th the R. of any one tube, corresponding to $\frac{1}{6}\omega$ in B. The capacity is 6 gallons, for that quantity may be drawn off before the pressure of 1' is gone (corresponding to 6 k.c. in B.).

Compare in a similar manner the 3rd and 4th cases:—

3rd case, C.—Three rows *in parallel*, of two *in series*. E.M.F. = 2 volts. Int. R. = $\frac{1}{3}$ of 2ω = $\frac{2}{3}\omega$. Q = 3k.c.

C'.—Total pressure of whole system = 2ft., quantity = 3 gals., total resist. to flow = $\frac{2}{3}$ gals.

4th Case, D.—Two rows *in parallel* of three *in series*. E.M.F., 3 volts. Int. R = $\frac{1}{2}$ of 3ω = $1\frac{1}{2}\omega$ Q = 2 k.c.

D'.—Total pressure of system = 3', R. to flow $\frac{1}{2}$ of 3 tubes in series = $1\frac{1}{2}$, quantity = 2 gals.

Analogies are most useful in explaining or making clear what would otherwise be hard to comprehend. But they are never perfect, of course, and consequently must not be followed up too far.

W. Perren Maycock, A,I.E.E.

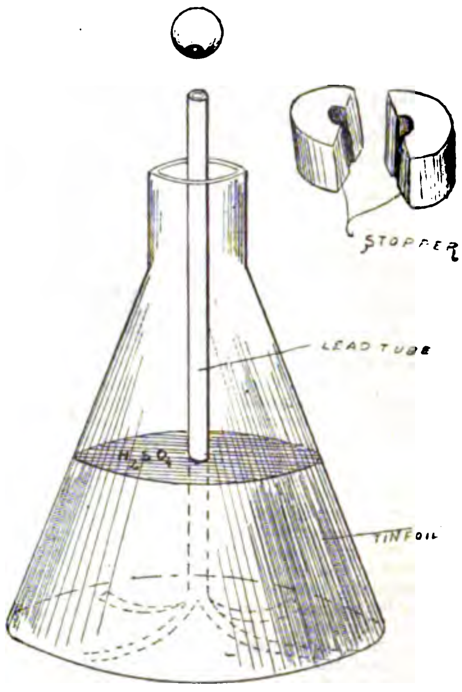
THE LEYDEN JAR.

[29751.]—IN letter 29689 F. W. Mason neglects the most important point in the construction of the Leyden jar—viz., insulation. Though the author of the above-named letter may think his "tumbler jar" an excellent contrivance, I must certainly say that I have never come across a poorer form of instrument. The inside surface in his form of jar is made a good conductor by the moisture coming from the evaporating water, and is therefore useless. The outside surface is the only insulation offered, and even it must be of the poorest quality, since it is exposed to the moisture and dust of the air.

I am anxious to know what F. W. Mason means by "specific *conductive* capacity" of glass; also what its action is in the Leyden jar. Hitherto I have been told that *induction* took place in a Leyden jar, and was led to think that if the glass had anything perceptibly conductive in it at all it was to be rejected. Further, we were taught to think that the capacity of a Leyden jar depended upon (1) the distance between the two conductors; (2) the size of the active surface of the conductors; (3) the nature of the dielectric between them (extra dense glass being the best). From F. Mason's letter it appears that as long as a thin glass tumbler is used it does not matter whether in only *stands* on a tray of zinc or whether it is *covered* with tin-foil.

The jar shown in the Fig. is of the type first adopted by Sir William Thomson. It will be found to act well under all atmospheric conditions, and is always ready for use, without the preparatory drying process before a fire. To make a Leyden jar of this type, procure a glass jar of the shape shown of good, dense, flint glass; carefully wash with soda-water and a rag, then with ordinary water without the rag, and lastly with distilled water. Cork the bottle without drying the inside, with a cloth dry the outside, paste on the tinfoil over the lower half of the jar, and varnish the upper half (outside only) with shellac varnish: next the split leaden tube (the novel part of the instrument, due to the author) is inserted and opened inside the bottle by pressing it down, as shown in the figure. The tube now stands in the jar without touching the neck at any part. The length of the legs should be made a little over half diameter of the bottom of the jar. Strong H_2SO_4 is then poured through the lead tube, with the help of a bit of rubber tubing and a funnel, until it is level with the top of the tinfoil. The advantage is that a narrow-necked bottle can be used without fear of destroying the insulation by splashing when pouring in the sulphuric acid. The object of the narrow neck is, of course, to diminish the size of the path for escape of the charge, or to improve the insulation. When not in use, an indiarubber stopper in two halves surrounds the lead tube at the mouth, and closes the bottle against the moisture and dust of the air. The H_2SO_4 then also absorbs all the moisture there may perchance be on the inner surface of the glass. A small ball may be made to slip over the end of the lead tube to prevent "brush discharge."

Regarding the thickness of the glass used, the best "double extra dense" flint glass may be charged with a potential difference nearly equal to 100,000 volts per $\frac{1}{10}$in. thickness, or, more correctly, a "Leyden jar," made as described, and of the glass mentioned, ·1in. thick, may be charged fully with the said voltage, or by an influence machine giving 1in. sparks. Though it may be possible to charge with a higher potential difference than this, it is not safe. The neck of the bottle must be made so large that a spark cannot pass from the lead tube to the dirt and dust which collects on the outer surface of the jar. It therefore varies with the P.D. used.



The difference between a good "Leyden jar" and a bad one is this: A good one will retain nearly the whole charge given to it, whereas a bad one will lose nearly all the charge you give it. A large machine is required to fully charge a bad jar, and a small machine will fully charge a good one (both of the same capacity). A given machine will fully charge a good jar in a short time, and a bad one in a much longer time. A good jar will hold its charge for a long time; a bad one loses it immediately. A good jar will also stand a charge of higher P.D. than a bad one (both having the same thickness of dielectric). A thick-glass Leyden jar may be just as good for the purpose for which it is intended as a thin-glass one. Thickness or thinness of the glass has nothing whatsoever to do with the *quality* of a "Leyden jar," though it affects the capacity.

Gilbert B. Luckhoff.

ORGAN MATTERS—TONE COLOUR.

[29752.]—IN "Chopin's" letter of the 8th inst. (29697), he is labouring under a wrong impression as to the two grand instruments he refers to. It must not be assumed that because I did not allude to them, I ignore them. Quite the reverse.

I have enjoyed many a Saturday afternoon at Mr. Best's recitals, and heard the "Stormy Linnell" with a sense of feeling that would prepare one to see it in the perfection that nature gives it. In fact, I never heard "that boisterous turbulence" so musically rendered on any other instrument. Its resources for such are immense, and its position aids it very much. But one must not lose sight of the fact that no such results could have ever been attained if its builder—who, by the way, I may say, is *the* builder in England—had not got the courage and wisdom to guide his ability out of the stock-in-trade lines that still govern the heads—or blockheads—of most of the builders (?) of the present day.

It not unfrequently happens that when a builder of such high renown as Mr. Willis holds, departs from one system and makes a change for the better, that a host of brain-sucking parasites come poking about and measuring his work, and producing a *fac-simile* of what they have seen; but, at the same time, don't understand, and never will. I once heard a man say that his reeds were the "same as Willis's," because he took the scale off some original stops by Mr. Willis; but having the scale of any man's pipes will not be a guarantee that his intonation will be precisely the same, or, indeed, as good, unless he is a "master" of his art, and even then he has not had the worrying drudgery that alone gives experience to overcome the various difficulties that crop up. Some time ago I worked in a firm in London where the tuning is done by crushing the ends of the pipes, and I happened to remark that it was a most un-mechanical way to do it, not to say anything of the second-hand appearance of the pipes or the alteration in quality of each identical pipe. The reply was, "It is a quicker way, and besides, we do not believe in a man knocking down cones or brasses on hard metal, and altering the position of the languids; we always tune this way, and we always will." Now, if a pipe be cut carefully to its length, no such thing as heavy knocking of cones or brasses is needed to tune it. I suppose the contents of a tuner's bag of this sort is a "candlestick," and a wood-chopper to tune the reeds with—certainly nothing more is needed. One must not expect anything in the form of "tone colour" out of such manipulation as this. It unfortunately happens for "tonal" art that many builders think that if a pipe has a certain form, that simply getting it on its speech is the acme of voicing; but a greater aim than this is to be taken. Under certain conditions of scale, pressure, breadth of mouth in proportion to circumference, height of mouth, thickness of material, length of feet, especially in metal work, nicking and slotting, piercing (as in harmonic flutes), &c., pipes can be made to produce tones other than the result that comes from the simple nicking and adjustment of languid and lip necessary to insure speech. In this, and the quantity of tone of a particular quality to form the groundwork, and the variety to further impress the ideas of the composer on the ear, and give rise to pleasurable feelings that slumber in the breast and need awakening, is the real aim of a builder of true feeling—in fact, it is really the picture of sound that needs painting, to first of all interest, add then impress. The nature of the building, whether for sacred or secular uses, has a great deal to do with it as well. For instance, a tender religious piece has more effect in a quiet aisle than in a singing-saloon, and a chorus of "Champagne Charley" would be more suitable in a saloon than in the choir of a time-worn cathedral. A favourite simple hymn tune, such as "Hursley" or "Luther's" carries the associations of early life and "colour" with us everywhere, and no matter where we hear it, it carries pure feelings of a kind and forgiving nature, and promptly brings us all to the one level spiritually.

I remember well my first Sunday at sea when going to the Cape. The service was conducted in the larger saloon, and the earnestness of all was a notable thing. When the hymn—"Great God, What do I see and Hear"—was given out, there seemed to be a unanimity amongst the congregation that far exceeded anything I ever remembered before or since; all sang their best, and each one for himself—all restraint or feeling of being criticised being banished; it made one feel comfortable, knowing that there was only 1in. of iron between all hands and eternity; the true ring was in it, and it is such a true ring that elevates all true men above the grovelling thoughts of making money by a trade such as the organ line. We all have the same wood, ivory, lead, tin, brass, &c., to use, and probably, if as a matter of commerce, we pay universally the same price to produce an open diapason or a trumpet; then in all propriety let us voice it, and present it to the public as a work of art; the prestige lies there. Then, if we can introduce perfect mechanism to control it, we have done our best and we shall reap if we faint not. I am pleased to say from experience that greater interest is being taken by the public in organ matters; the many disappointments they have had have guarded them against the ignorant and prejudiced statements of the "trade," and they are not only thankful, but satisfied that their desires as to "tonal" and other construction have been made known to men of education and constructive ability—men who have striven against crushing odds, backed up by the statements of ignorant and biased members of the "trade," that they were "outsiders" and should be opposed for opposition's sake. One thing certain is that the results of these men's efforts are being universally "copied" by nearly everyone who eschewed them before, and in many cases by doing so they have been made to eat the leek. These same copyists have for years tried every available resource they knew of to produce such magnificent ideas of tone as at St. George's Hall and St. Paul's Cathedral, but have totally failed. I have frequently heard from them that the lack of a player, such as the talented gentlemen who perform at the before-mentioned places, does not bring the "beauties" of their instruments out; but all the combined talent of the professional and good amateur organists put together would never entitle the construction or tone of their organs to any successful issue other than a "commercial" one. I would be very happy to see letters from other gentlemen like "Chopin" ventilate the subject, not only of colour, but construction, in the pages of the "E. M." I beg to assure "Chopin" that "free reeds" are not uncontrollable as to "blare," for others as well as myself can reduce or increase the tones to a uniform standard of intensity.

Wm. Robinson.

ODOUR OF ANIMALS.

[29753.]—The letter of "The Lydney Dispenser" (29665), though it gives a probable explanation as to the reason why animals are odoriferous, hardly touches the original question, which referred more particularly to the odour of certain human beings. I suppose all of us who have a tolerably sensitive nose must have observed the phenomenon, which is totally disconnected from any habits of personal cleanliness or care in eating. I have two instances in my mind now—one of a young gentleman who had a most persistent odour of a goat—or, perhaps, that of a sheep might better describe it. It was not very strong, and a good many people might not have noticed it, but I always did. Now, this was not due to any lack of care of the person, for the young man was a gentleman—by that I mean in all those things, such as frequent bathing, plain eating, &c., that a gentleman is careful about. The other instance was rather agreeable than otherwise, the person in question having a faint smell as of violets always hanging around him (he never used perfumery in any shape). Might not this arise from the urine, which will have this smell when turpentine is taken, either through the stomach or by absorption. Those of us who have been brought into contact much with coloured persons know how abominably some of them smell. Capt. Richard Burton alludes to this in one of his works, and says (I quote from memory) that the smell has no relation to the habits of the negro, either of personal cleanliness or diet. I have never seen any explanation offered of the peculiar phenomenon, and if anyone can give us any light on the matter I hope he will do so.

H. E. Smith.

GAS BATTERIES.

[29754.]—I am much obliged to G. B. Lückhoff for his references to various papers on the above subject, and also for his suggestion of treating carbon plates; but I have come to the conclusion that, owing to their resistance and excessive fragileness, they can never be used with any great success in a gas-battery.

I have quite laid them aside for the wire-mesh plates, and with regard to these, though I quite acknowledge that the porosity is somewhat diminished by the preliminary plating, yet the gain in the conductivity and strength of the plate is a full compensation for the above loss. In the long course of my experiments I have naturally tried all sorts of devices, and at one time was very sanguine with regard to compressed porous metal plates; but, owing to my want of proper appliances, I had to give them up. In case, however, anyone would like to experiment with them, the following is the way to proceed:—First lay at bottom of the depositing tray a sheet of copper mesh turned up on three sides to the depth of ¼in., leaving the fourth side about 2¼in. higher, on which to attach connecting wire, this fill with copper oxide and compress, then pour in dilute sulphuric acid (one of acid to nine of water), and having laid two glass rods across the oxide as insulators, place a carbon plate, which has been previously well washed to clear of detached carbon particles on the top, and after leaving for some time, in order to allow a portion of the oxide to be taken up in solution, connect the carbon and copper mesh to the positive and negative poles of a battery respectively, using an E.M.F. of about three volts. Then, when all the oxide is converted into metal, platinise; but, apart from my reason given in my letter to F. W. Mason, I think they would prove too fragile unless strengthened by a backing of stout metal, and they could only be used in caustic solutions.

With regard to the experiment of gold and platinum plates, G. B. Lückhoff must remember that both possess catalytic properties apart from occultation, and I am not at all sure whether, in the future gas battery, some metal not capable of solution in the cell (such as allotropic lead) will not be used instead of platinum, since, under certain conditions, and in certain acids, the latter metal seems to lose its catalytic power—at any rate, for a time. But these experiments must be left to others, as, owing to untoward circumstances, I have been compelled to give up all experimenting for a time, being chiefly employed lately in packing up all the apparatus which has proved such a source of endless research and interest for some years past; and, since I hardly know when I may resume my investigations, I have determined to make public property the cell which I have mentioned in my letter to F. W. Mason, and which is the practical outcome of much thought and experiment, and is the latest improvement invented by me up to the 22nd January last, when I ceased from my work. So much was I impressed with the above, that I had already got out twenty-two frames for the 18-cell battery I mention in letter No. 29631, page 481 of last vol., and made rough drawings of the above, which, if the Editor could find room, I shall be glad to send, since they explain fully, and embody several additional details which may prove interesting to the readers of this discussion on gas batteries.

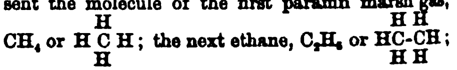
G. B. Lückhoff is pleased to say he thinks I am a bit ahead of other inventors of gas batteries; but, still, I hope he does not accuse me of believing that the current flows from the – to the + pole of a battery; and if perchance I have been fairly successful, it is owing to the fact that for more than two years I have given them my unremitting care and undivided attention. Of course, I naturally feel much disappointed at not being able to carry out my latest design of the 18-cell battery, which will, I think, prove a really workable one; but I shall undertake to do so at my earliest opportunity, when, perhaps, by F. W. Mason's help, I shall be better acquainted with the working of platinum deposits and the difficulties to be overcome. But since an opportunity has been given me by this discussion, I wish to make known to others facts which may prove useful in future experiments on gas batteries, so that they may accomplish that which I am debarred from doing—at any rate, at present.

According to G. B. Lückhoff's desire, I have much pleasure in publishing my address; but I am generally rather chary at so doing, since once before it brought such an amount of correspondence from outsiders, which, to say the least, was tedious to answer; however, this does not apply to G. B. Lückhoff, for I shall be glad to receive his communications.

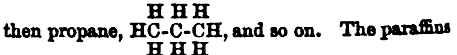
March 6. **Alfred Treeby.**

PATHOGENETIC EFFECTS OF VASELINE.

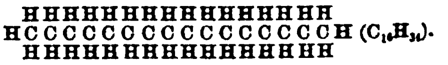
[29755.]—"Gamma Sigma" says he objects to my dictum that "vaseline is all petroleum." I am not surprised; I should object to such a "dictum" myself. I never made the assertion. "Vaseline is all paraffin" is what I said. The doubts lingering in "G. S.'s" mind are to be attributed to his indiscriminate use of the words "petroleum" and "paraffin." All petroleum is paraffin, but all the paraffins are not petroleum. If he were to re-read my last letter, being careful to distinguish between the two words, the matter ought to be clear to him. I will, however, add one more explanation. We may compare the paraffins to a series of objects of gradually increasing size, like those toy sets of eggs sold about the streets. The smallest would represent the molecule of the first paraffin marsh gas,



CH_4 or $\begin{array}{c}H\\HCH\\H\end{array}$; the next ethane, C_2H_6 or $\begin{array}{c}HH\\HC\text{-}CH\\HH\end{array}$;



then propane, $\begin{array}{c}HHH\\HC\text{-}C\text{-}CH\\HHH\end{array}$, and so on. The paraffins of which vaseline is formed would be some of the last of the series; for instance—



$$\begin{array}{c}HHHHHHHHHHHHHHHH\\HCCCCCCCCCCCCCCCCH\\HHHHHHHHHHHHHHHH\end{array}\ (C_{16}H_{34}).$$

When raw petroleum is submitted to fractional distillation, we may distil off the gaseous and liquid paraffins; the solid ones remain in the retort, and of these latter vaseline is representative.

Charles E. Sohn, Analytical Chemist.

A MODEL LOCOMOTIVE.

[29756.]—Your correspondent, "J. G." asks too much. I have made loco. models, or, rather, miniatures from my own patterns, and everything was done at as low a price as possible. The cost of an entire set of iron, gunmetal, and brass castings and patterns (no forgings or sheet metal) for an engine 28½in. long, came to about £18, the castings alone coming to about £10. These are not shop prices, but patternmaker's and founder's. Some of the castings being difficult to mould, were charged by the piece: hence the apparently high price. I have given as much as £3 for patterns and castings of a pair of 2¼in. stroke cylinders, with ports cast in, covers, valves, glands, &c., included. These engines were to be complete to the smallest screw.

Unless "J. G." contemplates a very simple affair, he will not get over the job in a twelvemonth, except he goes to work with elaborate machinery, and works 10 or twelve hours a day. I opine that 1899 will still see him at it.

A. F. Shakespear.

Lüttichaustr. 14, Dresden, March 16.

[29757.]—I think that "J. H." intends that all patterns should be made by those taking in hand the locomotive he is at present describing in "Ours."

"J. G.," in his letter (29695) in issue of March 8th, speaks of the monstrous price of castings from our "model engineers." He must take into account that the labour and skill is nearly all on the patterns. I intend to make a loco. such as "J. H." is describing, or, at all events, to have a good try, and all I can say is that if all articles and drawings on the subject are as plain as those that have already appeared, that any amateur with tools, skill, and patience will be able to make a tolerably good working model. I never call a job wholly my own unless I make all patterns myself. I would not undertake to have the job done in a year, working in my spare time only—i.e., from 6 to 8 a.m., and 7 to 9.30 p.m.

E. G. F.

[29758.]—In reply to "J. G.," "Butler, Bros.," and T. S. Hurman, I have, after much consideration, decided that on the whole it will be more satisfactory to myself and my readers if I make the patterns of my own designs and supply their castings to those who may require them. I do so rather unwillingly, because my time is already amply occupied; but it is the only way in which the wishes of my readers can be met, and I shall be better able to advise on knotty points when the whole of the work has passed through my own hands. The making of sets of castings by different individuals, or firms, would necessarily cause hesitation among intending purchasers, would increase my correspondence, and lead to possible dissatisfaction. On the other hand, I could not supply tracings to one and withhold them from others. In making myself personally responsible for the castings, I do not mean the slightest disrespect to those gentlemen who have offered, through the "E. M." and privately, to take the work in hand; but I simply wish to adopt what appears to be the more natural and satisfactory course.

I cannot say off-hand what would be the cost of a set of plain, untooled castings for the loco. which I am describing. I think, however, that the estimate of "J. G." need not be wide of the mark. In work of this kind it is not so much a question of weight as of time occupied; but the larger the number of purchasers the less per set would be charged. If those of "Ours" who are willing to purchase sets of castings, when ready, will kindly send their names and addresses to the office of the "E. M.," 332, Strand, W.C., I can presently give a price per set.

J. H.

[29759.]—Along with many others, I look forward with great interest to the series of articles by "J. H." under the above title.

To my fancy, the scale chosen is not the most suitable, though, of course, one is not obliged to stick to it. One-eighth of full size—that is, 1½in. to the foot—would have been more easily worked from, as eighths on the rule would represent inches. Then, if reduced to half-size, sixteenths would equal inches.

I would suggest that "J. H.," if he would be so obliging, should make fully-dimensioned sectional drawings and plan to ¾in. scale. This would be no hardship to those who had already commenced ⅛th size locos., as you could not very well supply drawings of that size, and they could easily take off dimensions from the ¾in. drawings with proportional compasses, while those who chose to make any other size would find ¾in. scale easier to reduce and enlarge than ⅛th size. Also *Engineer* drawings that amateurs happened to possess would be more readily used for minor details when making to a proper scale of so much to the foot.

A ¾in. model engine alone weighs about 21lb., and might with advantage be made of brass. A ⅛th size model would weigh 120lb., and with 60lb. of steam in cylinders would exert a pull of 50lb., enough to haul about four tons on a rail.

In regard to "J. G.'s" suggestion that a firm should take the matter up and supply amateurs with castings and materials, I heartily agree with him, and should like to see a ¾in. scale set advertised, too, as I fancy most amateurs would consider 120lb. of iron rather a disheartening mass to tackle.

A charcoal fire burns well in a ¾in., though rather troublesome to start; and as one can get over 200sq.in. of heating surface in a boiler of that size, plenty of steam is made. Then one can easily lift and turn over such a model to show one's friends without the assistance of a travelling crane.!

H. Wake.

WHY COMPOUND ARITHMETIC IS NEEDED.

[29760.]—"Old Hand" has taken for a novelty (p. 53) a very old mistake, namely, that if the base of a notation be "capable of the highest subdivisions," its successive powers will be very divisible also. A few examples will show him this is not so. 12^2 = 144 has but 13 divisors, but 120 has 14; 12^3 = 1728 has 26 divisors, but 840 has 30; 12^4 = 20736 has but 43 divisors, but 2520 has 46; 12^5 = 248832 has 64 divisors, but 10080 has 70; 12^6 = 2985984 has but 89, whereas 27720 has 94, as has also 63360 = the inches in a mile.

What is wanted is not to abolish compound arithmetic (like the Chinese and Sans-culottes), but to have a single weight, measure, or money table, instead of a score of different ones.

E. L. G.

REPLIES TO QUERIES.

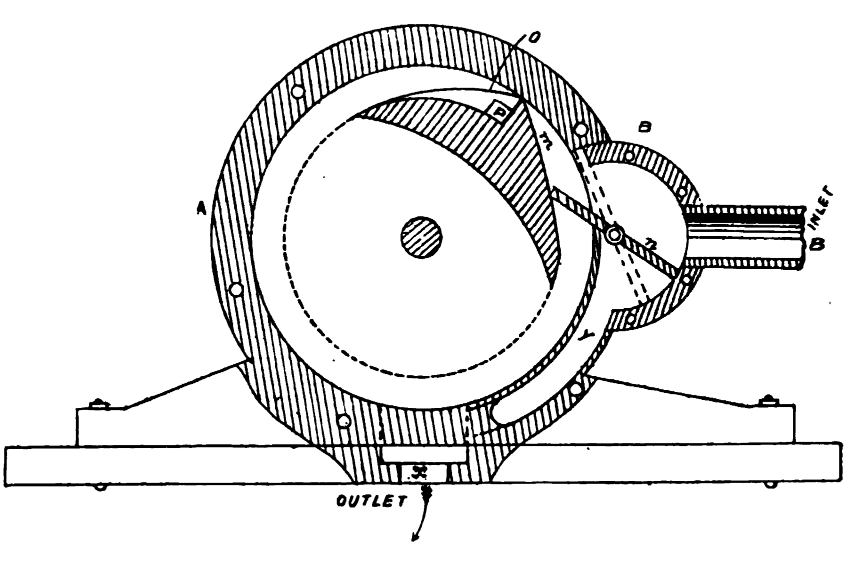
**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67094.]—**Midland and South-Western Junction Railway, and Thames and Severn Canal (U.Q.)**—The route of this line is through Ross Cross, Withington, and Andoversford, where it will join the Great Western line from Banbury to Cheltenham, over which it will have running powers between Andoversford and Cheltenham. The contractor for the works is Mr. Charles Braddock, of Westminster Chambers, and the works are so far advanced that the extension is to be opened early in 1890. I hear that 1,020 men are employed on the line. As to the Canal, I have no information.

W. E. C. B.

[67699.]—**Water-Motor Percussion Floats.**—I think a motor of this principle would suit. I have seen them going by steam and water under pressure, and wrought well. A is the cylinder in which revolves a rotary-grooved piston, with a cam *m* secured in the groove; one face of the cam is curved and the other straight. B B is a case countersunk in the cylinder A, and resting on the flanges of the rotary piston. O is an opening in front of the cam, communicating with the openings P on each side of the rotary piston for the exhaust, which escapes between the cylinder covers, and passes through the channel *x*. The valve *n* is a close fit to the sides of the case B. The channel *y* is an outlet for condensed water that might lodge under the valve *n*. The long end of the valve *n* is kept in the groove of the piston by the extra pressure bearing on it. The steam or water presses on the cam *m*, and causes the piston to rotate. The shaft of the piston works on suitable bearings mounted on a seat.

M. R.



[67702.]—**Slicing Oranges.**—I have a machine for slicing oranges for marmalade, made by Fallows and Bates, Manchester. I cannot make a drawing; besides, it is a patent.

A. G.

[67718.]—**Hand Mill.**—Will not what is known as an ordinary coffee-mill answer? Any firm of machinists would make a mill to the required size—not stated—on receipt of order. What does "F. W. C." mean by "any hints"? What hints does he want?

E. G.

[67719.]—**Bahia, Brazil.**—"Gas Engineer" cuts himself off from replies by asking for answers from those who have "been out there." The climate is healthy for the Tropics, and as to eating and drinking, he will no doubt adopt the customs of the European residents rather than of the natives.

C.

[67742.]—**Reeds for Organ Pedals.**—If this querist means harmonium reeds, he must consider whether it is worth while, for they will be out of tune so often. If he merely wants to practise pedalling, the pedals can be connected to the manual. However, if he must have free reeds for pedals, he can find the method of adding them described several times in back volumes. See, for instance, Vol. XLI. pp. 171, 568; but free reeds used with pipes were condemned many years ago. They are not worth the trouble of adding.

F. C. O.

[67764.]—**Medical Coil.**—Perhaps this querist has not made his medical coil quite correctly according to the instructions. At all events, he can find full information in many back volumes of the "E.M.," or he could apply direct to the author of the book. It is impossible for any reader of his query to tell him what is the matter.

S. T.

[67771.]—**Fretwork.**—"Boney" can procure any quantity of ¼in. mahogany from the dealers in wood. I would recommend him to consult the advertisements.

T. M.

[67773.]—**Surgical Electrical Lamp.**—If "Ursa Minor" will refer to p. 378, Vol. XLI., he will find that a surgical electric lamp of the kind said to be devised by Drs. Roth and Reuss, of Vienna, was shown at the stall of Mr. J. W. Swan at the Inventions Exhibition in 1885. The device for sending the light down a glass rod was the invention of Mr. P. Ward, who used to contribute to these columns, and I have an idea that he described it some time ago. No doubt particulars could be obtained from Mawson and Swan, Newcastle-on-Tyne.

Nun. Dor.

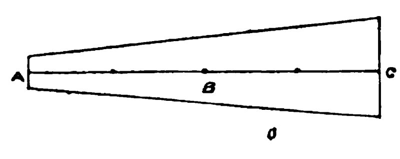
[67780.]—**Lead Pipe.**—It is scarcely likely there were particles of iron in the lead, but very probable that they were brought into the lead pipe from the iron mains.

K. P.

[67782.]—**Slow Tricycle.**—This is a funny query. The idea of having a flywheel is rich; but of course the answer] is, that it depends on the strength of the rider.

Q.

[67796.]—**Telescope.**—As the solar focus is 52in., the diameter of moon's image by it will be a bare ½in. Let "Amateur Optician" trace upon paper a diagram like this:—A = ½in., A C 52, and C 4in.,



and it will represent the refracted cone of rays produced by the o.g. Three stops will be enough, one placed at 13in. from A, one at 13in. from C, and one equidistant at B. The internal aperture of each stop must be cut out to correspond with the diameter of the cone of rays where the stop is placed: if too large, oblique pencils of light will pass to blur the image; and if too small, the rays refracted by the marginal zone of the o.g. will be cut off and prevented from reaching the eyepiece. If the o.g. is not a first-rate one, its definition may be improved by stopping the aperture down to 3½in. or 3in.; and supposing it were a non-achromatic lens, the definition would not be really good under any circumstances; but the evil effects might be greatly mitigated by stopping the aperture down to 2½in., and choosing a lens of very much longer focus. Now, "Amateur Optician" must take, say, 48in. of tube large enough to admit the cell of o.g. at one end, and at the other end, a sliding piece of tube, say, 1½in. in diameter, and 9in. to 12in. in length; in this tube the eyepiece must be fixed. If this be a single convex lens, say, 1in. in focus, then distant objects will be visible when the o.g. and eye lens are about 52 + 1in. apart, the actual distance for any definite object being dependent upon the focal power of the observer's eye, and the eyepiece must be shifted to and fro slightly till the clearest definition is obtained. For a Huyghenian eyepiece, two lenses are required, say, an eye-lens ½in. diameter, and 1in. focus, and a field-lens 1in. or 1¼in. diameter, and 3in. focus. Each lens is preferably plano-convex, the flat side of each one placed towards the eye very carefully parallel, and at a distance from each other equal to a little less than half the sum of their foci. Between these lenses, and at the focal plane of the eye-lens, a small diaphragm must be put, and over the eye-lens a cap with a central hole about ¼in. diameter, and ¼in. distant from the flat front of lens. I should advise the querist to buy No. 1167 "E. M." In the "E. M." for Feb. 15 were offered Herschel's "The Telescope," and Simms's "The Achromatic Telescope." I bought the former, and would advise "Amateur Optician" to buy the latter if still on offer: it is just the book he requires. If further information be wanted, write again.

J. C. Linscott.

[67813.] — **Engineers' Accounts.** — I thank "Prime Cost" for noticing my question, but beg to point out that £32 10s. per annum is 12s. 6d. per week, or nearly 3d. per hour, not 1½d. Is it usual, when making an allowance of 10 per cent. for repairs, to allow so much as 10 per cent. for depreciation? Is the amount for power merely supposition, or do you know of such a machine costing so much to drive? Why do you consider that rent, taxes, and office expenses should not show in prime cost? Do they not have a very material bearing on the cost of the work? And, in making out the cost of any job, must not an allowance be made for them? Therefore, is it not better to arrange the accounts to show these in relation to every job as nearly as may be, leaving the profit and loss account only to settle the small differences that will occur. You say some firms add a per-centage to P.C. of labour and materials to cover rent, &c. It seems to me wrong to consider the materials in this way, as the object is to find the cost of converting the materials, and the amounts due for these expenses depend on the time the work is in hand and not on the amount of materials in them. This is the view I take, and my entries are in this form weekly, for each job in hand.

Wages, say	£10
Rent, taxes, driving, say	5
Machinery, and office expenses of manufacturing, but not of selling, calculated as a proportion of wages	
Materials in details, say	7
Total cost	£22

Anything above which received for the work may be called net profit; of course, subject to correction of the profit and loss account. If the job runs over a number of weeks the materials are not entered till completion, or when they can be ascertained, and the entries are closed as total for week excepting materials. The principle I go on is that each workman should have charged against him a proportion of the expenses, and I don't see how to charge it except as a percentage on his wages, which may sometimes handicap the higher-waged ones, but should be corrected by their doing more work in proportion to the lower ones. What do you think of this? The necessity of doing all work at the lowest possible price, while still avoiding loss, would justify a deal of trouble for a fairly accurate result.

J. M. G.

[67905.]—**Electro-Magnet.**—To Mr. Bottone.—It is possible to magnetise a bar of steel by means of discharges from Leyden jars or from a Wimshurst machine (provided with Leyden jars) by proceeding in the following mode:—Take the steel bar and roll round it one or two turns of well paraffined (wax) paper. Coil round it in one continuous direction several feet (say 50, if the bar is 6in. long by ¼in. in diameter) of No. 24 silk-covered copper-wire. Baste this with hot melted paraffin-wax. When cold, attach a knob of metal to one end of the wire. Now charge a Leyden jar (the larger the better), and place the small wire end of the coil against the outer coating of the jar. Approach the knobbed end of the wire to the knob of the jar, so as to discharge it. You will find the steel bar magnetised.

S. Bottone.

[67920.] — **Chalybeate Springs.** — So called from the Greek word *chalups* (steel), but which term is in medical language now applied to any springs of water containing iron or some of its salts in solution. The history of iron springs in their medical aspect, and in the rise and fall as to popular favour of towns where chalybeate waters became the attraction, is very interesting, and particularly suggestive as to the non-stability of fashion, specially when the said fashion was erected on an unscientific basis. When I was a schoolboy the name of Jephson—Doctor Jephson, of Leamington—was a standard topic of conversation in most drawing-rooms within some 100 miles of that town, then becoming popular on account of the ferruginous waters, and by no reason of Jephson's comet-like fame, who prescribed iron in the form of muriate together with some purgative pill, for every patient who consulted him; but he and his practice soon passed into oblivion, for the stimulation to the whole physical energy which Jephson's iron-prescription exerted for a time was soon followed by its opposite relaxation, together with additional troubles inevitable to such heroic treatment. One great feature in bringing Jephson his early renown was the enormously increased vigour of the animal appetite felt by his patients, notably their sexual enjoyment—soon, however, to be succeeded by a condition bordering upon impotence amongst his male patients, and by abortion or sterility *pro tem.* by the ladies. Allopathy has of late become somewhat more circumspect as to its iron prescriptions, thanks to the teachings of those M.D.'s who are homœopaths in their management of the sick—not homœopaths by profession only. Amongst allopathic authors, Dr. Ringer, in his "Handbook of Therapeutics" (Lewis, of Gower-street, London), gives salient *exposés* as to iron as a medicine, and which may be read with profit (as to coin, perhaps) by "B. B.," while a personal use and trial on his own person of some chalybeate spring or of some such prescription for a few weeks may teach him some little perhaps of the mischief his contemplated speculation would be able to effect upon members of his own race. The more delicate and sensitive the subject, the more sensitive (adversely) is the patient to the action of the above drug, most powerful in its action on the body, and actually dangerous to the minds of those who are so situated as to be denied legitimate relief to its stimulation.

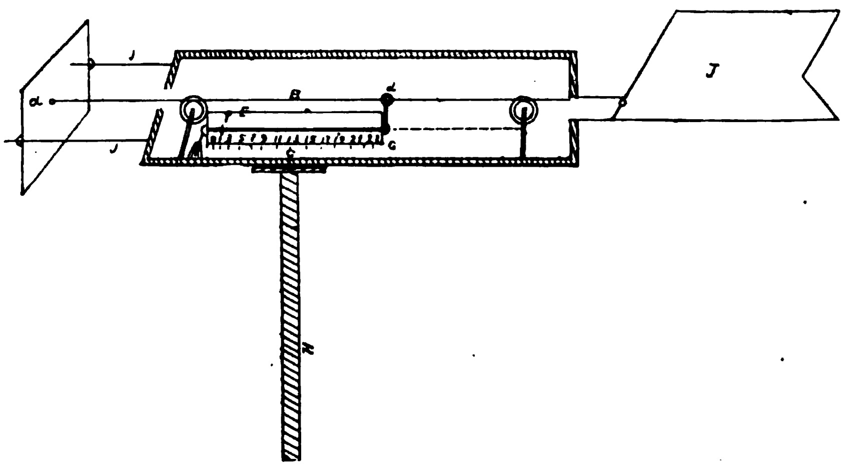
The Lydney Dispenser.

[67922.]—**Water-Blower.** — I cannot answer exactly your query, as you do not say the size of brazing, &c., required—whether ⅛in., or 3in. or 4in. If you give particulars, and have a regular fall of water, I may be able to design for you. I can send sketch of apparatus as used for very small work; but if required for large—that is, up to 3in. or 4in., use bellows as supplied by Messrs. Griffin and Son, 22, Garrick-street, Covent-garden, London.

Aquarius.

[67948.]—**Wind-Pressure Gauge.**—I am much obliged to "F.R.Met.Soc." I inclose a rough sketch for his inspection. A, pressure plate; B, horizontal steel spindle; C, spring balance; D, collar connecting the spindle and balance; E, small wire and thin slip of brass against which the index finger presses and leaves at the highest point; G, base board; H, pillar on which the latter revolves; F, vane which keeps the pressure-plate against the wind; J, J, two small steel arms, which pass through loops in the pressure-plate, and keep it square with the wind.

J. F.



[67960.]—**Starting Compound Condensing Engine.**—I have several times met with an engine losing the injection water, and in each case it was due to air in injection pipe or being drawn in with water. The injection cock should not be left open when engines are stopped; having a vacuum, the injection should be opened at the same time as the engine starts, and closed when engine stops.

McGill.

[67980.]—**Recovering CuSO$_4$.**—Mr. Bottone directs that copper be dissolved in dilute sulphuric acid. Will he kindly say how this is to be managed? as I have hitherto been under the impression that the metal is insoluble in that liquid.

Sm.

[68014.]—**Telescopic Eyepieces.**—One feels tempted to reply to this query "Cui bono," as I should imagine it is quite beyond the power of a "New Sub." to make up an eyepiece to give a power of 150 on a focal length of 40in. The rule is that in the Huyghenian the focus of the field-lens shall be about three times that of the eye-lens, and their distance apart shall be half the sum of their focal lengths. For a low power let eye-lens be 1in. focus, field-lens 3in., placed 2in. apart, and this combination is equal in power to a single lens of 1½in. focus, and on 40in. focus gives a power of 27. Eye-lens ¼in., field-lens ¾in., give a power of 106; eye-lens ⅕in., field-lens ⅗in., give a power of 133; eye-lens ⅓in., field-lens 1in., give a power of 80. The rule is this: multiply the focal length of eye-lens by that of the field-lens, multiply again by two, and divide the product by the sum of the focal lengths of the two lenses. By this method we get a value which represents the focal length of a single lens equal in power to the compound eyepiece. The focus of the o.g. in inches must now be divided by this product, and the resulting quotient expresses the power given by this particular eyepiece on a focus of 40in. One example should make this clear. $\frac{1}{5} \times \frac{3}{5} \times 2 = \frac{6}{25}$, and this divided by $\frac{1}{5} + \frac{3}{5} = \frac{6}{20}$. The focus of o.g. is 40in., and dividing this by $\frac{6}{20}$ $= \frac{40 \times 20}{6} = 133$ power by this eyepiece. The construction and method of finding the power of a Ramsden or positive eyepiece differ from the above.

J. C. Linscott.

[68023.]—**Watch Repairs.**—Before proceeding I understand that you mean cylinder for the word escapement, and as the cylinder is the proper name for your escapement, I shall for sake of clearness call it so. First, you must not take cylinder off the balance to remove the pivot plugs. You can place the punch on the plug without removing anything. You must then rest your cylinder on one of the holes of the riveting stake. Care must be taken in choosing the hole that the part on which the hair-spring collet fits does not slide into the hole, or else you will drive the cylinder out as well as the plug. The plug only must be shifted out, the cylinder to remain in original place. Secondly, the plug of pivot is fitted into cylinder, and not cylinder into plug. The cylinder and verge escapements are of quite a different class to each other. If the bottom pivot of a verge is broken, you will have to fit a new verge. You can fit a new bottom pivot to cylinder in the same manner as you do the top one. The Jacot pivoting turns is a tool for the forming of pivots of all kinds. In one end is inserted a centre, which has twelve notches or beds, of graduated sizes, in which the pivot lies when being reduced to proper size with a pivot file and burnisher. You may buy a small pair of turns in any tool shop, that will be a substitute for a Jacot tool, for the sum of 4s. 6d. I believe that is the cheapest turns advertised; but remember you will have to make the centres yourself. I do not know of any device as a substitute for turns. The pivots must be nicely made, or else your results will not be satisfactory. See answer to 68049 this day.

Welsh Horologist.

[68022.]—**Freezing.**—The vacuum pump causes the water to evaporate, and thus lowers its temperature. The sulphuric acid is to absorb the vapour. If there were no water to evaporate there would be no reduction of temperature (except that due to expansion of air), and therefore you could not freeze your ices. Sm.

[68016.]—**Carbon.**—Carbon may be set free from CO_2 by the action of potassium, sodium, or magnesium at a red heat; also by phosphorus and boron in presence of an alkali. Sm.

[68027.]—**Lead-capping Carbons.**—Use stiff clay to form your mould. In paraffining carbons, immerse them wholly in the fused wax until air bubbles cease to escape. Then hang up to dry. Sm.

[68033.] — **Drilling Small Holes.** — To "M. H. R."—I wish you could see the Indian native armourers do this work. For many years they made me excellent nipples for percussion guns, from a large wild-fowl piece to a light double-barrelled one, and I have seen them do more diminutive holes than those. They only used a rude reciprocating drill with a bow to rotate it. I have been very successful with the "Archimedean drill," the chief points being to lower the temper of the steel you wish to pierce to the lowest safe degree, to forge the drills stout, and only reduce the boring portion by the file to the size and depth of required holes; this saves much breakage, and enables the workman to remake the cutting-tool as often as he may chance to break it. The angles of the cutting-edges must be adapted to the metal you wish to pierce. Cool lubrication is requisite, as the heat of friction soon reduces the temper of a delicate drill. I think I prefer the form of Indian reciprocating drill-stock (with small additions of my own), which was figured and described by me in the pages of the "E. M." many years ago; but this tool requires much practice in working the bow, which I took in hand as a very young amateur mechanic, and still use at the present time. I have only seen "bort" used for the larger sizes of holes. Eos.

[68036.]—**Brassing Solution.**—Try the following solution. I have always obtained excellent results with it:—Acetate of copper, 2oz.; potash, 2lb.; sulphate of zinc, 5oz.; liquid ammonia, 1½ pint; cyanide of potassium, 4oz. Dissolve the acetate of copper in a quart and a half of water, add half the ammonia, then dissolve the sulphate of zinc in two quarts of water at 190° Fahr. When zinc is dissolved add the other half of the ammonia to it. This should be well stirred for a few minutes, then dissolve the potash in two quarts of water, and, lastly, dissolve the cyanide of potassium in another quart of water. Then add the solution of copper to the zinc solution, then the cyanide, and then the potash. Stir well, and allow solution to stand for two hours, then make up solution to 3½ gallons. Work with a milled brass anode (which should be well cleaned before immersion) and three Bunsen cells. Too much care cannot be exercised in having the articles for the bath scrupulously clean, as if they are not, the result will, in nine cases out of ten, be a failure. A little ammonia and cyanide may be added when the solution works slowly. Watt, in his last book, prefers to use a small amount of arsenious acid to the solution; but I cannot say that I am particularly in love with it. If added, it should be at the rate of ¾oz. to six gallons.

F. W. Mason.

[68045.]—**Portable Vapour Bath.**—Stout jean, this is a twill material—and nothing better.

Jack of All Trades.

[68048.]—**Self-Hardening Steel.**—Mushet's self-hardening steel requires forging same as ordinary tool steel, but not hammering at to cold.

Oxford-road, Sheffield. Gilbert.

[68049.]—**Cylinder Pivots.**—The reason that the cylinder was knocked out was because you did not rest it on the proper hole of the riveting stake. The shell of cylinder is only a little larger than the plug, so you must get a hole which will only allow of plug going through. Your punches, I believe, are all right. If you made them same as drawing you will have no trouble; remember to harden and temper them, or else they will bend. You can buy the punches ready made. English jewel-holes are not fitted same as Geneve jewels. The English jewel-holes are fitted into small brass settings, which again fit into other settings in plates and cocks, by being pushed gently into their places, or else kept in position by a couple of jewel screws. The Jacot pivoting tool must only be used for finishing off the pivots with pivot file and burnisher. The pivot is turned nearly to proper size firstly in a pair of ordinary turns. The notches are graduated, so when you cannot reduce the size of pivot in one notch, turn the centre for the next smallest, and so on until you have pivot to right size. Then burnish with a pivot burnisher, and finish off the end of pivot in one of the holes of a small disc at the other end, with rounding off file and burnisher. See answer to 68023 this day. Welsh Horologist.

[68051.]—**Japanese Tumblers.**—It consists of two little puppets which turn round axles adapted to two parallel tubes containing mercury. When we place the little contrivance in the position of Fig. 1, the mercury being at *a*, the two dolls remain perfectly motionless; but if we lower the doll B, so that it stands on the second step, No. 2, the mercury descends to *b* at the other end of the tube, the centre of gravity is suddenly displaced, the doll A then accomplishes a rotary movement, as shown by the arrow in Fig. 2, and finally alights on step 3; and so on, as many times as there are steps. J. H. King.

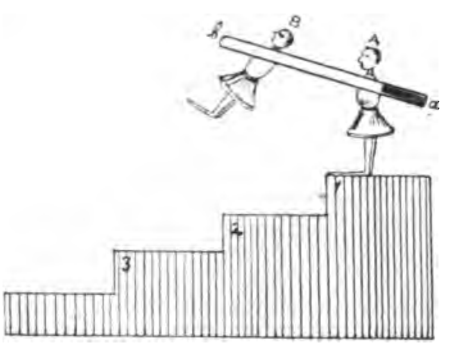


FIG 1.

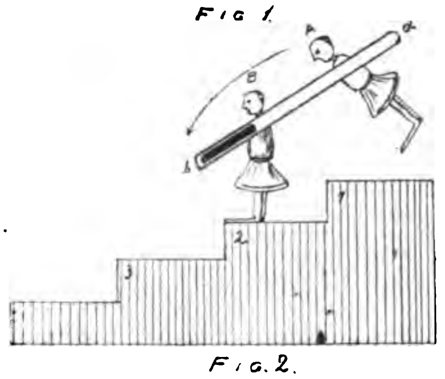
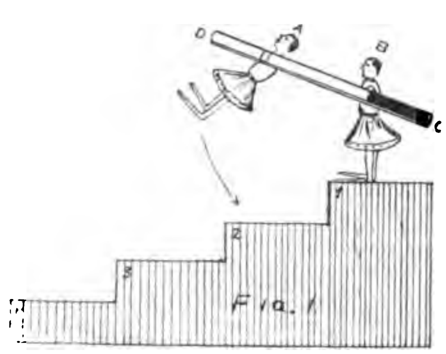
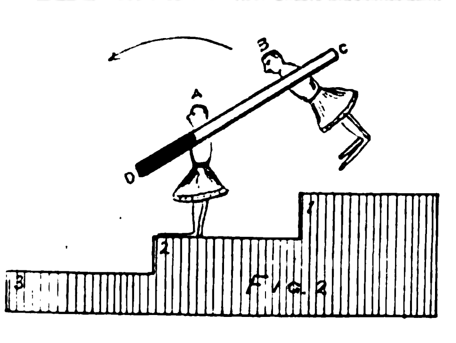


FIG. 2.

[68051.]—**Japanese Tumblers.**—This amusing toy consists of two little puppets which are made to turn round axles adapted to two parallel tubes containing mercury. When placed in the position of Fig. 1, the mercury being at C, the figure remains motionless; but if we lower the doll A, so that it stands on the second step, the mercury descends to D at the other end of tube, the centre of gravity is suddenly displaced; the doll B then accomplishes a rotary movement, as shown by arrow in Fig. 2, and finally alights on step No. 3. The same movement is then effected by the doll A, and is repeated as many times as there are steps. Photus.





[68051.]—**The Japanese Tumblers.**—The two toy men are joined together by the two slant rods, which are hollow, and inside each rod is a globule of quicksilver; the ends of the rods are fastened up. The toy men have a hole through the upper part of their bodies and a wire passed through; the wire must not fit the holes tightly, but let the men swing about on them; the rods are connected by these two wires, which are fastened to them. You place the tumblers on the steps, and the figure on the second step being lower than the one on the top, the quicksilver runs down the rod, and is just heavy enough to lift the top figure over the head of the second one and place it on the step beneath; this keeps on as long as there are any steps, or till it comes to a level place. The four connected together would be on the same principle with a little more quicksilver in the rods. The ropes would be slanting down across the stage, and would act the same way as the steps. Mecum.

[68052.]—**Chemical Analysis.**—It is hardly possible to answer this offhand without a trial. I should do this:—To a solution of the powder in a small flask add an alkaline hypobromite, whereby the nitrogen of the urea is evolved as gas, and may be collected over water. CO_2 is evolved also, thus:—

$$CO(NH_2)_2 + 3NaBrO = 3NaBr + 2H_2O + CO_2 + N_2.$$

Next boil the solution, when the ammonia will be evolved in the free state, leaving behind sodium phosphate and tartrate with excess of reagents used. Precipitate the PO_4 by magnesium mixture, which will carry down with it some tartrate also; but the greater part will be left in solution. Sm.

[68066.] — **Measuring Pendulums.** — The length is reckoned from the point of suspension to the centre of gravity of the whole—i.e., slightly below the centre of bob itself.

W. Perren Maycock.

[68069.]—**Electro-Magnets.**—I have made one this week that will lift 8lb. Particulars of sizes: Procure ½in. round soft iron rod 12in. long, bent horseshoe shape equal ends, then annealed in wood fire. Turn two boxwood bobbins to fit iron 2½in. long, 1½in. diameter, and wind them full of No. 22 c.c. wire, inside end of wires pass through top end of bobbins, and connect them together, outside end of wires tightly fastened so to connect one Leclanché cell; with this I can carry 7lb. anywhere to length of wire from cell. Half the above sizes would suit "W. T.'s" purpose. Somerset Lad.

[68071.]—**Power.**—An ordinary 20c.p. dynamo will absorb about ⅛-man power. I am doubtful whether so small a water-wheel could develop such power, though, of course, this will depend to some extent on the pressure at which your water originally is. If you make the hole for the passage of the water smaller, you will naturally get less power, as it meets with more resistance in passing, besides there being less weight. S. Bottone.

[68072.]—**Lamps.**—If you are prepared to spend £10,000 in fighting the Edison-Swan Co. in the Courts, you will probably be able to find some six or seven experts in this country who will be glad (for a consideration) to put you up to the manufacture of glow lamps—for that is what it amounts to.

Govan. Engineer.

[68072.]—**Lamps.**—According to different manufacturers, different means are employed. The filaments are either cotton, bamboo, or other carbonisable vegetable fibre cut to the desired thickness and length, then raised to a red heat between proper metal plates, so as to reduce them to a hard graphitoidal carbon. These are then attached to the platinum wires by means of a paste of gum-water and carbon, or pinched between the split platinum wire end. The globe is then exhausted of air and hermetically sealed. All very easy, is it not?

S. Bottone.

[68073.]—**Commutator.**—When the commutator is at its best position with regard to the brushes, is when there is the least sparking at the brushes, and the largest current in the circuit. This, of course, can be tested by an ammeter, or roughly by noticing which position will enable you to light the lamp of highest voltage out of several. The Pacinotti ring armature is certainly one of the best forms. When made of laminations and mounted on spiders it runs perfectly cool. S. Bottone.

[68075.]—**Dynamo for Water-Wheel.**—Yes, this could be done; but as the best dynamo is not the most efficient motor, you must be content to lose a little power. Two man-power, say 250 volts; such a motor would take five to seven ampères at, say, 55 volts pressure, so you would want 28 cells of accumulators. This same motor could, without any charge, be used for the charging the accumulators.

S. Bottone.

[68076.]—**Unidirection Current Machine.**—To Mr. Bottone.—The possible defects are: First, wire touching the iron at some place: test this by touching one cheek of the armature with one terminal of a freshly charged bichromate battery, and seeing whether you get a spark on drawing the other terminal along the bare iron of the armature. Second, the slits are in the wrong position: they should be against the brushes, when the armature cheeks face the magnets. The machine should light easily a 4-volt 2½c.p. lamp, if wound with No. 24. S. Bottone.

[68077.] — **Water-Wheel.** — You don't give quantity of water passing, so any answer must be vague. Theoretical velocity of water under 6ft. head = $8\sqrt{6} = 19{\cdot}6$ft. per sec. Run your wheel at 60 per cent. of this = 13 revs. per min. The actual power will depend on the "quantity" of water, the velocity of wheel floats, and "head" of water above the tail race.

Govan. ENGINEER.

[68078.]—**Recharging Medical Battery.**—To MR. BOTTONE.—Fill the space between the carbon cell and the porous pot with granular graphite and black oxide of manganese. Fill the porous pot with a saturated solution of salammoniac, thoroughly moisten the crushed graphite and manganese with the same. Of course the previous charge must have been removed, and the zinc and carbon washed and cleaned. S. BOTTONE.

[68080.]—**Frame Saw.**—If "Angulus" thinks he is going to cut plank up to 12in. deep with engine of 2-man power, he will be deceived; and as he is trying to work now, I may say he is merely grinding, and not cutting, the timber. It is impossible to cut with any speed with the timber dragging against the saw both in up and down stroke. The timber should be fed in the up stroke, and be stationary in the down stroke, to take thrust of saw. The feed motion should be driven from end of crank-shaft, and arranged so as to vary the speed of feed with depth of timber. Should the stroke be increased, more power will be required. A speed of 250 revs. would be fast enough, and the teeth of saw from ½in. to ⅝in. from point to point, with round gullet. The saw should have about ⅛in. lead—that is to say, the top of saw to overhang the bottom ⅛in. to let the dust fall freely, which, if brought back, will heat the saw and cause it to run out of truth.

Scorrier Saw Mills. A. R.

[68082.]—**Shocking Coil.**—To MR. BOTTONE.—Do not use pint cells, use two quart cells coupled up in series. If you must use pint cells, let them be single-fluid chromic-acid cells, with lifting elements. S. BOTTONE.

[68082.]—**Shocking Coil.**—Does "Unshocked" use a condenser? If not, let him add one of, say, 40 sheets 7in. by 5in., connect it to the coil, and keep adding fresh sheets until the spark at the contact-breaker almost disappears, which is a sign the condenser is sufficient for the battery power. Another cell would also increase the shock. It is a pity he cannot substitute 36 s.c. for his 28 c.c.; he would get shock enough and to spare then. C.c. wire is a complete mistake for secondary.

B. HARCOURT.

[68083.] — **Fletcher's Bath Heater.** — If "Kappa" will communicate with us, giving full particulars, we shall be able to advise him as to the best way to overcome his difficulty. The fixing and arrangement of a makeshift flue is by no means a simple matter if it is to be satisfactory, and all local external conditions require to be carefully considered.

Warrington. T. FLETCHER AND CO.

[68084.] — **Induction Coil.** — T. Heatly's secondary wire has probably parted, most likely at the division, where the wire of these one-division coils frequently snaps from the division being moved slightly. I suppose his battery is in good order? Is he connecting the galvanometer to the secondary and the battery to the primary in testing the wire? Because the secondary current is so quickly alternate that the galvanic needle has frequently no time to do more than slightly shiver. Let him attach one cell to the secondary and galvanometer, and then, if no deflection ensues, the wire is evidently broken, or the joint gone wrong; the intensity of the secondary current, when the coil is in action, enabling it to leap the slight gap the feebler flow of the battery current cannot pass, though it loses half its force in the process. The maximum amount of battery power for a coil seems a doubtful point. I use six quart bichromates (single cell) for 3lb. of No. 36 for secondary; probably this is not enough, but it is safe. If I made another coil I should send the proposed current through the reel of secondary before winding; and, if the heat produced appeared likely to affect the insulation, would withdraw a cell. I don't think T. Heatly's battery is too strong. Every break in the secondary means not only an expenditure of force inside the coil, but further destruction of the insulation by the sparks. As to the condenser, see reply to No. 68082. I cannot answer the Rheotome point. The secondary current simply rushes to and fro in the wire when the terminals are open; under these circumstances the primary current experiences greater resistance, but I do not think any injury is done to the coil.

B. HARCOURT.

[68086.]—**Organ Blowing.**—To MR. BOTTONE.—The motor described in the ENGLISH MECHANIC for March 15, under the heading "Electro-Motors, how Made," would, if furnished with an armature 2¼in. by 6in., develop quite one man-power; this would require about twelve quart cells to get full results, though it could be worked with six. Cost of motor, if home made, 35s.; cost of battery of twelve cells, home made, £3; cost of maintenance of batteries, working one hour each day, 30s. per month. S. BOTTONE.

[68090.] — **Aluminium Palmitate.** — Add alcoholic solution of sodium (or potassium) palmitate to an aqueous solution of alum. Aluminium palmitate will be precipitated. SM.

[68092.]—**Regulating Gas Burner.**—If "Incubator" will advertise his address in this paper, I will supply him with a burner that will answer his purpose. JOE BLAIN.

[68092.]—**Regulating Gas Burner.**—Some thirty years ago I made an incubator heated by gas, and met with all the trouble mentioned by your correspondent. I had a look at Cantello's, exhibited in Leicester-square, heated with charcoal, which required a good deal of attention to keep the heat regular. I thought gas was the very thing, but soon found I was wrong. It varied 20° to 30°. I then tried to make a governor or regulator. After expending £8 or £9, I succeeded in making a very simple and good regulator. The next difficulty, after hatching the chickens, was to feed them, not having time to attend to them in business hours. Since then I have done nothing with it, as I could not get anyone to join me in working it. The ground I had was only large enough for ten or twelve hens. My egg-way was my own make, and different to any in use then or now; it would take any size egg. If your correspondent will please publish his address, I shall be glad to correspond with him. W. S.

[68094] — **Water Motor.** — I have one of Wheeler's rotary motors fitted up by myself. I get 1,700 per minute when not driving. It also drives a fan of Rownson and Drew's forge for melting brass, &c., Water pressure 45lb. per sq.in.

MEMBER CAMERA CLUB.

[68095.] — **Launch Engines.**—Draught very large; should it have been depth? Assuming the draught to be 5ft., the size of cylinders would be: h.p., 8in.; l.p., 15in.; stroke, 9in.; boiler, 5ft. diameter; length, 6ft. 6in., H.P., 45. The total weight of machinery = 5 tons. Propeller, 4ft. diameter, 5ft. pitch. The speed 10½ miles; for 12 miles, 70H.P. would be required. McGILL.

[68097.]—**Boring Holes in Granite.**—If "Sonny" will use a copper or zinc drill in a vertical, and feed with emery and water, I think he will find it succeed. E. G. F.

[68099.]—**Boiler Stress.**—

Surface of shell = $7 \times 3{\cdot}1416 \times 25 = 615{\cdot}7536$

" " ends = $7^2 \times {\cdot}7854 \times 2 = 76{\cdot}9692$

Whole internal surface in square feet = 692·7228

Total pressure in tons

$$= \frac{692{\cdot}7228 \times 144 \times 70}{2{,}240\text{lb. in a ton}} = 3117{\cdot}2526.$$

GOMER.

[68105.]—**Bath.**—Porcelain enamelled baths are allowed to be about the best. Weight from 6 to 8cwt., and price from £6 to £15; copper, tinned and painted, from £10 10s.; light zinc baths, painted, from £3 to £5; painted iron, from £1 5s. to £4; polished plate zinc, from £4 to £5 10s. Porcelain, slate, and iron baths require a larger supply of hot water than copper or zinc. Any bath which is painted requires to be carefully used. The bath for rough usage is polished plate zinc. Whatever bath is used, it should be washed and dried after use, and if a zinc bath gets this attention it is the best bath of the lot. J. K.

[68108.]—**Sulphide of Tin.**—Roast the tin sulphide in a current of air so as to burn off the sulphur or dioxide, and convert the tin into oxide. Then mix the oxide with an excess of powdered charcoal and oil, place in a crucible, and expose to a bright red heat. This will reduce the tin to the metallic state. S. BOTTONE.

[68109.]—**Creaky Boots.**—Soak the soles of the boots well with linseed oil by standing them in it on plates for about ten hours.

J. S. MANDANE.

[68112.]—**Incubator Regulator.**—"R. H. J." does not say how his indicator is heated—by charcoal, oil, or gas. If by charcoal or gas, see my answer to 68092. W. S.

[68112.]—**Incubator Regulator.**—Try a zinc helix fastened at one end, and having the other extremity attached to a "motion governor," and from that to the gas-cock. If that does not suit, here is another:—U tube, half-full of mercury; couple of corks, one closing each limb, platinum wire thrust though each, one dipping into mercury; said wires connected with battery and electro-magnet. When temperature rises mercury expands, completes circuit (after manner of fire alarm), sets magnet in action, which attracts armature connected with lever, and turns down gas. When it cools down a few degrees, armature falls and turns on gas. LUX.

[68114]—**Problems.**—

$$H = \frac{X^2 \times n \times A \times R \times S}{F}$$

$$A = \frac{H \times F}{X^2 \times n \times R \times S}$$

$$R = \frac{H \times F}{X^2 \times n \times A \times S}$$

$$S = \frac{H \times F}{X^2 \times R \times n \times A}$$

McGILL.

[68115.]—**Electro-Motor.**—If you make a motor of the Manchester type, with armature about 4½in. diameter, 3in. deep, wound with about 4lb. No. 18 on armature, and 10lb. or 12lb. No. 20 on the fields, connected up in shunt with the brushes, you should have an efficient machine, which would stand about 7in. high, and occupy a floor space of about 10in. by 12in. This would require about 8 ampères at 50 volts pressure, to give the required output, so that 25 cells of large accumulator T-type, 66 hours ampère-hours capacity, each cell containing eleven lead plates 6in. by 8in. by 11in. S. BOTTONE.

[68119.]—**Gassner's Dry Battery.**—To MR. BOTTONE.—It is not necessary that the zinc should take the place of the outer cell; only convenient. You may use a zinc roll in an earthen jar just as well. I cannot tell you the best proportions; but I used with good effect a paste made of plaster of Paris 1lb., oxide of zinc ¼lb., saturate solution of chloride of zinc sufficient to make a stiff paste.

S. BOTTONE.

[68125.]—**Dynamo.**—Put as nearly 1lb. of No. 20 as you can get on the armature; wind the field-magnets with 10lb. of the No. 22 wire.

S. BOTTONE.

[68125.]—**Dynamo.**—On a Siemens armature you might get 2oz. No. 24 silk-covered copper wire, and if you could get 12oz. on the fields you would be able to light two six-volt lamps. Of the latter portion of your query I know practically nothing; but you will see plenty of illustrations in the catalogues of the large telegraphic stores manufacturers.

S. BOTTONE.

[68126.]—**Paris Exhibition.**—A full reply to querist would become an advertisement. If he will communicate with me, I can help him and others to obtain what he desires. See Address Column.

Leicester. PHIPPS.

[68127.]—**Soldering Zinc Bath.**—If "Dark Zinc" will use spirits of salts full strength after cleaning zinc, and solder of half tin and half lead, he will succeed. He must thoroughly clean the part that is leaking. If there is a band on the bath cut out the part that is bad, insert a fine saw in seam to clean edges, hammer up, and sweat again with solder, then clean band and solder on again.

J. K.

[68128.]—**Watch Timing.**—(1) Take off balance cock, draw out pin which fastens hairspring to stud, remove balance with hairspring attached; now carefully turn the collet, holding the spring so that when balance is replaced and the watch put in beat there will be less superfluous spring projecting through stud. (2) Remove the spring from collet and place it upon a piece of wood nicely round so as to fit centre coil; now make a piece of fine iron wire flat, so that it will pass freely between the coils, and with oilstone dust and oil use it as a grinder, operating only on the centre coil. (3) After removing the hairspring from brass collet, put it upon an oilstone, and with the finger carefully rub it backwards and forwards, first on one side and then on the other, until sufficiently reduced. Soak in benzine to remove oil. In either case proceed with care; otherwise the spring will be made too weak. CHRONOMETER.

[68130.]—**Alcohol and Fermentation.**—What kind of fermentation do you mean? If alcoholic, it is generally stated that a solution of sugar will cease to ferment when the alcohol reaches 10—11 per cent. If you mean acetic, lactic, or other so-called "secondary" fermentation, I cannot tell you what amount of alcohol will act as a restrainer. I have known a wine containing 20 per cent. of alcohol to turn sour when kept in a warm place.

SM.

[68130.]—**Alcohol and Fermentation.**—If I understand your question rightly, the answer is this: Fermentation can no longer go on in a saccharine solution in which the alcohol has reached 14 per cent. If a larger percentage of alcohol be present the wine has been fortified, or, to be more explicit, alcohol has been added to that wine. In addition to alcohol C_2H_5HO, however, during the fermentation of grape-juice, many other substances are formed, such as the various ethers which give the wine its bouquet. In many inferior wines where the aroma, bouquet, &c., are insufficiently marked, almonds, nuts, and peach kernels are added to supply the deficiency. You mention yeast as being added to the grape-juice to produce fermentation. I believe in the case of wines this is seldom done, the germs floating about at all times in the atmosphere being sufficient to set up fermentation. In many cases it is necessary to fortify wines, because, without added spirit, natural wines will not keep—by oxidation from the oxygen of the atmosphere becoming simply vinegar. Potato spirit is frequently used for this purpose, but is decidedly bad, as it gives rise to amylic ($C_5H_{11}HO$) as well as ethylic alcohol. Amylic alcohol is another name for "fusel oil." New wines contain aldehyd, but this, by the action of the ethers, malic and succinic acids, &c., soon alters; hence the advantage of old wines. The colour of wines should be derived from the pericarp, or outside skin of the grape, white wines being made from white grapes strained, and in some cases decolorised. Of course, when fermentation ceases no further alcohol is formed, hence all wines containing more than 14 per cent. of alcohol must have been fortified. When I say alcohol I mean absolute alcohol, not proof spirit, proof spirit being a spirit containing 49 per cent. by weight of absolute alcohol. The English Customs have the proof spirit tables for taxing wines. Proof spirit was first so named from the gunpowder test. The following list may be of interest:—Natural clarets contain about 8 per cent. of alcohol, burgundies 10 per cent., red wines from 9 to 12 per cent., white wines from 8 to 13 per cent., and fortified ports and sherries from 20 to 22 per cent. The percentage of spirits may be tested as described in reply 67495—i.e., Mulder's test.

FREDERICK DAVIS.

[68131.]—**Voltage of Leclanche and Fuller Cells.**—The voltage of the Daniell being taken as 1·079 volt, that of the Leclanché is 1·6, and that of the Fuller very nearly 1·8 volt. The current depends entirely upon the resistance. The internal resistance of a well-made Fuller is less than that of the other two. S. BOTTONE.

[68131.]—**Voltage of Fuller and Leclanche Cells.**—Voltage of Leclanché varies according to type, &c.: 1·402v., 1·46v., 1·59v. (Thompson), 1·47v. (Ayrton), 1·48v. (Jamieson and Munro). The mean of all these is 1·4804v., so practically we may say 1·5v. Voltage of Fuller is as nearly as possible 2v. Voltage of stand. Daniell varies according to type and charge. P.O. patt., saturated sol. $ZnSO_4$, sat. sol. $CuSO_4$; voltage = 1·079. U-tube gravity pattern, 1·104v. when sols. of Zn and Cu sulp. have equal density; 1·074v. when sp.gr. $CuSO_4$ = 1·1, and sp.gr. $ZnSO_4$ = 1·4 at 15° C.

W. PERREN MAYCOCK, A.I.E.E.

[68132.]—**Factory Spindles.**—If "Yokel" will heat his spindle to a full red and bury it in dry sawdust, he will find it quite soft enough to turn if he allows it to remain until the sawdust has smouldered away and become cold. His iron box should be suitable for the purpose providing it is not less than, say, 4in. wide and deep for ½in. spindle, and 5in. for ¾in. I have softened them frequently in this manner. G. G.

[68134.]—**Gramme Dynamo.**—If driven at about 2,500 revs. per minute, or not less than 2,000, your dynamo should give six or eight ampères at 25 to 30 volts pressure, so that it would be capable of running eight lamps of from 25 to 30 ohms resistance. The question of the advantage of high and low voltage lamps is best decided by the facility of conveying the current. It is cheaper to convey a current of (comparatively speaking) high voltage and small ampèrage, than to carry a large current of low potential. But the light given off by a Bernstein lamp taking 20 ampères at four volts pressure is distinguishable from that given by a Swan taking 80 volts and one ampère. S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "W. E. C. R." has replied to 67094.

67456. Varnish Stains, p. 406.
67489. Locomotive Query, 407.
67491. Weaving, 407.
67492. Tangent Galvanometer, 407.

67729. Transparent Show Bills, p. 489.
67744. Ferry, 489.
67755. Electric Bells, 489.
67758. Quill Floats, 489.
67761. Gas-engine, 489.
67766. Jewelry, 489.
67769. Cryolite or Sodium Aluminate Fluoride, 489.

A NEW automatic magazine rifle, invented by R. Dewhurst and H. A. Pitcher, has been brought out at Neillsville, Wisconsin, where it is making quite a sensation. Like the Maxim gun, the cartridges may be fired singly, by pulling the trigger for each desired discharge, or the gun may be set so as to fire itself off, with great rapidity, until all the cartridges in the magazine are used.

QUERIES.

[68135.]—**Speculum Grinding.**—For a considerable time I have employed my leisure time by attempting to grind and parabolise a glass speculum, as I would like to say that I have made a telescope worth having. I have succeeded so far, but there is one difficulty I cannot overcome, and were any fellow-reader able to assist me I would feel thankful. I think Mr. Linscott could if he feels inclined, and he is very kind in giving information on these matters. My machine is of the ordinary description. It has a principle mandrel on which either the speculum or tool can be affixed. It has a back and forward motion and also a side one. The proportions are 30 to 1. I can give either a straight stroke or a circular one, or anything between these. I can grind and polish a speculum evidently satisfactorily well; but when I put it under the pinhole test and view it from the centre of curvature by means of an eyepiece of, say, 70 power, I can focus it so that the pinhole looks sharp and well defined, and even when I put on different stops, I cannot detect any difference of focus, between any of the portions left exposed. In fact, the surface seems to me to be perfectly spherical, and when I apply the shutter or shadow test, except a little uncertainty towards the margin, I can detect no difference. When I draw back the eyepiece behind the focus the point of light enlarges to a circle. Now were the surface of the mirror truly spherical, this circle of light would be equal all over, but it is not so. The centre is apparently right, but around the margin there seems a bright band. It appears to me to be in consequence of one part of the mirror, during the process of working, being always covered by the tool while the other or marginal part is only alternately so, the tool and speculum being the same size. In my opinion this produces the difference on the face of the speculum, and as long as it is so, it cannot be correct. I have tried various methods to correct this, but cannot succeed. Can any good friend assist me in this matter?—AMATEUR.

[68136.]—**Turbine for Lathe.**—I have a 3½in. centre lathe, and I want to turn it by a turbine if possible. Our house is supplied with water from a spring about 100ft. above it; the water is brought down in pipes, and supplies other houses on its way to ours. The inside diameter of pipe from the last house it feeds to ours is 1in., and it branches off from this into 2 or 3 1¼in. pipes. Would, say, a ¾in. pipe with a ⅜ jet, on a 3ft. diameter turbine have sufficient power to turn the lathe for either wood or metal-turning, or screw-cutting? If not, please say what size turbine, pipe, and jet would be sufficient for above object? A sketch of turbine would oblige.—HYDROSTATICS.

[68137.]—**Bending of Fire Bars.**—For the past twelve months I have been in charge of a semi-portable Robey engine and boiler, which is used for driving an ore washing mill, and is kept in constant motion for 9 hours each day. I should be much obliged if any experienced person would help me to find the cause of the fire-bars bending. The bars are 3ft. 4in. in length, and there is plenty of room for expansion. The bottom of the ash-pit is 18 inches from the fire-bars. The ash-pit is cased in on three sides, and on the front side underneath the fire-door there is a swing-door, which is used to regulate the draught. I always keep this door open so as to keep the fire-bars as cool as possible; but in spite of this they get red hot and bend, which causes them to overlap each other like a venetian blind when closed. This has the effect of stopping the draught to the fire, and then I am not able to keep the steam. I always keep the ash-pit clear of ashes. The boiler is fired very hard, the fire having to be cleared of clinkers every 3 or 4 hours. I have consulted many experienced tubular boiler firemen, but they can give no definite reason for the bars bending; and, as a last resort, I hope some reader of the ENGLISH MECHANIC will help me out of the difficulty.—W. W.

[68138.]—**Lapidary's Work.**—What books are published on lapidary work? Can any reader describe method of turning and polishing the agate boxes?—T. M. BEAR.

[68139.]—**Chemical.**—Will Mr. John Grey or others please to give the formulæ of copper sulpho-cyanide and barium sulpho-cyanide? Also say in the destructive distillation of shale, what compounds or elements may be looked for? The formulæ for these compounds would greatly oblige.—PARAFFIN.

[68140.]—**Steel Bicycle Chain.**—I have a Safety bicycle, the chain of which was bright and easy working. It is now rusty and stiff at joints. Will any reader kindly inform me how to bring it to its former condition?—PROSELYTE.

[68141.]—**Nickel-Plating.**—Will some reader tell me which is the best battery to use for above? I have some parts for a model engine, which I wish to plate. Never tried to plate before, so shall be glad of a few hints.—NEW SUBSCRIBER.

[68142.]—**Permanent Way.**—Can any reader give the width of rails and clearance for flanges of wheels at heel of switch, as adopted by each of the leading railway companies?—LIBRA.

[68143.]—**Silver Chaser's Pitch.**—Will some of our readers kindly give the recipe for mixing this pitch ready for use?—F. W. S.

[68144.]—**Cuckoo Clock.**—I shall be much obliged to any gentleman who will tell me how to put this right without advising me to send it to a clockmaker. The clock has a separate spring for the striking, &c., and is not a cheap one. It has gone well for a very long time, but a few nights ago something seemed to give way, and it then "cuckoo'd" until the spring was run down. I carefully examined the inside and found that a little pin on the second wheel (that is, the wheel that drives the fly) was broken off. I drilled it and put in another pin. A brass lever is allowed to drop, and stop the wheel by coming against this pin, and so stops the striking. There is a lever raised by two pins on the hour-hand wheel (as the clock strikes the half-hour) that releases the brass lever from the pin and allows the clock to strike. Now when the striking is started, the brass lever is not allowed to drop for two or three minutes, and for this time the striking continues. The clock used to give a warning at two minutes to the hour, but does not now. How can I remedy it?—W. G..

[68145.]—**Washing French Merino.**—Can some one tell me the best way to wash some black dress material of the above? Soap always seems to spoil it, and I believe there is a way without soap.—W. G.

[68146.]—**Marine Steam Engine.**—Will "T. C." or others kindly answer? I intend making a double high-pressure engine; cylinders 3in. by 5in. Is there any rule to go by, so as to make the respective parts proportionate, such as ports, traverse and size of valves, thickness of piston and rod, shaft and link, &c. He will probably refer me to working drawings; but as I am of a somewhat independent character, I would sooner do the whole thing myself, if it can be so done by any recognised rule. What sized boat would such an engine drive, and at what speed? Its strength at 60lb. What sized propeller would he advise, and what cut-off? Also size of boiler and force pump for same. Would a double expansion engine run into much more work, and what would be the respective sizes of the cylinders to develop the same power, as the above named high-pressure ones? My lathe will not allow me to turn anything larger than 6½in. diam.—ESCA.

[68147.]—**Photo. Enlarging Apparatus.**—I have almost constructed an enlarging apparatus; but before putting together should be glad to know what is the correct distance at which the condensers should be fixed from position to be occupied by negative. The apparatus is made for ½-plate or smaller, with carriers, and for 8in. condensers. What is the best means of illuminating to use? My lantern body is 8in. long inside, sides 8½in. high inside, and lined with tin, which is arched up to a height of 10in., width 5in. I had thought of the "Pamphengos" lamp, but this is so expensive—viz., £2 2s.—and I fear that limelight would entail a lot of future expense for oxygen, &c. Are there any laws of optics to regulate the distance of illuminant from condenser in proportion to the distance of latter from lens?—INDIAN.

[68148.]—**Water Motor.**—Could any of "ours" give section of Bailey's Thirlmere water motor?—MEMBER CAMERA CLUB.

[68149.]—**Britannia Hot-Air Engines.**—Do these work the same as Seal's engines?—MEMBER CAMERA CLUB.

[68150.]—**Chemical.**—How can I separate and qualitatively recognise the following acids?—formic, acetic, oxalic, tartaric, and salicylic, especially the last.—JUNO.

[68151.]—**G.N. Engines.**—1. Why are G.N. engines built without domes? 2. What is the respective average consumption of coal per mile of engines of 8ft. and 7ft. 6in. class? 3. Why are G.N. surburban engines so slow at starting and getting up speed, as compared with other surburban engines, such as N.L., &c.?—T. ROBINSON.

[68152.]—**L. and S.W.R. Old Passenger Locos.**—Can any reader oblige me with a sketch and dimensions of some one of the old four-coupled passenger engines on this line, such as Sussex, Transit, Ganymede, &c.?—W. E. C. B.

[68153.]—**Rhymney Railway and Brecon and Merthyr Railway.**—I should be glad of any information about either of the above railways. Are they worked by rolling-stock of their own, or by the L. and N.W.R., or some other of the larger lines? A sketch with dimensions of any of the types of engines used would be much appreciated.—W. E. C. B.

[68154.]—**Testing Strength of Soda Crystals.**—Can any of "ours" instruct me how to test the strength of soda crystals? The price varies very much, and there must be a corresponding difference in the quality.—HARROLD.

[68155.]—**Cycle Chain Wheels.**—What is the best way of making these detachable, so that they may be changed in a few minutes?—A. H. SHAKESPEAR.

[68156.]—**Lantern Transparencies.**—I have been making some lantern transparencies from Cowan's gelatino-chloride plates, using the following solutions:—No. 1: Citric acid, 120gr.; ammo. carb., 88gr.; cold distilled water, 1oz. No. 2: Sulphate of iron, 140gr.; sulphuric acid, 1 drop; distilled water, 1oz. Mix three parts of No. 1 and one part of No. 2 at the time of using. Then I find some plates turn a greyish blue and others a reddish tint, while some are quite brown. Can anyone tell me what might be the reason of this? I fix in the ordinary hypo. solution after development. Would too much sulphuric acid have anything to do with it?—X. Y. Z.

[68157.]—**Cup and Ball Microphone.**—Some time ago I made a pair of above microphones and electro-magnet receivers, as described in "E. M." of June 10th, 1881, No. 846, but cannot get them to work. They transmit the ticking of a watch over my line, 56yds. in length, fairly well when the watch is touching the microphone, but when spoken into I cannot make out what is said, there is such a rattle, or rather frizzle, going on which drowns all the talking. I have since made two "E. M." receivers, which, by themselves, speak nicely, but when put in circuit with above microphones the same rattle goes on, so I conclude it is the microphones which are in fault. I have hunted up back volumes and tested for defects, such as loose contacts, vibrations, too much battery power, &c., as mentioned, and tried thicker diaphragm, but without improvement. Would Mr. Bottone or some other reader kindly say where I am wrong, or give me instructions for making a better microphone?—INKPOT.

[68158.—**Hot-Water Fitting.**—I am fitting up a house with hot-water, using a cylinder in kitchen, pipes ¾in. iron. Would some of "ours" inform me if I can put a branch in cold supply to sink with a screw-down stopcock to supply cylinder, as I should like to save running a separate supply for cylinder, or would it make water hot at sink?—PLUMBER.

[68159.]—**The Maoris—their Medicines.**—A lady who has recently joined her brother, engaged in agriculture some 40 miles from Auckland, New Zealand, but five miles only from the coast, and whose cattle roam through 300 acres of his inclosed land and through an extensive area of the Maori aborigines, speaks of a shrub, the leaves of which these natives chew as a remedy in diarrhœa. Can anyone give the name of this shrub, and say whether it acts as an astringent in its primary effect, or do more or less large doses cause diarrhœa? There is also a tree or shrub, the leaf of which proves fatal to cattle eating it. Is its name known, and its action? It seems to me that men's first idea of medicine must have been conceived from some animal, probably a dog or a cat, eating grass, &c., for remedial purposes—i.e., as an emetic in one instance, as a purgative in another. On p. 181 of the *Monthly Magazine of Pharmacy*, I read of a new medicine—"acetylphenylhydrazine." Now, won't such names cause pharmacy to topple over? Well, well, pity is felt for future chemists' apprentices by—The Lydney Dispenser.

[68160.]—**Imitation Ivory or Celluloid.**—I am in want of a material to have something like the appearance of porcelain or ivory that would work into thin sheets for stamping out into various patterns when in a soft or warm state; any composition that would take on a white enamelled surface, and stand exposure to the weather without being too brittle, would suit the purpose. Perhaps some kind of celluloid, if such a thing can be made on a small scale, would be most suitable.—J. F. J.

[68161.]—**Chemical Gilding.**—Would any of our chemical readers look over their recipes for the process of gilding glass with a chemical solution, or give any hints that would help over the difficulty? It is principally for gilding the inside of clear glass vessels where gold-leaf cannot be applied. Also can anyone tell me if pure copper can be deposited on glass in any similar way to the depositing of pure silver on glass for mirror purposes.—J. F. J.

[68162.]—**Stereotype.**—I have made a copy in plaster of Paris of a flat surface covered with delicate tracery. I want to make a copy of this in stereo metal. I have tried to accomplish this by pouring the melted metal upon the plaster cast, but the metal bubbles up, and, instead of forming a delicate copy of the original, shows scarcely any resemblance to the figure on the plaster cast. Can any reader describe a cheap method by which I may accomplish the object?—A Would-be Stereotyper.

[68163.]—**Small Power Engine.**—Would any of our mechanical readers kindly inform me the best and cheapest way to drive a 5in. lathe (back-geared) by a small engine and boiler, for, as I am a cripple in my lower limbs, I cannot use a treadle? Please state size of engine and boiler (vertical) that would drive this. About the probable cost and any other information will greatly assist an—East Ender.

[68164.]—**Lever Bicycle.**—Having made a 42in. bicycle to drive with levers, the centre of the lever works on the crank pin, and a long connecting rod from end of lever to top of fork, and the pedal at the other end of lever, I find this throws a great weight on the back wheel. Will some reader kindly explain how this can be remedied, or give descriptions of a good one to suit this size of machine?—H. Ward.

[68165.]—**Prismatic Dioptric Dissolving Apparatus.**—The following description of above is taken from an old edition of the "Magic Lantern" by "Phantom":—"The body is a square, having its four corners truncated, thus yielding an octagonal body having four principal and four minor sides. Upon two of its principal sides are attached ordinary lantern fronts, in front of the object glasses of which is placed a 3in. plate-glass prism, so mounted as to be adjustable at any angle. The limelight is employed in the usual way in the interior of the lantern; and passing through the optical arrangement with a lustre proportional to the large diameter (3¾in.) and long focus 5¼in. of the condensers, is so refracted by the prisms in front that the two discs of light are made to perfectly coincide. It is equal to the production of a well-defined disc of 20ft. in. diameter." Can any of the optical friends of "Ours" give any information respecting this form of lantern? If effective, I should think it must be much handier than a double lantern, as it only has the one light to need attention.—Photus.

[68166.]—**Wimshurst Machine.**—Will some correspondent tell me how to varnish glass discs for the Wimshurst machine? I have done several, but in a day or two an appearance like crystallisation occurs nearly all over the plate. Should the glass be warmed and the shellac varnish applied in one thick coat, or in three or four thin ones?—J. C. W.

[68167.]—**Pyrotechny.**—Can some one tell me of a rule for calculating the length of rocket sticks from the size of the bores of the case?—N. J.

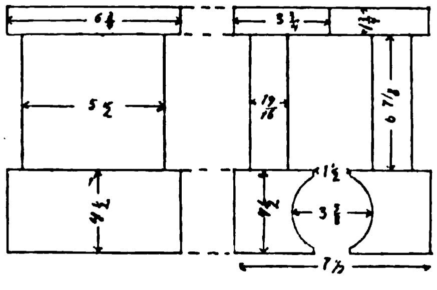
[68168.]—**Losing Watches.**—Will some one advise an amateur on the following excessive gaining and losing of watches? I have just cleaned two watches. One, an English lever, loses 50 seconds an hour. The hairspring is pinned at its shortest, just allowing it to beat regularly, and appears not to foul anywhere. The other is a Geneva lever which gains 70 seconds an hour; hairspring pinned at its longest. The regulators of both are pinned at their furthest point.—Puzzled.

[68169.]—**B Flat Clarionets.**—Can "Vulcanite" give any information as regards learning the clarionet? Which instrument do you recommend to one that does not wish to transpose, or, in other words, play the same as it is written? Some recommend B flat and others the C instrument. Which instrument is best for marching and which for the ochrestra, or will either instrument do? What book do you recommend best for a beginner? Can you give any hints for a beginner, so as to prevent pitfalls? How about selecting and making a reed hard and soft. Which is best? Is it proper to play the instrument with the reed uppermost? If so, why?—Hydrokinoney.

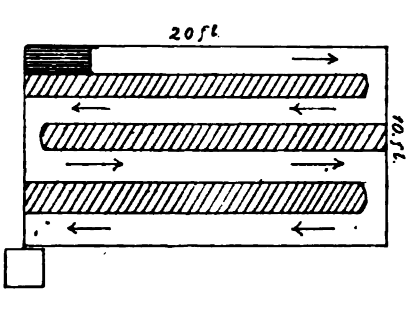
[68170.]—**Clarionet or Oboe.**—Would "Vulcanite" kindly say which is the easiest to learn, the clarionet or oboe? Why have some clarionets 13 and others 14 keys? Would anyone recommend me to purchase a low-priced instrument, say, 25s.? Wherein comes the difference—is it in price only?—including appearance, or would there be any difference in tone and likewise in playing between the high and low-priced instrument? Is there any difference in playing required for orchestra and military band?—Bombarde.

[68171.]—**Brown Tiles.**—Will "Jack of All Trades," "Potter," or some other correspondent give recipe of ingredients for colouring tiles? I have to make some tiles a dark brown colour, not glazed. Our clay burns a bright red colour, and I am instructed to dip them previous to burning, so that the colour might be permanent. Recipe or book on the above would greatly oblige a—Thirteen Years' Subscriber.

[68172.]—**Dynamo.**—Will Mr. Bottone or some other of our electrical friends tell me if I could light ten or twelve 16c.p. lamps with the dynamo of size as above? I have the castings of fields, cast-iron. Could I use a Siemens H armature, so I could have 50 volts E.M.F.? If not, how am I to make armature? Give number of wire, and number of layers on fields; also on armature. Give Brown and Sharp's gauge, as out here in Canada we can get nothing but American wire. I would build a Siemens H armature up of Russian sheet iron. I would also want to connect up as a shunt machine. What should I use as a resistance between the brush and field terminal? Should I stand behind a lathe and let the wire go on in winding to the top and over the same on both fields?—Advance.



[68173.]—**Drying Floor.**—I have a drying floor, 20ft. by 10ft., with flues running, as per inclosed sketch. Now, I find I get much too great a heat on the iron plates (⅜in. thick) covering the first flue, and on the fourth I hardly get any at all. Consequently I get one side dried as it were in no time, and the other just the reverse. I shall be glad if any of your kind readers would tell me how to remedy it, and get a uniform heat over the whole of the floor. I can get plenty of pull from the chimney.—Brier.



[68174.]—**To Mr. Bottone.**—I have made a magneto machine as described by you in the "E. M.," Oct. 7th, 1887, on p. 127, and I have followed your instructions all right as far as I can see, and now cannot get the least current out of the machine. Would you be so kind as to tell me where it is wrong: I may add I have wound the armature with No. 30 s.c. wire as much as it will hold, and the magnet is good, being a new one. Please tell me any likely cause of failure, and would it be suitable for plating?—Magneto.

[68175.]—**Fastening Stereo Metal to Rubber.**—I want to fasten indiarubber stamps to stereotype metal. I have made the face of the metal rough, and warmed both rubber and metal before cementing, and all I have tried has failed after a time, owing to the rubber requiring frequent pressure. I have tried various kinds of cements and fish-glues. Also want a cement suitable for a small strap that runs round a ⅝ shaft.—L. A. Lockwood.

[68176.]—**Welding Metals.**—Some time ago I read that Prof. Thomson had demonstrated before the New York Society of Arts that pieces of metal being placed end to end under a forcible pressure, and an electric current being passed through them, a perfect welding could be obtained, even between metals otherwise incapable of being welded together, or between different metals. Is this being carried out commercially? If so, should be glad of any information as to the process.—H. C.

[68177.]—**Electric Clock.**—I want to make an electric clock for shop-window. Is any particular train and escapement required; and also how does the current work the clock hands. I would like to know the best battery to use, and length of pendulum.—An Amateur.

[68178].—**Coefficient of H.**—What is meant by the coefficient of the Earth's horizontal component? And how is it calculated, when it is desired to know the value of the deflection of a tangent galvanometer in ampères, taking the value of H as 17?—K. C. B.

[68179.—**Coating for Carbon Cells.**—Would any of your readers be good enough to furnish me with a good formula for coating the outsides of carbon cells, so as to render them perfectly watertight?—J. W. F.

[68180.]—**Fret Saw.**—I have a sewing-machine stand, Swan pattern. I want to know whether I can use the same for making a machine fret saw. If so, would be obliged with description how to construct the arm. A sketch would oblige.—A. R. Temple.

[68181.]—**Mechanics.**—A perfectly flexible chain hangs over a smooth fixed point, and is allowed to move under the action of gravity; when it is in any given position find (a) the acceleration of its velocity; (b) the tension at a given point of its length. Verify the formula for the tension by deducing from it (c) the tension at the middle point when the hanging ends are equal, and (d) the tension at any point when the chain is just leaving the smooth point.—Undaunted.

[68182.]—**Stamps on Pewter.**—Can a reader give me any information about the name, marks, and stamps which are found on old pewter articles, such as tankards, plates, &c.? They much resemble the hall marks on silver plate. Did the Pewterers' Company at any time have control over the workers in pewter, as the Goldsmiths' Company have over the workers in gold and silver at the present day? Any information or title of a book on the subject will be gladly received.—Pewter Worker.

[68183.]—**Compressed Air.**—Will some kind reader explain me the following? A steam-engine at the mouth of a coal-pit is employed in compressing air to a density of four atmospheres, or 60lb. This compressed air at once acquires a high temperature, and for convenience is cooled with water down to 60°; it is then conveyed in a pipe to the bottom of a pit, and along ¼ of a mile horizontally, where it is set to work an engine similar to the ordinary non-condensing engine. The air, when liberated, produces a freezing atmosphere all round. Why does it freeze so, as the pipes leading from the engine are quite hot?—Gomer.

[68184.]—**Furniture.**—Some of my French-polished furniture has got into bad order through the improper use of furniture cream. I was advised to wash it with soap and water, which certainly brings off the dirt, but a good deal of the polish with it. Can any one tell me of a way to clean it without injuring the polish?—Housekeeper.

[68185.]—**Bacon.**—Why is it that some kinds of bacon melt away in the frying-pan, while with other sorts it does not do so?—Housekeeper.

[68186.]—**To Mr. Bottone.**—Is there not a mistake in your answer to query 68010 in stating 50 ampères? The machine has been wound before with 7lb. No. 18 on arm., and 20lb. No. 16 on fields. It has to work a Serrin arc lamp, which takes 11 m.m. carbons, the magnet of which is wound with No. 16 (but could easily be rewound), the dynamo is about 25 yards from lamp. I don't exactly know what effect a low voltage would have on the light produced; but as far as I can learn from your books, it requires a certain amount of voltage to drive the current through the resistance of the fields, leads, and lamp. The question is, would 20 to 25 volts in this case be enough? I want, as I said before, to get the best results. Would you give me as an alternative the sizes and quantity for a current of from 10 to 12 ampères; also the size of inside and outside dia. of rings you recommend, and how many layers of wire in depth. I can understand from your treatise how to calculate the voltage, but it does not show clearly how you get at the ampères and speed. Would you kindly work it out for me in this example? I have no doubt many others are puzzled in a similar way.—Electric.

[68187.]—**Model.**—Will "S." kindly favour with the principal sizes of his engine in No. 67932, such as travel of slide-valve, cut-off, port holes, dia. of flywheel, etc.; also indicated H.P., what kind of boiler, with sizes? Have you found the governors designed by "T. C.," of Bristol, satisfactory?—H. C.

[68188.]—**Kepler's Second Law.**—Will one of your astronomical readers kindly show me how to work the following problem, arising out of the above law? The axes of an ellipse = 2 and 1 respectively. The radius vector of a revolving body, starting from perihelion, moves through 10° in the first unit of time. What is the angle passed through in the second unit of time?—Finsbury.

[68189].—**Pneumatics.**—In connection with the rarefaction produced in the receiver of an air-pump, if after 10 strokes the mercurial gauge fell from 30in. to 15in, what would have been its fall after the first five strokes?—Theoretical Mechanic.

[68190.]—**Cement Plastering.**—In the Colonies facing-bricks are often unobtainable, and consequently exteriors of houses are cemented. How can this cement plaster be best applied, and coloured to imitate brickwork, red and straw colour, that will stand the rain and keep its colour?—ordinary paint objected to as being inartistic. Also how can plaster ceilings be made to stand well in Tropical climates?—Colonial Architect.

[68191.]—**Wounds.**—In the "E. M." for Oct. 12, '88, in reply to query No. 66497, "Birmingham" mentions that the breasts are sometimes pierced. I should be much obliged if he would give a detailed description how this operation is performed, with sketch showing the exact position in which the rings are inserted.—L. H.

[68192.]—**Hardening Bosses on Tricycle Crank Shaft.**—Having a tricycle to repair recently, ball-bearings, I had the misfortune to break one of the bosses on the crank shaft; so I have made a new one. They are made of cast iron. Would any one kindly tell me how I can harden the same.—A Constant Reader.

[68193.]—**Punkhas—Machines to Drive.**—A long-felt want in India is a simple punkha-pulling machin Many patents have been taken out, but none have be successful hitherto, and the punkha-coolie still retains hi position in European houses in the hot weather. Wh is wanted is a small engine, hot-air, steam, petroleum, o electric, and which will not require more than 25s. month to keep it up. Can any reader put me in the wa of making such an engine or machine? A punkha easily pulled, one coolie can pull six, and I require on three in full swing night and day.—Mack-Jute, Ca cutta.

[68194.]—**Ice.**—Small engines for making ice or ice water are greatly in request in India. I have seen o sample of such a machine here, but it does not work wel and, moreover, requires acids. Can anyone give me as sistance by sketch or otherwise in the design of a cold-a machine? I have plenty of power for driving or makin a refrigerator?—Mack-Jute.

[68195.]—**Largest Locomotive.**—Would any o your kind readers tell me which is the largest locomoti in the world, and on what railway it runs? Also its d mensions, and if you can, would you be so good as to give sketch of it?—J. M. C.

[68196.]—**Leclanche Cells.**—In No. [illegible] p. [illegible] "Electrician" says, writing of the above, [illegible] the [illegible] glomerate form the solution should well cover [illegible] the agglomerate plates." Is this advice co[illegible]—Agglomerate.

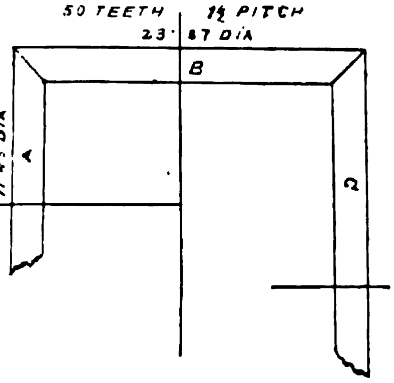
[68197.]—**Chinese Oiled Silk.**—To "Jac[illegible] Trades."—Having tried your recipe for Chines[illegible] on Horrocks's long cloth and found it the best I [illegible] used, shall be obliged if you can tell me what [illegible] make it white or cream colour?—Sail Cover.

[68198.]—**Lap of Valve.**—Will "T. C., Bristol," or some other reader answer the following? How can I, when on the road, find if back lap of slide-valve is broken on locomotive, otherways than taking off the gland, which takes too much time? Cylinders have no waste-water cocks?—Engine Driver.

[68199.]—**Hand - Painted Posters.**—I wish to make some of those hand-painted posters which are now so much used for theatrical advertising. I should be glad if some kind reader could inform me of the kind of colours used, or any other information respecting same would gladly be received by—Retsop.

[68200.]—**Coating Electrical Accumulators.**—Can anyone kindly inform me the proportions for mixing the litharge, sulphate of lead, &c., as used for coating the plates of electrical accumulators?—One in a Fix.

[68201.]—**Bevel Wheels.**—Would "J. H.," "T. C.," or any of "ours" give me information on the following? I have two wheels in gear, A and B. B cannot be removed, and I wish to put C in place to alter velocity. Would you kindly show me how to find the largest and smallest wheel which will run with B and utilise whole width of teeth?—Tyke.



[68202.]—**Motor.**—With motor described on p. 472 of last volume of "Ours," is it possible for it to stop when poles are exactly opposite and springs of commutator on slits, and fail to restart until moved by hand? If such is the case, will Mr. Bottone or other kind reader give arrangement of one that will start in any position—a reversible one preferred?—H. Church.

[68203.]—**Motors.**—To S. R. Bottone.—Would you recommend armature of make Fig. 9 rather than Fig. 7 in your electro-motors of last week's issue? 2. Should commutator be of solid brass with nicks filed through, or should it be a piece of hard wood turned up, then two half-circles of brass fastened on it? What should length of commutator be? Does it signify?—A Learner.

[68204.]—**H.P. of Portable Engine.**—As I have a portable steam-engine, with cylinder 10¾in. diam., 14in. stroke, 50lb. pressure, 90 revs. per minute, cut-off at ¾, I should very much like to know what is the indicated number of I.H.P. the engine is working. If some of our friendly readers of the "E.M" would be kind enough to work out the sum at full length as simply as they can for me, I should feel greatly obliged.—Rd. J. Merry.

[68205.]—**Lantern.**—Can anyone tell me the reason of the corners of a square picture appearing brown when on the screen. I use a blow-through jet, and have 4in. condensers. What distance from the screen can the largest disc be got with a portrait lens 5in. focus. When I take out the front lens the focus of the back lens is 10in., and if I remove the back lens the front lens is 10in.; a small cap fitting on the lens (back) makes the focus 13in. What size discs can I get?—J. P.

The increased speed of trains is bringing up anew, says the *Railroad Gazette*, the old question of counterbalancing locomotives. This is not only the case in the United States, but we have lately heard of a case in Australia, in which the permanent way was severely damaged by the passage, at high speed, of a locomotive which had not been properly balanced. We recorded, in our issue of August 3rd, a case on one of the Western roads, where the rails were bent ⅜in. to ½in. by the severe pounding of an engine supposed to be insufficiently counterbalanced. Some of the counterbalance weight was removed, and no further trouble of the kind appears to have been had with that locomotive. Some master mechanics are now recommending the removal of all weights inserted for the purpose of counterbalancing the reciprocating parts. This problem contains one of the difficulties in the way of running at much higher speeds than those at which we now travel. Through trains in the West—not only passenger, but freight—are now moving at very high speeds. We have knowledge of one passenger train which has been averaging fifty-eight miles per hour for a run of three hours, including several stops. An estimate shows that this train must have often travelled seventy miles per hour. At this speed of seventy miles per hour the centrifugal force of the extra counterbalance is enormous, and it is a question if greater care must not be taken to avoid excess of balance if such speeds are to become common.

Two large teeth, in an excellent state of preservation, have been picked up on the beach at Withernsea, Yorkshire. They are of ivory, weigh about 2lb. each, and are supposed to belong to the mammoth elephant.

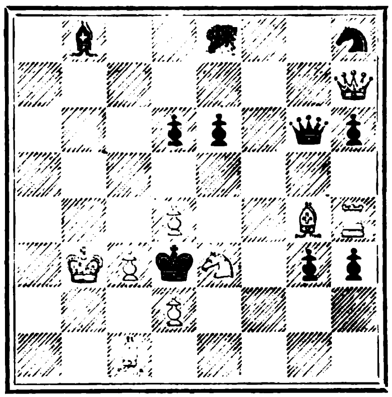
CHESS.

All communications for this department must be addressed "Chess Editor, English Mechanic, 332, Strand."

PROBLEM MCXLI.—By J. W. Abbott.

(First Tourney Problem.)

Black.



White. [9 + 9

White to play and mate in three moves.

Solution to 1,138.

White.	*Black.*
1. P-K 7.	1. B takes P (best).
2. Q-Q Kt sq.	2. Kt-K 4 (best).
3. Q-K Kt sq.	3. Kt-K Kt 3 (best).
4. Q-Q R 7.	4. Anything.
5. Q mates.	

Mr. V. Gorgias' Problem should have been numbered 1,140, and a B R should be at Q 8.

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,139 by A. Bolus; to 1,138 by Locke Holt, W. Greave, and H. G. Walsh (see notice in last number).

Names entered for Tourney:—C. Reader (C), J. Ough (A), W. Jay (A), A. Wissenden (C).

W. Jay has kindly offered an additional prize in A or C in the form of a chess book of the value of 2s. 6d.

J. Ough.—The scale of marks was given in last number.

J. P. T.—Thanks for corrected version. We think that the problem is now sound and very good.

Locke Holt.—We have, we believe, answered your queries by post.

A strong contingent of players will attend the American Chess Congress from England, including Messrs. Gunsberg, Blackburne, Burn, Mason, Pollock, and Lee. France will be represented by M. Taubenhaus, Germany by Herr von Bardeleben, and Russia by M. Tchigorin. It is expected that the American contingent will include Captain Mackenzie, Messrs. Lipschutz, Delman, Max Judd, and Hanham, and probably Mr. Steinitz.

The match between Steinitz and Tchigorin, in Havana, is reported to have come to a premature end, in consequence of the illness of Tschigorin, which is stated to have been caused by the sultry climate of Havana. It is hoped, however, that he will be able to take part in the New York Tournament.

The *Wesley College Quarterly* is just starting a second Handicap Solution Tourney. Entrance fee, 6d. Also a second Problem Tourney in two-movers only. Entrance fee, 1s. For full particulars address, Chess Editor, 17, Royal-terrace, Kingstown, co. Dublin. We may add that several prizes are offered in both tourneys in money and books. The problems for the Handicap Solution Tourney appear in the March Number of the *Wesley College Quarterly*. There are 18 in all.

Steinitz, in the recent match with Tschigorin, introduced a new move in the defence to the Evans Gambit, which he supports in the February Number of the *International Chess Magazine*. Tschigorin, as is well-known, is very partial to the Evans Gambit, and played it several times when he had the first move in the recent contest.

Messrs. Burn, Mason and Pollock, competed in the tournament of the Irish Chess Association, which commenced on the 4th inst.

The frequency of the pulse-beat is increased by drinking hot water or tea, diminished by drinking these cold. Adding a warm covering to the clothing of the body increases the pulse by about ten beats a minute. Mental activity diminishes it more or less.

The alligator of the South, like the buffalo of the West, is likely soon to become extinct. The slaughter of the alligator for its hide, like the slaughter of buffaloes for their hides, has been so great, that it will be only a few years before the lonely lagoon of Florida will have lost its last specimen.

Here is one example of the magnitude of the New Zealand frozen meat trade:—In 1888, 16,384,169lb. were exported from Otago alone. Of this quantity there were 255,639 carcases mutton, 17,846 carcases lamb, and 3,379 quarters beef.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 20, and unacknowledged elsewhere:—

R. E. Phillips.—Pekin.—Mosaic.—H. Spink.—J. M. B.—E. Humphrey.—Mechanic.—An Old Reader.—J. D. C. G. T. C.—Geo. H.—O. Bolton.—Al Fard.—Handy Man. Experimenter.—R. H. Craven.—New Subscriber.—Young Engine Man.—East Anglian.—S. Bottone.—G. F. Davis.—W. Wooldridge.

C. J. L., Tex. (Something depends on what you can get in Texas; but we presume you can procure ordinary black paint and common varnish. Then paint the black boards a dead black, using an excess of turps, or if you want them bright, an excess of oil. Rub down with pumice-stone when dry, and repeat, and then coat with varnish. Before that dries dust over every part with fine coke-dust, flour emery, or fine sand. The fine dust is obtained by taking, say, crushed emery or coke, and stirring it up in a deep vessel with water. The heavier particles will fall to the bottom quicker than the smaller particles, and by pouring off the water after a second or two and allowing that to rest you obtain a fine powder or grit, when the water is run through blotting paper. That fine powder when thoroughly dried should be dusted on the varnished board while the varnish is still "tacky"—or it may be mixed with the varnish—and when all is dry you have a surface which readily takes the chalk-marks. There are several recipes in back numbers, but there is nothing better than the coating that can be obtained by the method we have described.)—A. Marriott. (Indiarubber is not "manufactured": it is a natural product, and if you will say what it is that you want to do with it, we may be able to help you. At the same time we may inform you that you will find all available information in back volumes.)—Daniel Spink. (See Hints No. 5 above. We cannot reply by post. Why not write and ask Mr. Moy about the light engine and boiler? His address is 8, Quality-court, Chancery-lane, E.C. There is no secret about that—merely "London" would no doubt find him, thanks to our excellent Post Office.)—H. E. W. ("Line" means the 12th of an inch, unless some other meaning is expressly indicated. 2. As you have no "special means" to tin your bicycle, why not paint it? You will find many hints in back numbers. Paint, properly applied, or enamel, is better than tinning.)—Viru Cobalus. (Any of the works published for the purpose will suit—there are some dozens; and the teacher of any science class will advise. See the catalogues of such publishers as Longmans, Macmillan, Crosby Lockwood, Collins, &c., or look up the indices of back volumes.)—Quondam. (You can mend your mackintosh with rubber dissolved in bisulphide of carbon—a solution which you can buy at any of the rubber shops or at most dealers in leather. See indices.)—Firing. (See indices under "model boiler"; but we expect you will have to use the ordinary wicks, and then spirit will be better than paraffin.)—A Novice. (For hill-climbing a tricycle should be geared "down"—that is, the treadles should make more revolutions than the wheels; but see what has been said in back numbers.)—H. G. C. P. (If you have a "powerful telescope" which you have rendered "much more powerful by a simple augmentation" possibly you may be able to teach the "proffessors" something. As you say, "proffessors in general are very impatient of having pertinent questions put to them, which, of course, are posers." Of course they are: a child can puzzle a philosopher—for an answer; but the odds are that the philosopher knows a little more than the child. If you send us any definite question, no doubt you will receive a definite answer—by the "proffessors who never brook any desent." Is the question with which you favour us a conundrum or what?—"How is it possible for a globular body throw a shadow of any other shape than that of a disk?")—N. Winkle. (You can make a galvanic belt by cutting up some pieces of zinc and copper to a suitable size and wrapping them up alternately in canvas, connecting the copper of one division with the zinc of the next, and so on. See indices: the subject has been exhausted.)—David A. Pool. (The "Model Locomotive" series of articles was commenced in No. 1247.)—John Winkfield. (If you mean the Ferranti system, see back numbers, or procure the specifications of the various patents. See also Hints No. 5.)—M. Slovootsay. (If you would indicate what you are aiming at, we might be able to help you; but to take your question as it stands, "a solid body" placed in a vacuum undergoes no change, except what may be due to the removal of the atmospheric pressure. See Hints No. 5 above.)—Caxton. (Our readers are not interested in your schemes, and we are not inventors-general. You should put your question to experts and pay their fees. So far as we can understand your design, it is crude, not to say unworkable.)—H. S. (To make modelling wax, melt 2lb. of beeswax, and add 4½oz. of

Venice turpentine, 2oz. of lard (free from salt), and 1½lb. of elutriated bole of the required tint. Mix thoroughly and gradually pour into water. The wax should be well kneaded under the water, and is then ready for use.)—F. W. (The saws used in fret machines are made in Germany, France, and England; but see Hints No. 4.)—HALF JACK. (See the indices. There is no work on the subject. The brass is either red naturally, owing to the large proportion of copper, or the brass is pickled in acid, which dissolves the zinc and leaves a film of copper on the surface.)—BARNES. (For hot-air engines see Nos. 1175, 1154, 1156, and the indices generally, especially that for XLIII.)—DAVID SKINNER. (The numbers are out of print.)—L. E. GEO. COLLINS. (Several hydraulic engines in back volumes. If for organ work, precure the specification of Blennerhasset's patent.)—AQUA. (For fur in kettle see pp. 188, 211, 231, Vol. XLVI. (2) Use the white zinc paint, and see if that will do. What you ask for would be worth patenting.)—Q. Y. Z. (If you will learn the rudiments of mechanics, you will (probably) understand why perpetual motion is impossible. See Dircks's "Perpetuum Mobile," published by E. and F. N. Spon.)—LEARNER. (Explain what you mean by toe cappels, and look up the letters on slide making in the last volume.)—I. SOMMER AND C. HOWARD, Moscow. (Add tannin to Russian glue until ropy; skive and clean the ends of the leather belts, anoint with glue and press together until cold. Answers for both purposes. 2. No book on that subject.)—J. FORREST, JUN. (We do not know of any work on the subject, but there is information to be gleaned in the cyclopædias and in back volumes. See Hints No. 5 above.)—THOS. KERR. (There are several schools of the kind—some at Glasgow, for instance; but you will find a list in *Whitaker's Almanack*. There are also the science classes. See Hints No. 5 above.)—FLYWHEEL. (See indices of back numbers. What size is the lathe, and what power would be required? No one can answer such a query without details.)—CHURCH WINDOW. (The methods of etching glass have been frequently described. See the index published last week and back volumes.)—CECIL WOOD. (The articles on Organ Construction by "Adept" are in Vols. IX., X., XI., and XII. They are out of print; but an advertisement in the Wanted Column might bring offers.)—F. B. (A description of a phonograph and how to make one, by Mr. Shelford Bidwell, appeared in No. 683. The specification of the original patent is, we believe, not in stock, but it can be seen in the Patent Office Library. The specification of the later patent has not been published, we imagine, but it can be seen on payment of the fee of one shilling. 2. We do not know which is the best make of lamp for burning benzoline, but we should try the "gas-maker lamp," illustrated and described in No. 1047, and patented by Mr. Wood, Blindley Heath, Godstone.)—P. SYKES. (Yes; but it would not be achromatic. It would show coloured rings round the objects. 2. Twice the pitch would act more quickly, but would be a weaker screw unless the nut were twice the length too.)—G. J. L. (About arsenical wallpapers, see pp. 456, 513, Vol. XLV. See indices of back volumes about the batteries, or even recent numbers.)—J. H. (If your queries were received no doubt they were answered, if not inserted. You do not say what material the pot is made of; but perhaps a little butter added to the syrup would help you. See indices.)—SUMMER SPORTER. (The best bait depends on the season, and so does the distance from the bottom. Why not procure one of the manuals?)—R. G. L. (See indices. A carbon transmitter of any kind seems to be protected by the decisions of the law courts.)—ANXIOUS TO KNOW. (We have stated many times that any one can make a patented invention for experimental purposes, but if it is used for benefit or profit, an action could be brought. It is scarcely likely, unless considerable damage could be proved. Your other query was no doubt answered in this column, if it was not inserted.)—AN OLD READER. (It is impossible to find out the wording of a provisional specification; but when a complete specification is accepted anyone can see it on payment of the fee. Practically, influence is necessary, but when you have obtained protection you can send the details to the War Office. Simply a question of mass and momentum; but the friction must be deducted.)—T. GRIFFITHS. (No space to spare. You have surely had your share lately!)

A New Rupture Appliance has been invented which will save sufferers a lifetime of torture. It may be seen and tried at the Medical Battery Co.'s Electropathic and Zander Institute, 52, OXFORD-ST., LONDON, W. (corner of Rathbone-pl.), where an experienced and skilful surgeon examines patients free of charge. The stock of leather and other trusses is being sold at half usual prices. Note only address as above.—[ADVT.]

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Holloway's Pills purify the blood, remove all obstacles to its free circulation through the lungs, relieve the over-gorged air tubes, and render respiration free, without reducing the strength, irritating the nerves, or depressing the spirits; such are the ready means of escaping from suffering when afflicted with colds, coughs, bronchitis, and other chest complaints.

USEFUL AND SCIENTIFIC NOTES.

The Corinth Canal.—The *Bulletin du Canal de Corinthe* gives the following account of the works on the canal now in course of construction across the Isthmus of Corinth. During the last three months the work has continued regularly and almost without interruption except for feast days. Despite the season there has been an average of five working days a week. The coldest weather experienced was 2 deg. below zero. There was a little snow, which did not, however, lie long, and in January one or two shocks of earthquake. The number of workmen engaged varied between 1,200 and 1,400. The cube executed in this period was 382,000 mètres, or an average of 5,500 per working day. No falling-in occurred, and the subterranean waters gave no trouble. A new place of discharge for 250,000 mètres of earth has been assigned the contractors close to the workshops at Isthmia. All arrangements are being made for the renewal of the work in the spring.

The Structure of Timber.—A new method of exhibiting and studying the structure of timber by means of thin slices has been advanced by Mr. R. B. Hough, of Lowville, New York, U.S.A., and received a great deal of attention at the recent meeting of the American Association for the Advancement of Science at Cleveland. He employs frames made of cardboard, holding three samples of the wood, each being about 2in. wide and 5in. long, and from $\frac{1}{30}$in. to $\frac{1}{300}$in. thick; these exhibit the wood in three relations, one slice being transverse across the grain, another radially running from the outside towards the heart, and a third in a tangential section. The first and second show both the sap wood and the heart; they also reveal the grain and the structure of the wood in a most beautiful manner. These various frames are arranged in book form for the purpose of study and examination. They retain all the characteristics of the wood, and are easily recognised, while the effect of the light shining through them is to show the peculiarities of the grain far more accurately and picturesquely than by simply looking at the wood in the mass.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good value offered for all kinds of **Instruments** and Collections of Apparatus of Scientific nature.—CAPLATZI, Science Exchange, Chenies-street, Tottenham Court-road.

Astronomical **Telescopes.**—Several to be exchanged.—J. BASSETT, 48, Leswin-road, Stoke Newington.

Wanted to exchange genuine **Trade Recipes and** SECRETS for others. Send lists to S. A. FIELD, The Hill, Witney.

Wanted, Dumpy Draining Level or Equatorial Head, for 3in. Refractor, in exchange for 4in. metal SPECULUM REFLECTOR, by Watkins, on brass stand, screw motions, two eyepieces, in mahogany case.—T. R., South Croxton, Leicester.

Vols. V. to XI. "**English Mechanic,**" first-class condition, all bound. What offers? Prefer Banjo.—J. E., 4, Station-road, New Swindon, Wilts

Will exchange good 6½in. **Reflector,** finder, three eyepieces, on firm, iron, altazimuth stand (with slow motions), for Microscope and cash to value £7 10s. Stand alone nearly worth it.—WHITE, 57, Hartington-road, Station-road, Walthamstow.

"**English Mechanic,**" Vols. XXXVI., XXXVIII., and XLVII.; 71 numbers of Vols. XXXIX. to XLVIII. Offers as under.

Half-plate Camera, two single dark slides, with ½ and ¼-plate carriers. Offers to the value of £1.—ROBERTS, Photographer, West Barnet.

"**The Engineer,**" "**Builder,**" "**Building News,**" about 200 numbers of each, 1877-1882; "Franco-Prussian War," fine illustrations, cost 45s. What offers?—BERNARD, Maryfield, Cork.

66 **Racial Photographs** from Egyptian Monuments, &c., taken by Mr. Flinders Petrie, in 1887, carte-de-visite size, unmounted, cost 12s. 6d. Will exchange. What offers?—EDWARD W. DRURY, 125, Coltman-street, Hull.

Curved **Brass Plate,** 2ft. 3in. by 8in., on board, with fittings, lettered: "Servants' Registry. Hours 10 to 4, Saturdays 10 to 2, Wednesday Evenings 7 to 9," cost 45s. Exchange offers.—Below.

Griffith and Henfrey's "**Micrographic Dictionary,**" 4th edition; 21 2s. 6d. parts "Nesbit's Land Surveying," 11th edition, three 21s. vols. "Encyclopædic Dictionary," now publishing. Exchange offers.—Below.

Above **Brass Plate and Books,** good as new, for Lathe, Electrical, or Chemical Apparatus. Exchange offers, together or singly.—L., 150, Allerton-road, Woolton, Lancashire.

Small combined **Drilling and Tool Grinding** MACHINE, also Polishing Lathe, new condition, at great sacrifice. Exchange offers invited.—G. GULLIVER, Barnsley.

Slide-rest wanted, 4½ or 5in. centre. Exchange ENGLISH MECHANIC, Vols. XXXVIII. to XLV., bound.—J. DICKSON, 31, Spring-gardens, Edinburgh.

"**Muspratt's Chemistry of Arts and Manufactures,**" 47 1s. parts, for Cassell's "Popular" or "Technical Educator," new edition preferred.—GRAY, 240, Southampton-street, Camberwell, London.

Pair of **Steel Skates,** quite new. Exchange Model Engine Parts or Castings.—C. POATE, care of W. Poate, West-street, Havant.

"**English Mechanic,**" Vols. XLV., XLVI., XLVII.; "Building News," Vols. L., LI.; "Engineering," Vols. XLIII. and XLIV.; clean, unbound. Offers wanted.—F. RAYNER, Sherwood, Nottingham.

Wanted, small Engine and Boiler. I have also for exchange 100c.p. Gramme Dynamo.—DONALD F. ADAMSON, Surbiton, Surrey.

Model **Steamer Hull,** complete deck fittings, 6ft. long, 9in. beam, tail shaft propeller; winner of seven prizes. Exchange.—EVANS, Chapel-road, Garston.

Bench Lathe, 3in. centres, 2ft. iron bed, T-rest, wheel, crank, and treadle complete, in good working order, nearly new. Wanted in exchange, with cash, 5 or 6in. centre Lathe, or offers.—HUY, 113, Tachbrook-street, London.

New ¼H.P. **Horizontal Engine,** first-class finish, on solid mahogany stand, polished flywheel, cylinder 2½in. bore, 3½in. stroke.—COLLINS, Eaton-place, Tonbridge.

New vertical **Launch Engine,** link motion, reversing gear, lagged cylinder, 4in. bore, 5¼in. stroke, with brasses to bearings, crosshead, connecting rod. Exchange.—Above.

Wanted, Rat-trap Ball Pedals and Double Alarm. Exchange ELECTRICAL PUMP, Water Wheel Model, Induction Coil, Vacuum Tubes, Lamps, three quart Bunsens, Tennis-racket, cone Pedals.—WHITE, George-street, Croydon.

Two new Timms' Patent **Tool Holders,** 8 tools, cost 25s. each; separate or otherwise. Want 20c.p. Dynamo Fittings, Chromic Cells. Offers.—JAMES TAYLOR, Ilminster.

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Printing Press, Albion foolscap folio, wooden stand. Hand or small Treadle Machine in exchange.—Apply AMATEUR, c.o. Alder, Engineer, Gallowgate, Newcastle-on-Tyne.

48in. **Bicycle,** balls both wheels and pedals, hollow backbone, good condition. Exchange, with cash, for Safety.—F. BARKER, 3, Lodge-road, Southampton.

Three-cell **Bichromate Battery,** 6in. corrugated carbons, good zincs, strong brass screw clamps, glass cells, box, 5s. Exchange 6s.—LEWIS, 10, Chryssell-road, London.

Two **Glass Cylinders** for electrical machine, 6½in. long, 12in. circumference. Offers.—Address, A. BARKER, 4, Collison-street, Nottingham.

50in. **Bicycle,** half plated, balls and hollow throughout, lamp complete, good condition, value £6. Exchange 5in. slide-rest, ½-plate outfit, or offers.—WALTON.

Full-size **Drawings** of 100 and 200-candle Dynamos, modern design and efficiency, with all particulars. Offers requested.—WM. WALTON, London-road, Gloucester.

Locomotive Model of N.L.R., built off scale 1in. to the foot, 17in. long. Complete set of Marine Engine Castings.—Below.

Boiler, vertical, complete and all fittings, stands 14in. high. Complete Horizontal Engine, 1in. bore, 1½ stroke.—Below.

Marine Engine, slide-valve, 1½in. stroke, ⅝ bore, new, complete. New Brass Cylinder, 2in. bore, 3½ stroke, complete.—Below.

Castings, complete sets horizontal engine, 1½in. stroke, ⅝ bore. Sewing Machine, stand, complete.—TILBURY, 21, White Post-lane, Victoria Park, E.

Whitney, The Scientific Exchange, 117, City-road, a few doors from Old-street. All kinds of Scientific Apparatus Exchanged, Bought, Sold, and Lent.

Ampere Meter, up to hundred amperes, good condition. Want Lathe Tools, Drilling Spindle, Cutting Frame, Electrical Goods, or offers.—DICKINSON, 8, Woodsley-grove, Leeds.

"**Cassell's Natural History,**" 4 vols. (parts), clean and Complete. Offers.—R. H., 20, Suffield-road, South Tottenham.

For exchange, a real African **Knife and Sheath,** blade 1 foot long, and inlaid and brass handle.—G. PETTIT, Ecton, Northampton.

Cyclostyle, 16½ by 10, exchange for Clarionet or Wearing Apparel.—W. BROWN, 42, Millbank-street, Westminster.

Induction Coil, all ebonite fittings, commutator, large surface condenser, ⅜in. spark, best English make. Offers requested in Scientific Novelties.—As under.

Large **Medical Coils,** twelve binding screw handles, &c., complete, equal new, very fine instrument. Offers in small saleable goods.—HARRIS, 17, York-street, Nottingham.

Bessemer Steel, round, 3-16in. to 1in., short bars. What exchange offers for 10cwt.?—GILBERT, Steel Merchant, Oxford-road, Sheffield.

Bicycle Hub Dividing and Drilling Machine. Exchange for sociable or tandem Tricycle that will pass an ordinary doorway.—F. T., 57, Highgate-hill, N.

Good large Gyrostat wanted. Electrical or other APPARATUS in exchange.—H., 63, Perham-road, London, S.W.

A well-made **Chest of Carpenter's Tools,** best makers, worth seeing. Exchange offers only.—GULLIVER, 72, Tudor-street, Oldham.

7 vols. "**Amateur Work,**" new one month ago, in exchange for hand Printing Press, Type, &c.—R. E. BANNISTER, Paddock-street, Ardwick, Manchester.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 29, 1889.

EXTRACTS FROM BERGERON.—XXII.

Description of the Rose Engine.

SINCE the invention of the Rose engine, it has been endeavoured to give it all the perfection of which it is capable. It was seen in Père Plumier's work that all the motions, longitudinal as well as horizontal, were regulated by counterpoises, which method plainly exhibits the infancy of the art. A very little reflection enables one to perceive that as the motions of the lathe were very numerous, and accomplished in very brief periods, these counterpoises could only act by jerks, which were necessarily imparted to the work itself; since a falling body tends to an acceleration of its speed, and if during its fall it is suddenly raised again, the motive power which lifts it experiences a shock which is all the more severe if the weight is a heavy one, and the space traversed considerable.

It is with good reason that towards the beginning of the 18th century springs were substituted for these counterpoises, the force and tension of which there is power to increase or diminish, and which, far from gaining energy as they unbend, become, on the contrary, weaker, and lend themselves more readily to the power which restores their original tension. Thus, since this improvement, there has been gained for the Rose engine much more accurate results, and work of far greater perfection has been obtained. The [headstocks of] Rose engines generally oscillate on centres placed a little below the level of the bed, as will shortly be seen from the details into which we are about to enter.

The late Hulot observed that however short the curve described by the centre of the mandrel, and consequently by the work itself, the tool does not cut the materials in the direction of this same curve, but perpendicularly to its centre, and the circular portions produced by the contours of the rosettes have not their centres on any radius of the circle of rotation. He has therefore planned to give the headstock a motion parallel to the lathe-bed, and, consequently, to the rubber and the tool. This very ingenious invention has not met with all the success it promised; it soon became evident that the lathe concealed imperfections difficult to avoid, and which will be perceived when we give details of its construction, in addition to which, as engine-turners in gold prove, there is in the parallel motion much greater friction than in the motion about a centre, and as they require an exceedingly smooth motion, Hulot's invention has not many approvers among this class of workmen. Lastly, the effects which the Rose engine is intended to produce in the hands of a gold-worker are very different from those which a toy-maker or an amateur desires. The first works upon a material infinitely more precious, upon which he designs to cut curves and patterns of little depth; the other cuts deeply into ivory so as to be able very often to bring out the pattern as pierced work, as we frequently see it. A little more or less resistance on the part of the lathe makes no difference to an amateur who is carving material which he cuts deeply. We think it well, therefore, to present both lathes to our readers, and to detail all their respective advantages by describing their construction, without concealing from them that the lathe with a horizontal motion has not been so generally adopted as the other. None of our readers will ever construct a Rose engine. It is a tedious and difficult job, and for this reason we might have dispensed with details of construction; but as this machine is very complicated, and there is often need to take it entirely apart, either for the purpose of thorough cleaning or of changing or putting back the rosettes, it has appeared to us necessary to describe the form and purpose of all the pieces of which it is composed. We will begin with the lathe which moves on a centre, which is the one most generally used.

Fig. 1, Plate XLIII., represents this lathe seen lengthwise. A A are two iron poppets, to which has been given the name of parallels, and in which revolves the mandrel B B in its collars, *a a*, set in bearings as in the ordinary lathe. Fig. 2 represents the same lathe seen in front. A is the poppet or front parallel, which is forged in one piece with the other parallel, and the crossbar represented by the dotted lines D D in Fig. 1, which joins the one to the other. The cap *c* is fixed upon the parallel by means of two screws or capstan-headed bolts *d d*, and the screw B passes through the thickness of the cap, presses upon the upper brass, and prevents the mandrel from shake. *e e* are two square holes which receive bolts, by means of which is fixed the ring of the elliptic chuck, as has been shown elsewhere, and this is the object of the two lugs, *f f*, which are in one piece with the parallel. The other parallel is precisely similar to the first, except that it has no such lugs. We have said that the lowest part of each parallel descends a little below the lathe-bed; and towards *b* a kind of poppet, *c* (Figs. 1 and 2) is fixed upon the bed by two shoulders, opposite to each of the two parallels, and outside them by means of two screws, Q Q, Fig. 1, which render them immovable. A centre screw (*i*, Fig. 2, and *b b*, Fig. 1) passes through each poppet, and enters a somewhat deep conical hole made in the base of the two parallels, by means of which the mandrel and the two parallels which carry it can move in a direction parallel [at right angles.—O. J. L.] to the length of the bed, upon the centres furnished by the pointed screws. On the summit of the two poppets C C C, Fig. 1 and 2, is worked a groove ten or twelve lines deep, by two and a half or three wide. These grooves receive a stop-key, *h*, fixed at the point *o*, and which, when raised, catches by its edge in a notch in the detent *p*, which secures the tail-piece of the parallel, and prevents all motion of the headstock. Under this stop-key is placed a wooden wedge, *g*, similar to that in a chuck-lathe, to prevent the key from falling back. There is a similar key to each poppet. The two parallels are tied together by a bar of iron, which could only be shown by a dotted line at D D, Fig. 1, and as this is forged in one piece with the parallels, it can be seen that neither can move without the other, which compels them to a common parallel motion. At the middle of the cross-piece D D, Fig. 1, is fixed by a strong rivet a tail-piece E, which descends a long way below the lathe-bed. At the end of it is a flattened eye giving passage to the bar F, Fig. 2, which is attached at one end to a serpentine spring, securely fixed below the bed of the lathe. The bar F is pierced along its length with a certain number of holes, in which a pin can be put, and in consequence of the fact that the spring either draws towards itself or thrusts away the bar, and consequently the tail-piece E; the parallels and also, therefore, the headstock are moved to and fro in order to produce the effect, which will be explained presently.

At this point we must recall the fact that the nose of the mandrel of the Rose engine ought to be precisely the counterpart of that of the chuck lathe, for although one may rough down and round off the work upon the Rose engine itself, it is much better to prepare it upon the ordinary lathe, and afterwards to mount it on a Rose engine, which, being thus less exposed to rude shocks, preserves its correctness much longer. There is but little motion in the lathe in the direction of the width of the bed; nevertheless, it must be provided for in the direction of the length of the mandrel. And this latter is but natural, as the necks of the mandrel have the power of sliding lengthwise on their bearings in the parallels or headstock. A spring, F, Fig. 1, gives it an impulse lengthwise, the point of tension being at the lower end of the spring. A circular notch at the upper end causes it to embrace the mandrel in a groove specially made for the purpose. At the height of the bed this spring is held by a pin, which passes through it, and at this point the thickness of the spring is increased. This pin is held in a piece of iron fixed to the bed, and as the spring is extended below, the end of it enters a slit made in an iron bar, H, Fig. 2, of which one end is fixed to a poppet, I, by means of a bolt, K, while the other end, fitted with a wooden handle, L, which comes out in front of the bench, is held at pleasure in one of the notches of the rack G, Fig. 1, to right or left, according as it is desired that the mandrel shall tend to move in the direction of its nose or towards the opposite end. This tension can be increased at will by placing the bar in such or such a notch of the rack-plate as may be selected. Generally all parts which we have described are made of iron; those which still remain to be explained are of brass. Upon the bed, and parallel with the axis of the lathe mandrel, two standards of brass arise, similar to H, Fig. 1—one on the front side of the bed, and the other on the back, as seen in profile at M M, Fig. 2. These two pieces are firmly fixed on the bed, pass through it, and are secured below by four nuts, of which only two can be seen at *c c*, Figs. 1 and 2.

They are united to each other by means of the two tie-bars N, Fig. 2, secured to the standard by bolts and nuts, *d d*, Fig. 1, and K K, Fig. 2. As it is this frame which carries the rubbers which sustain all the shocks caused by the contours of the rosettes, it can be readily conceived how necessary it is to give them all the stability possible. On the horizontal part of each of these two pieces, H, Fig. 1, and in front of the frame is a groove seen in profile at *l l*, Fig. 2, which receives the small hook *a* made on the rubber-holder, Fig. 3, of which we will presently point out the use. The lathe mandrel is of iron, turned accurately cylindrical upon two centres, so that all parts of it shall be accurately concentric.

In addition to the usual shoulder, against which the chucks rest, another is made, *g*, near the front neck *a*, Fig. 1. A sleeve of brass, accurately bored throughout its entire length, and turned outside to a perfect cylinder, is fitted over the mandrel with slight friction, and abuts against the shoulder *g*. Upon this sleeve are placed the rosettes, which should fit very truly: a steel feather fixed to the sleeve lengthwise prevents them from turning independently of each other, owing to a little notch made in each to allow the feather to pass. These rosettes are placed in pairs, back to back, and each pair is separated from its neighbours by a washer *e*, *e*, *e*, *e*, which is sometimes of brass, but which is better made of wood, the grain in the direction of the mandrel. Wood never shrinks lengthwise: thus there is no fear that the rosettes will acquire play between them; and, on the other hand, this material lends itself better to the pressure of the nut which presses them one against the other. Towards the end of the mandrel is a hexagonal part, upon which the pulley is mounted, and at the back of this is a nut which secures the whole tightly together, so that no part shall shake, yet so nicely that the pulley can cause the mandrel to turn inside the sleeve when it is desired to change the divisions of the rosettes in the manner to be seen presently. The pulley has

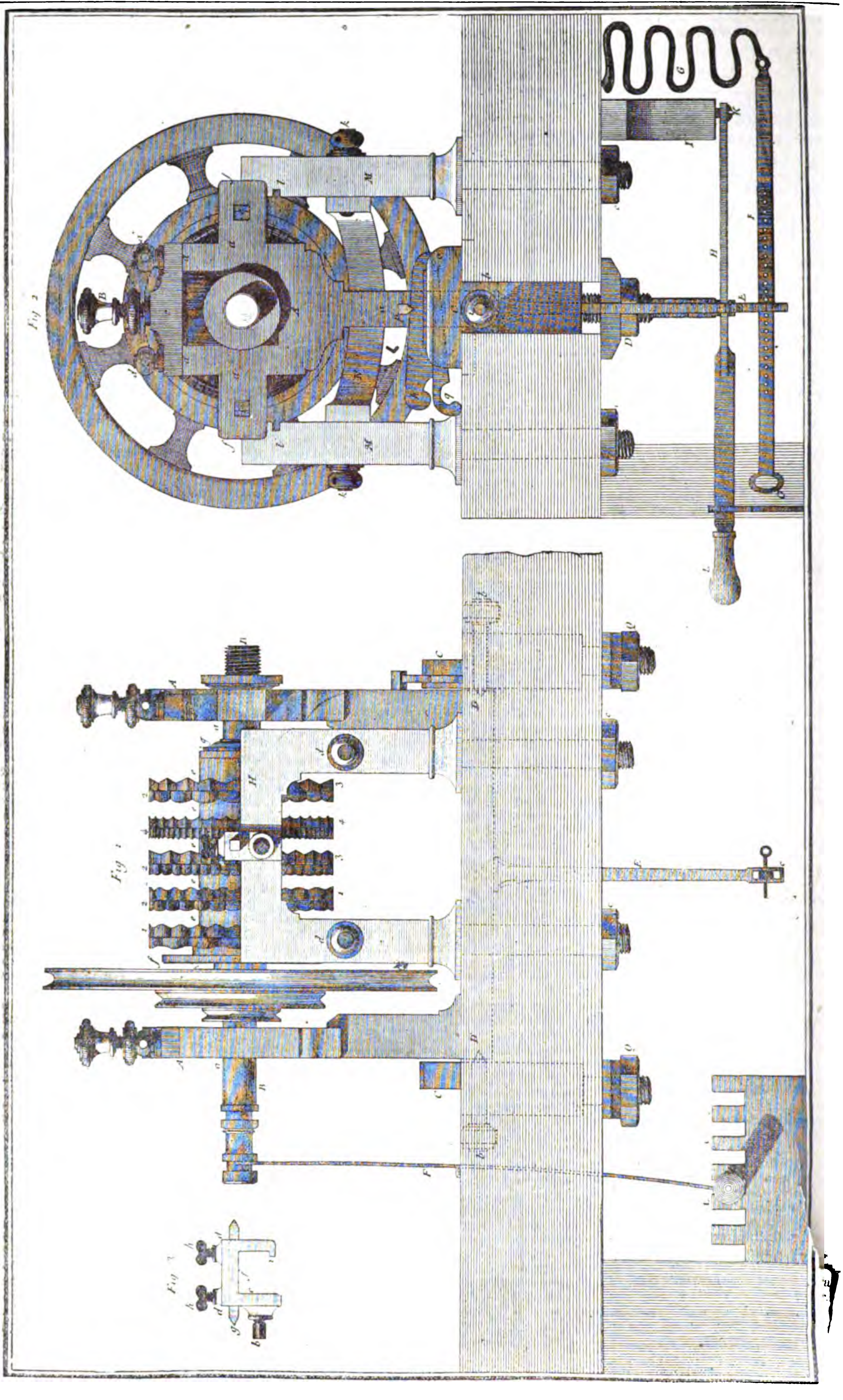


Fig 2
B
K
M
G
I
H
D
L
Fig 1
A
H
D
C
F
L
1
2
3
4
Fig 3
b
h
d

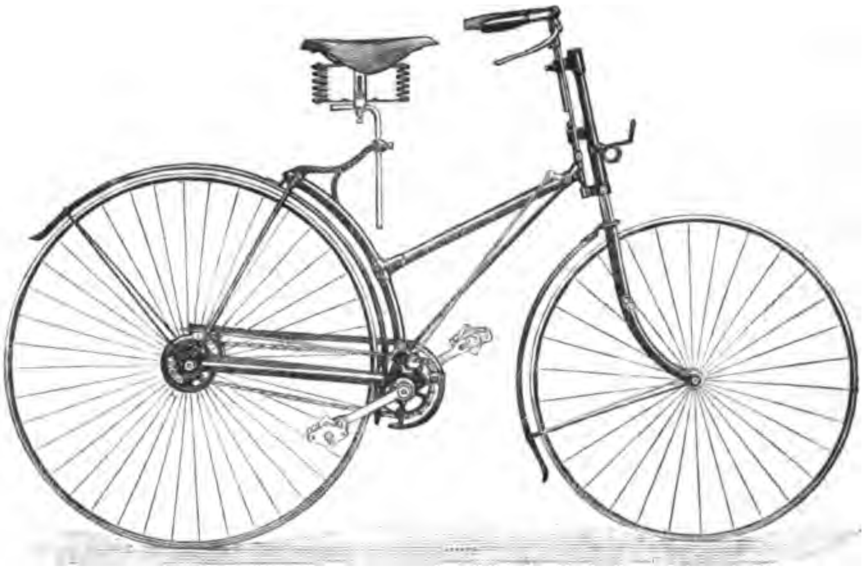
three speeds for the cord, so that the motion of the lathe can be accelerated or retarded according to need, and it will be found presently that this power is very necessary. Ordinarily the pulley is solid, and carries a click, which takes into the notches of the division-plate, Fig. 1, which is fixed on the same sleeve as the rosettes. By this plan the rosettes and their sleeve and the division plate turn with slight friction upon the mandrel (which may be considerd immovable with regard to the chuck and the work which it carries), and means are thus provided to change at will the relation of the rosettes to the work. This will be rendered clearer in the sequel. The rubber carrier, Fig. 3, is placed upon the piece H, Fig. 1, and M, Fig. 2, and is introduced by one of its ends, so that the little work seen at that part enters the groove *l*, Fig. 2; a clamping-screw, *b*, Fig. 3, presses against the piece H, and fixes the rubber securely at the spot where it is placed. With respect to this rubber-carrier, it will be seen that the screw acts in a part much thicker than the rest of the piece, so that there may be a greater number of screw-threads and that it may have more substance. The screw ought not to bear directly against the part H, and there is fitted in front of the rubber-carrier, and upon the face *c*, a spring or pressure piece of steel, which receives the pressure of the screw, and which itself presses against the part without defacing it. At the upper part of the rubber-carrier, following the line *d d*, there is worked in its thickness a groove which descends a little below its lower surface, *f*, and in which slides with slight friction the rubber *g*. We have here shown two pressure screws, *h h*; but, generally speaking, there is but one in the middle, and such will suffice. The screw presses on the rubber through an intervening washer, and secures it firmly in the position at which it is placed. It is plain that this rubber must be very rigidly held in position, since the rosettes striking against it at each of its undulations tend to make it yield, and this shock is all the greater according as the waves are more in number and deeper. Sometimes little rollers are used, Figs. 6 and 7, Pl. 44, instead of rubbers. The one is simple when it is only desired to obtain a single movement; the other is double when two movements are wanted at the same time; but these rollers can only be used when rosettes are employed of which the contours or waves are sufficiently large to permit the roller to penetrate to the very bottom of them. In all other cases it is absolutely necessary to employ a rubber having so acute an edge as to allow it to reach the bottom of the angle formed by the two curves or two straight lines which meet. Very often one may see in the workshops rubbers of ivory. Without doubt they would be the best, were it not that the slight consistency of this material makes them become blunted in so short a time, especially when it is necessary to give them a knife-edge and make it very thin to allow it to penetrate very angular patterns on the rosette. It is necessary from time to time to sharpen them with a bastard file.

Rubbers of steel, hardened and well polished, are not disposed to become blunted, and render the pattern very neat and sharp; but they in a short time wear the rosette, unless great attention is devoted to them. For instance, if the rubber does not bear against the entire thickness of the pattern (rosette), it forms ridges upon it, which quickly spoil the rosette, especially if the rubber is somewhat sharp; but when the design permits them to be somewhat rounded, they are to be preferred. They should be sharpened from time to time with a little rouge or putty-powder, so as to retain their polish, which prevents their cutting the waves of the rosettes. It is necessary to apply now and then a few drops of oil. We have for some years employed hippopotamus tusk for this purpose, which dentists use for false teeth. We think we have described sufficiently the construction of the Rose engine, so that an amateur can dismount it and remount it at pleasure. We may premise that this necessity is of more frequent necessity than might be supposed, in order to remove the deposit or "gum" which forms, and to supply fresh oil to all rubbing parts.

O. J. L.

THE "STEEPLECHASER."

THE "Steeplechaser," manufactured by the Centaur Cycle Co., Coventry, and fitted with the "Springbock" anti-vibration fork, is certainly one of the safest and easiest machines made. The name was suggested by a prominent cyclist who was invited to test its capabilities. He was completely astounded to find how easily it could be made to trip over bricks, kerbstones, planks, drain-pipes, hurdles, gates, and other such *slight impediments*.



His opinion of other machines was, "That without taking into consideration the drawback of additional weight, entailed by the unavoidable complication of construction, the benefit gained is principally to relieve the vibratory shocks to the body, and very little to the hands and arms, and that the relief thus obtained is purchased by considerable loss of power in the springing of the frame when more than ordinary pressure is applied to the pedals." In the action of the "Springbock" fork there is *no depression of the spring* in the steering post from the *weight of the rider* or *pressure upon the pedals*; but when the wheel is brought into contact with an obstacle, the spindle rises in the socket without any sensible disturbance of the horizontal position of the machine, or in other words, the effect is *as if the obstacle suddenly disappeared in coming in contact with the wheel.* So that vibration is practically killed *without the slightest loss of power*. We described the "Springbock" in February, 1888, shortly after its exhibition at the Stanley Show, and our anticipations of its welcome by all riders seem to have been abundantly confirmed.

THE ANALYSIS OF IRON AND STEEL.—I.*

By An Analyst and Assayer.

IT is purposed in this article to describe methods for the determination of the several constituents of iron and steel which from an experience extending over a considerable period the writer has found to be most suitable and satisfactory. It is hardly necessary to observe that the obtainment of anything like accurate results demands the employment of pure *chemicals*, as also the observance of strict cleanliness; and further, due regard to all the *precautions* to which attention is called. We shall consider the determination of silicon, combined and graphitic carbon, sulphur, phosphorus, manganese, copper, chromium, &c.

Silicon.

In the estimation of the silicon advantage is taken of the fact that upon treating iron or steel with nitro-hydrochloric acid the iron enters into solution as ferric chloride, while the silicon is oxidised into silica (SiO_2), which by subsequent evaporation and heating is rendered insoluble.

For the determination, take five grammes of the sample in a state of fine division (preferably drillings), place in a porcelain dish of about 400 cubic centimètres capacity, and having placed a glass cover over the mouth of the dish to guard against loss by spurting, add 60 cubic centimètres of nitro-hydrochloric acid,* and heat at a temperature of the water oven or sand bath. When it is judged that all is in solution, remove the glass cover, after rinsing any of the liquid which may have spurted on to the same with hot water into the containing vessel, and carefully evaporate the solution of ferric chloride down to complete dryness, after which heat the dish and contents strongly over a Bunsen burner until the dry residue is black. When this is effected allow the dish and contents to cool, add 50 cubic centimètres of hydrochloric acid, and again take to complete dryness. Allow the dish to cool, re-moisten with hydrochloric acid, cover the mouth of the dish with a glass cover, and evaporate at a gentle heat until a crust commences to form on the surface of the liquid, which dissolve by the addition of a few drops of hydrochloric acid. By this treatment the SiO_2 is rendered insoluble, and is contained in the hydrochloric acid solution, which is now diluted with five times its bulk of water, and passed through an English filter paper which retains the silica. Invariably small portions of the silica adhere to the sides, &c., of the dish; it is removed by means of a "policeman"—a piece of caoutchouc tubing at the end of a glass rod—and rinsed into the filter. The filter and contents are now washed three times with a dilute solution of hot hydrochloric acid—one of acid to two of water—and subsequently with hot water, until a small quantity of the washings give no colouration when mixed with a dilute solution of ferricyanide of potassium. If a steel be the subject of analysis the filter paper, together with the contents, are now transferred to a platinum crucible, ignited† at a strong red heat, cooled, and the residue, silica (SiO_2), containing 46·67 per cent. of silicon (Si), weighed.‡ Should, however, an iron be under examination, the residue on the filter will not only contain silica, but any graphite or free carbon that may be present in the metal. When this is the case the filter-paper, together with contents, is placed in a crucible, and the paper burnt off at the lowest possible temperature. (During this operation care must be exercised not to employ a high temperature, which would result in a loss of graphite.) When this is effected the residue, graphite and silica, after cooling, is weighed, replaced in the crucible, the graphite burnt off by ignition at a strong red heat, and the residual silica weighed. As is evident, the weight of silica deducted from the combined weights of the graphite and silica will give the graphite on the weight of the metal operated upon.*

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* All rights reserved.

* Prepare a "stock" of nitro-hydrochloric by mixing one part nitric acid, sp.gr. 1·42, with three parts strong hydrochloric acid.

† It is usual to dry the filter papers and their contents in the water oven previous to ignition. This may, however, be dispensed with by conducting the ignition at a low temperature until the water is expelled.

‡ The weight of the filter paper ash must in all instances be deducted.

The silicon may also be determined by the following method:—Dissolve four grammes of the metal, contained in a beaker, in 100 cubic centimètres of dilute sulphuric acid—one part acid to three parts water—and evaporate the resulting solution until heavy white fumes are given off. Allow the beaker and contents to cool, add 100 cubic centimètres of hot water, and heat to boiling, with constant stirring, until the mass of ferrous sulphate has dissolved. Collect on a filter the insoluble silica and graphite, if present, wash with acid, &c., as previously described.

The purity of the silicas obtained as above should always be tested by fusion with potassium sulphate, as not unfrequently they contain considerable quantities of iron, as shown by the silica being more or less of a red colour, and also by titanium, should the same be contained in the metal. With this object mix the silica, after ignition, contained in a platinum crucible, with four times its weight of potassium sulphate, place a cover on the mouth of the crucible and fuse, first employing a low heat, gradually increasing to brightness. At the end of twenty minutes allow the crucible and contents to cool, then place in a dish containing cold water and digest until the fused mass has dissolved out. When this is effected wash the crucible, &c., withdraw the same, collect on a filter the residue, pure silica, wash thoroughly, ignite, and weigh.

(*To be continued.*)

ASTRONOMICAL NOTES FOR APRIL, 1889.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 3 50·11 P.M.	0 43 59	4 43 47	0 40 8·49
6	0 2 21·79 ,,	1 2 13	6 38 8	0 59 51·25
11	0 0 58·35 ,,	1 20 32	8 29 38	1 19 34·02
16	11 59 41·92 A.M.	1 38 59	10 17 33	1 39 16·78
21	11 58 34·96 ,,	1 57 34	12 1 14	1 58 59·55
26	11 57 39·44 ,,	2 16 22	13 40 1	2 18 42·32

The method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 348 of Vol. XLVIII.

The entire absence of spots and other indications of disturbance on the surface of the Sun deprives him of any interest whatever as a telescopic object. The Zodiacal Light is still visible after sunset, particularly during the earlier part of the month.

The Moon

Enters her First Quarter at 1h. 47·0m. p.m. on April the 8th, and is Full at 10h. 18·6m. on the night of the 15th. She will enter her Last Quarter at 1h. 55·8m. p.m. on the 22nd, and be New at 2h. 5·0 a.m. on the 30th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	1·0	0 57.3 p.m.
6	6·0	4 45·1 ,,
11	11·0	8 51·7 ,,
16	16·0	12 11·0 a.m.
21	21·0	5 0·3 ,,
26	26·0	9 25·2 ,,

Occultations of (and Near Approaches to) Fixed Stars by the Moon.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
4	δ¹ Tauri	4	10 18 p.m.	Dark	101	63	‡11 9 p.m.	Bright	243	209
5	B.A.C. 1563	5½	6 37 ,,	Dark	84	49	7 53 ,,	Bright	261	221
7	*d* Geminorum	6	8 58 ,,	Dark	117	77	10 4 ,,	Bright	255	212
9	35 Cancri	6½	8 50 ,,	Dark	143	118	9 52 ,,	Bright	249	214
9	ε Cancri	6	11 38 ,,	Dark	67	26	12 26 a.m.	Bright	325	284
10	B.A.C. 2925	6½	12 1 a.m.	Dark	43	1	12 28 ,,	Bright	350	308
10	42 Cancri	6½	†12 7 ,,	N. by E.	16	335				
11	8 Leonis	6	2 4 ,,	Dark	70	29	2 47 ,,	Bright	328	289
11	37 Leonis	6	7 9 p.m.	Dark	142	165	8 15 p.m.	Bright	260	269
19	B.A.C. 5663	6½	†1 48 a.m.	N. by E.	17	29				
20	B.A.C. 6088	6	4 34 ,,	Bright	41	35	5 17 a.m.	Dark	329	317
21	B.A.C. 6448	6	‡12 10 ,,	Bright	65	101	1 4 ,,	Dark	308	340
22	B.A.C. 6864	6	†2 29 ,,	S.	179	208				
22	B.A.C. 6878	6½	3 11 ,,	Bright	125	150	4 7 ,,	Dark	227	244
23	η Capricorni	5½	4 23 ,,	Bright	34	56	5 15 ,,	Dark	304	319

† Near approaches. ‡ Moon below the horizon. An illustrated description of the construction and use of the above table will be found on p. 349 of Vol. XLVIII.

Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites, visible at Greenwich.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
1	Mimas	8·9 p.m.	14	Dione	12·8 a.m.	19	Enceladus	8·0 p.m.
2	Encoladus	2·4 a.m.	15	Mimas	1·7 ,,	20	Tethys	12·0 ,,
2	Tethys	2·9 ,,	16	Mimas	12·3 ,,	22	Tethys	9·2 ,,
3	Dione	2·1 ,,	16	Mimas	10·8 p.m.	23	Enceladus	10·7 ,,
4	Tethys	12·2 ,,	16	Rhea	11·2 ,,	24	Dione	11·6 ,,
5	Tethys	9·5 p.m.	17	Enceladus	2·2 a.m.	25	Rhea	12·0 ,,
7	Rhea	10·4 ,,	17	Mimas	9·4 p.m.	28	Enceladus	1·4 a.m.
8	Enceladus	8·8 ,,	18	Tethys	12·5 a.m.			
12	Enceladus	11·5 ,,	18	Mimas	8·1 p.m.			

A description of the construction and use of the above table will be found on p. 349 of Vol. XLVIII.

The Moon will be in conjunction with Mars (5° 7′ South of him) at 2h. a.m on the 2nd, with Venus at 5h. a.m. on the 3rd (Venus 11° 7′ North), with Saturn at 1h. p.m. on the 10th (Saturn 1° 9′ South), with Jupiter at 8h. p.m. on the 20th (Jupiter 0° 19′ South), with Venus again at 11h. p.m. on the 29th (Venus 10° 15′ North), and lastly with Mercury at Noon on the 30th (Mercury 5° 8′ North).

When our Notes commence the Moon is in Pisces, but at 10h. p.m. on the 1st she enters an outlying portion of Cetus; she quits this at 1h. p.m. on the 2nd and emerges in Aries. She is travelling through Aries until 4h. 30m. p.m. on the 3rd, when she quits it for Taurus; here she remains until 9h. 30m. p.m. on the 6th, when she enters Gemini; she leaves Gemini for Cancer at 3h. a.m. on the 9th; and Cancer, in turn, for Leo at 6h. p.m. on the 10th. Her journey across Leo terminates at 11h. a.m. on the 13th, at which hour she enters Virgo; she remains in Virgo until 2h. p.m. on the 16th, and then passes into Libra. Having traversed a considerable portion of the last-named constellation, she arrives, at 5h. 30m. a.m. on the 18th, at the Western edge of the narrow northern spike of Scorpio. By 2 o'clock the same afternoon she has traversed this and come out in Ophiuchus. At 1h. a.m. on the 20th she passess out of Ophiuchus into Sagittarius. She does not quit Sagittarius until 7h. a.m. on the 22nd, when she enters Capricornus. At 4h. a.m. on the 24th she leaves Capricornus to pass into Aquarius, and having traversed Aquarius, she quits it for Pisces at 7h. a.m. on the 26th. As she travels through Pisces she arrives, at Midnight on the 26th, on the confines of an outlier of Cetus; she crosses this, and at 7h. a.m. on the 28th re-enters Pisces—only, however, to plunge for the second time into another portion of Cetus at 5h. a.m. on the 29th. When she finally leaves Cetus at 7h. p.m on the 29th it is to enter Aries. She is passing out of Aries into Taurus at 11h 30m. p.m on the 30th.

Mercury

Is a Morning Star during the first three-quarters of April, but comes into superior conjunction with the Sun at 7h. a.m. on the 25th, after which, of course, he becomes an Evening Star. He is not very well situated for the observer, and as his angular diameter dwindles from 5·6 to 5·2, is devoid of interest as a telescopic object.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	23 29·1	5 58·5 S	10 49·1 a.m.
6	23 59·3	2 39·8 ,,	10 59·6 ,,
11	0 31·3	1 5·2 N	11 11·9 ,,
16	1 5·6	5 12·7 ,,	11 26·4 ,,
21	1 42·5	9 35·5 ,,	11 43·5 ,,
26	2 22·1	14 0·3 ,,	0 3·4 p.m.

The path indicated in the above ephemeris commences in Pisces, extends across practically the whole length of that constellation, and terminates in Aries. The planet, however, does not approach a single conspicuous fixed star.

Venus

Is an Evening Star, but is now rapidly approaching the Sun; in fact, she will come into Inferior Conjunction with him at 2h. a.m. on May 1st. The student should carefully watch the planet right through this phase, as she will present the exquisite spectacle of a silver hair of light in the telescope, and it is quite likely that her dark limb may be visible. About the date of Conjunction her diameter will subtend an angle of 58″.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	2 54·1	23 1·6	2 13·6 p.m.
6	2 58·2	23 38·3	1 58·0 ,,
11	2 58·6	23 50·6	1 38·7 ,,
16	2 55·0	23 33·8	1 15·5 ,,
21	2 47·7	22 44·5	0 48·5 ,,
26	2 37·6	21 23·0	0 18·8 ,,

This looped track lies in a barren region in Aries, and terminates been μ and ν in that constellation.

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* A more accurate method of estimating graphite will be described hereafter.

Mars, Jupiter, and Neptune

are all, for the purpose of the ordinary observer, invisible.

Saturn

Is an evening Star, but is approaching the west, and must be looked for as soon as ever the twilight has sufficiently deepened. He is receding from the earth, and his angular diameter diminishes imperceptibly from 17·4″ on April 1st to 16·4″ by the end of the month.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	9	5·6	17	53·0	8	24·1	p.m.
6	9	5·2	17	54·4	8	4·0	,,
11	9	5·0	17	55·0	7	44·2	,,
16	9	5·0	17	54·9	7	24·5	,,
21	9	5·2	17	54·0	7	5·0	,,
26	9	5·5	17	52·3	6	45·7	,,

Whence it will be seen that Saturn will remain sensibly stationary in an absolutely blank region in Cancer.

Uranus

Comes into opposition to the Sun at 5h. p.m. on the 9th, and but for his South Declination would now be favourably placed for the observer. His angular diameter is 4″ throughout the month, so that his planetary disc is perceptible with a moderate telescope. He is visible to the naked eye if his place in the sky is accurately known.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	13	16·1	7	20·4	12	37·8	a.m.
6	13	15·3	7	15·6	12	17·3	,,
11	13	14·3	7	9·8	11	52·8	p.m.
16	13	13·5	7	5·0	11	32·4	,,
21	13	12·8	7	0·3	11	12·0	,,
26	13	12·0	6	55·7	10	51·5	,,

This short retrograde arc is described in that void part of the sky between Spica and θ Virginis.

Minima of the Variable Star Algol

Will happen on April 15th at 2h. 54m. a.m., on the 17th at 11h. 43m. p.m., and on the 28th at 8h. 31m. p.m., and at other times when they will be invisible for the ordinary observer.

Shooting Stars

May be looked for from the 9th to the 13th, between the 19th and the 23rd (notably on the 20th), and from the 26th to the 30th.

Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of April 1st, 1889.

Star.	Souths. h.	m.	s.	
β Cancri	7	29	7·56	p.m.
ι Ursæ Majoris	8	10	7·67	,,
α Hydræ	8	40	34·42	,,
Regulus	9	20	47·59	,,
α Ursæ Majoris	10	15	4·57	,,
δ Crateris	10	31	56·11	,,
ε Corvi	11	22	25·48	,,
γ¹ Virginis	11	53	57·25	,,
α Canum Venaticorum	*12	8	43·14	,,
Spica Virginis	*12	37	8·80	,,

* Early morning of 2nd.

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list on any other night in April, as also that of determining the Local instant of its Transit at any other station, will be found on p. 350 of Vol. XLVIII.

THE METROPOLITAN MACHINISTS' COMPANY'S CYCLES.

At the recent Stanley Club Cycling Show at the Crystal Palace, at Sydenham, when some 1,200 machines were there congregated, we noticed the exhibit of the Metropolitan Company, and since then have visited their commodious show-rooms in Bishopsgate-street Without, which have just been doubled in size by the addition of the neighbouring premises. The "Juno" cycles made by this company are well known for excellence of workmanship, elegance of finish, solidity of build, and sound staying properties.

THE "JUNO"

THE JUNO DIAMOND SPRING FRAME

Of the tricycles, the "Juno folder" is one that especially recommends itself to those who have but narrow doorways or limited space at command. It will pass a 28in. passage. Provided with ball bearings throughout, including four sets to the main axle, it forms one of the most complete and admirable folding tricycles that have ever been brought out. By an arrangement as ingenious as it is simple, and constituting a source of strength, and not, as is sometimes the case in machines of this kind, an element of weakness—one wheel and half the axle detaches from the other half on to which it has been telescoped, and permits a 28in. door to be passed. The Juno Direct Steerer tricycle at £18 is remarkable value for money, while the Juno ball-bearing machine at £15 10s. commends itself with special force to that large class who want a first-class instrument at a really moderate figure. The Junos No. 9 and No. 10, £11 11s. and £9 10s., form excellent mounts for ladies or light-weight riders, being strongly and well made, though of light and elegant construction. The Juno diamond framed safeties are new this season, built with triangular frames. They are remarkably strong machines, though with very light running. The spring frame Juno safety is a luxury also for 1889, and we feel sure will find a large and grateful *clientèle*, who will find that bugbear "vibration" completely overcome at last. The Juno Safety, No. 9, £12, has ball-bearings to all parts, including pedals. This is a remarkably cheap machine of the cross + frame. This machine is the No. 4 of the 1888 catalogue, of which nearly 1,000 were sold during that year. Space forbids us to do more than note the No. 10 at £10 10s., and No. 9 at £9 10s., both of which may be characterised as excellent touring mounts at remarkably low figures.

Of the bicycles, the King of the Road and Mazeppa, we can do no more than mention. The Special Mazeppa at £9 10s. (balls all parts) is a first-class all-round touring mount of proved reliability and good sound quality. The Rational is a scientific attempt to combine the good parts of the Juno Safety and the Mazeppa Ordinary, and an attempt which has been crowned with a fair meed of success. The Mazeppa Bicycle No. 2 is a machine of sound sterling qualities, combined with a low price.

THE SCIENCE OF ANIMAL LOCOMOTION.

At the Royal Institution last week, the Friday evening discourse was given, before an unusually crowded audience, by Mr. Eadward Muybridge, of the University of Pennsylvania, on "The Science of Animal Locomotion in its relation to Design in Art (illustrated by the Zoopraxinoscope)." It was on March 13, 1882, when the Prince of Wales was in the chair, that Mr. Muybridge first brought the zoopraxinoscope under the notice of the Royal Institution, having just previously communicated some of his results to the Royal Society. The aim of his investigations is to study the movements of animals in motion in their various paces by means of instantaneous photography. The instrument, to which the name of zoopraxinoscope has been given, is in principle that of the zoetrope, or "wheel of life," as it is known in its toy form. A sequence of pictures traced from instantaneous photographs of a horse in motion, walking, trotting, ambling, &c., is made to revolve rapidly, while a disc with slits revolves in the opposite direction. The rapid succession of these, thrown from a lantern on the screen gives the appearance of actual motion, while turning very slowly allows each separate phase of the pace to be examined. The work was commenced as far back as 1872, when much controversy prevailed as to whether all the feet of a horse were, in the trot, clear of the ground at the same instant, but since then the *modus operandi* has been improved. The lecturer first described the method of taking the photographs. Omitting all reference to delicate adjustments, it may be broadly explained that several instantaneous cameras, whose "shutter triggers" are released by electricity, are placed in a horizontal row, a thread from each camera is stretched horse-breast high across the trotting track, the threads being 12in. apart. As each thread is broken by the animal's progress, a camera exposure is made, so that the whole series of photographs gives the successive phases of motion taken at intervals of only 12in. of progress. Complete sets of such photographs were shown for the different paces, including the jump. In some cases three sets of cameras have been used for taking views from different aspects. After the separate photographs, their combination in the zoopraxinoscope was shown. By another method, with a revolving cylinder with pins opening a series of cameras at equal minute intervals of time, photographs of other animals have been taken in the Zoological Gardens to study their mode of walking. This very interesting fact has been established, that, with the exception of the camel, all quadrupeds, even the sloth walking back downwards along a branch, move their limbs in the same order in walking. A child on all fours follows the same rule. The order in which the supporting feet move is—(1) Left hind, left fore; (2) both hind, left fore; (3) right hind, left fore; (4) right hind and both fore; (5) right hind, right fore; (6) both hind, right fore; (7) left hind and right fore; (8) left hind and both fore. In addition to "paces," such movements as kicking, rearing, plunging, &c., were shown in the mule, ass, and horse. In illustration of motion as depicted in art, the lecturer showed a number of photographs of well-known works in statuary and painting, pointing out in most cases their inaccuracy, but in others, such as Meissonnier's "Retreat of Napoleon," drawing attention to their truth. His illustrations ranged from the Assyrian slabs to the present time, and from the tent-painting of the North American Indians to the Salon and the Academy, nor was the drawing cut on bone found in the Perigord Caves omitted. Many artists, the lecturer said, held that their business was to create an impression rather than record facts. The once-despised photographic plate, perhaps, may help to educate them.

THE COLOURATION OF A COAL FIRE BY COMMON SALT.

It is probable that many persons have, like myself, been questioned as to the cause of the blue flame produced when a pinch of ordinary table salt is thrown into a coal fire. I have, however, never met with anyone who could explain the phenomenon, which appears to contradict the results of the usual experiments on flame colourations, in which a spirit or gas lamp is used. Among the attempts at explanation which I have heard suggested are:—(1) That the vapours arising from the salt prevent complete combustion, the blue flame of carbon monoxide being the result. (2) That the sodium flame cuts off the yellow light emitted by the glowing coals, and only allows the red and blue to pass. (3) That the colouration is due to the chlorine of the salt, which may, perhaps, combine with the carbon and hydrogen of the fuel to form compounds such as chloroform and tetrachloride of carbon, which are, in their turn, decomposed and oxidised, with production of the colouration in question.

The blue colouration seems to me to be of too purple a shade to admit of the truth of the first theory. The second theory seems rather far-fetched; but the third is pretty well borne out by the following facts, the result of some experiments which I have recently made:

1. The blue flame is not produced when sodium chloride is projected on to a red-hot platinum capsule.

2. The colouration produced by throwing sodium chloride into a coal fire is produced equally well by potassium chloride, and less readily by the chlorides of barium, calcium, and ammonium.

3. The colouration is not produced by the carbonate, phosphate, or sulphate of sodium.

4. Chloroform, carbon tetrachloride, and ethylene dichloride, when thrown into a coal fire, produce blue colourations, similar to that produced by sodium chloride.—Norman Leonard in *Chemical News*.

LANTERN PANTOGRAPHS.*

For the production of off-hand tracings for illustrations, especially during the projection of a series of experiments or pictures, nothing can excel a pantograph adapted to the lantern. Two forms are here shown, both of which produce figures on the prepared glass without exhibiting the arm by which the work is done.

The instrument shown in Fig. 1 is, perhaps, hardly deserving of the name given to it, as it is not strictly designed for accurate copying, on account of distortion, but it may be used in copying when a true figure is not important. It is designed rather for tracing upon the prepared glass while the operator watches the progress of his work as it is projected upon the screen.

The base-board is provided with a square central opening, having around it a rabbet for receiving the prepared glass. This board is adapted to the lantern, and furnished with a pair of small buttons for engaging diagonally opposite corners of the prepared glass and holding it in place. The tracing arm consists of a square metallic frame, *a*, containing a glass plate, and having at one edge an arm carrying a tracing point, and provided at the opposite edge with two parallel rods arranged to slide freely through a block, *b*, pivoted to the base-board. The centre of the glass in the frame *a* is perforated to receive a needle, *c*, which is pressed forward toward the prepared glass by a small spiral spring, as shown in the sectional view. The needle thus supported may be moved around upon the prepared glass in any required direction, and it may be readily lifted from the plate by pulling the tracing point away from the base-board.

By placing a design upon the board, it may be traced and reproduced upon the screen, and, if the designs are specially made so as to compensate for distortion, correct tracings will be produced.

By means of the pantograph shown in Fig. 2, anything, large or small, may be readily and correctly traced. The levers are arranged relatively, so as to produce upon the prepared glass a tracing one-third of the size of the original. With this pantograph, writing, figures, maps, diagrams, sketches, &c., can be made with great facility.

The base-board of this instrument is necessarily somewhat cumbersome, as provision must be made for the supports of the pivot of the pantograph, for the prepared glass, and for the design to be traced or a sheet of paper on which to mark. The base-board is adjustable up and down on a slotted

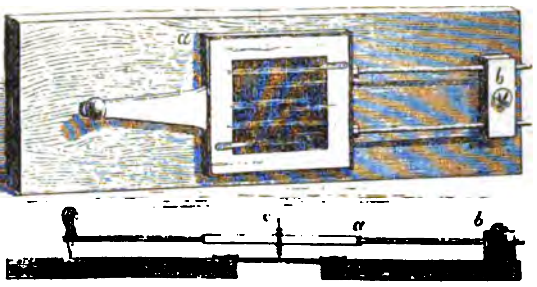

Fig. 1.—Simple Tracer for the Lantern.

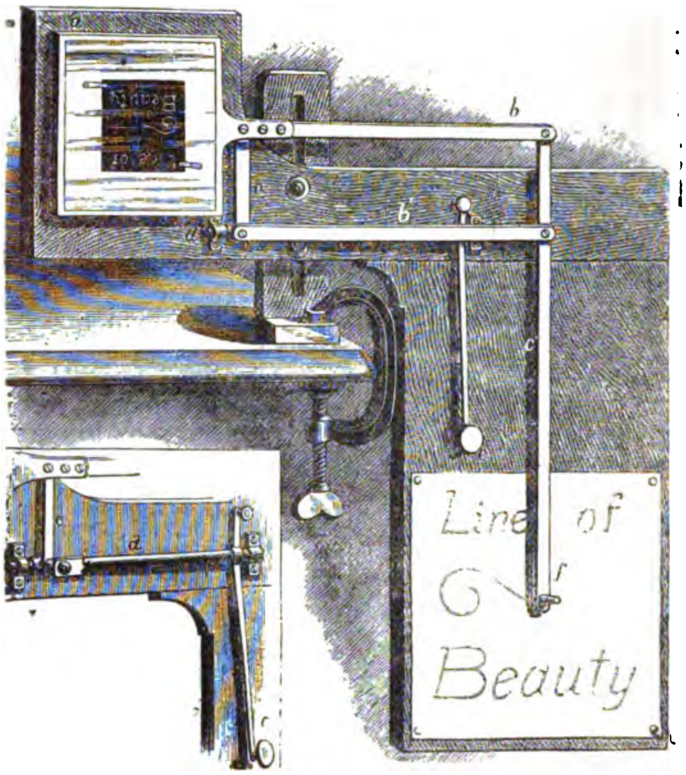

Fig. 2.—Lantern Pantograph.

standard, and the latter is provided with a foot, which permits of clamping it to the table.

The metallic frame *a*, which is attached to the arm *b*, contains a transparent plate of glass, having a central perforation, in which is inserted a stout sewing needle—a small carpet needle, for example. The bar *b* is pivoted to one end of the short metallic bar *c*, and the opposite end of this bar *c* is pivoted on a stud projecting from the rock shaft, *d*, which can turn in supports attached to the base-board. Upon the same stud is pivoted a bar, *b'*, which extends parallel with the bar *b*, and both these bars are pivotally connected with the bar *c'*. The lower end of the bar *c'* is provided with a tracing point, *f*, for which a lead pencil may be substituted when an original design is to be made. The paper on which the design is drawn is attached by drawing tacks to the lower part of the base-board. The rock shaft *d* is provided with a long key, *e*, which extends downwards, and is pressed outwardly by a spring underneath it. The key is prolonged above the rock shaft, where it is provided with a screw for limiting the motion of the key and shaft. The arrangement of the shaft and key is shown in the small detail view.

The shorter arms of the levers of the system are 4in. long, and the longer arms are 12in. long. That is to say, when the bars are at right angles to each other, the distance between the bars *b b'* is 4in., the distance between the bars *c c'* is 12in., the distance from the tracing needle at the centre of the transparent glass to the pivotal connection of the bars *b c* is 4in., and the length of the bar *c'* from the pivotal connection of the bar *b'* to the tracing point *f* is 12in.

The glass plate on which the tracing is made is preferably coated with collodion coloured with aniline. If this is not convenient, the glass may be smoked.

The needle is prevented from touching the prepared glass by pressing upon the key *e*, thus slightly twisting the entire system. When the point of starting is reached, the key *e* is released, when the spring under the key, through the key, rock shaft, and bar *c*, carries the frame *a* forward, and brings the tracing needle into contact with the prepared glass, when the tracing begins. When it is desired to interrupt the line, the key *e* is again depressed, when the needle may be moved to a new position without making a mark.

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* By Geo. M. Hopkins in the *Scientific American*.

GUIDE PLATES AND PINS.*

Herewith are shown a variety of kinds used in different foundries. Fig. 1 is a view of a part of a flask with a hole bored in it, and a piece of wrought bar iron, A, driven in it for a guide pin. Fig. 2 is the drag, and has a hole, B, bored in it to guide the cope. This is a primitive arrangement, but is used a great deal throughout the country at the present time. After a few heats the holes get burned out so that the cope fits most anywhere, except just where it is wanted.

Figs. 3 and 4 are cast-iron plates and pins, and are something of an improvement on Figs. 1 and 2; but either of these plans are about as poor an arrangement as could be used on a flask. The pins are in such a position under the edge of the cope the moulder cannot see to enter them in the plate; consequently is compelled to call an extra man to guide the pins.

For deep lifting or to guide "cheeks," dove-tail strips are often screwed fast to the sides, as at Fig. 5, and in cross section, Fig. 6, from C to C.

Fig. 7 shows one style of wrought pins for heavy iron flasks. In the lugs cast on the flask a recess is cored out for the collar D to fit into, and the nut E is screwed down on top of the lug. Sometimes there is a slot F in the pins, to drive a key into after the flask is closed together. This plan has been used on ordinary size cast-iron flasks with wrought pins, for the convenience of fastening them together, but it would take a powerful microscope to find one of the keys after they have been in use a while.

Fig. 8 is a wrought pin without the collar, and tapered at G. The holes in the lugs on the cope

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* By Robert E. Masters, in the *Manufacturers' Gazette*.

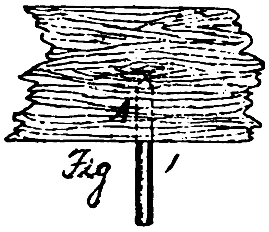

Fig 1

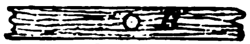

Fig. 2

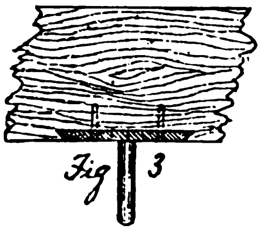

Fig 3

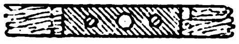

Fig 4

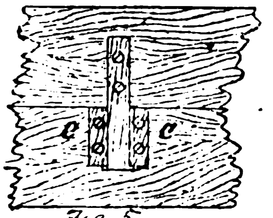

Fig 5

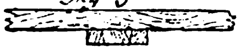

Fig 6

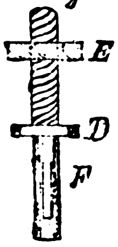

Fig 7

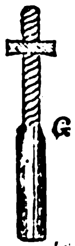

Fig 8

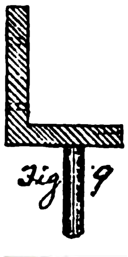

Fig 9

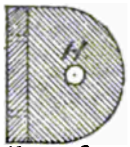

Fig 10

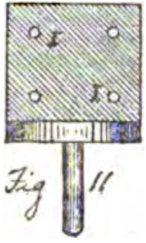

Fig 11

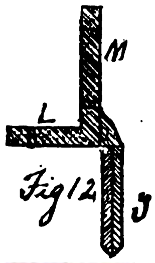

Fig 12

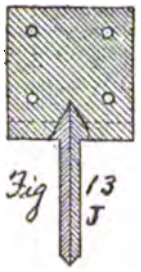

Fig 13

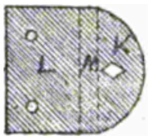

Fig 14

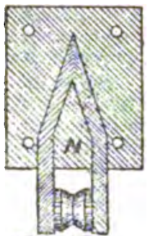

Fig 15

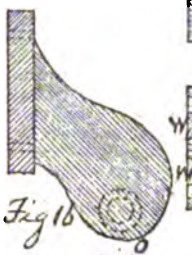

Fig 16

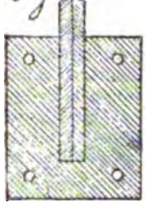

Fig 17

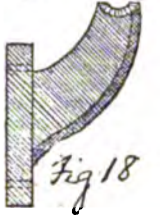

Fig 18

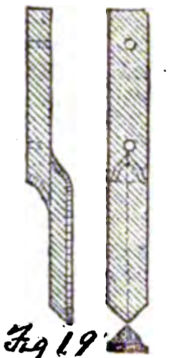

Fig 19

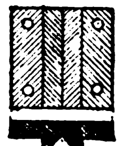

Fig 20

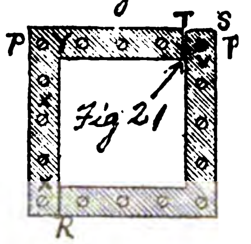

Fig 21

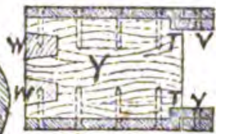

Fig 22

are reamed taper to suit these, and the nuts screwed down make very secure and firm guide pins.

Figs. 9, 10, and 11 are side plan and front views of a cast-iron guide pin. The dotted circle H, Fig. 10, shows the position of the pin. The plate to match this has a hole at H instead of the pin; otherwise they are identical. These plates are bolted (not screwed) fast to the sides or end of the flask through holes I I, and they give a steady guide to close by.

Figs. 12 and 13 are side and front elevations of a pin that gives satisfaction wherever it has been used. The diamond shape pin J is made heavy enough to stand handling when in use, and as it stands out clear there is no obstacle to prevent the moulder from seeing how to guide it into the hole K, shown in the plan of plate Fig. 14. L L, Figs. 12 and 14, are let in flush with the edge of the flask and screwed fast; the front plate, M M, shown in dotted lines, Fig. 14, fits against the side of the flask, and are secured with bolts or screws. These pins are not easily loosened, and prevent shifting of the flask. Figs. 15 and 16 fit into and work on Figs. 17 and 18, showing the front and side views of both (the upper and lower) parts of a rolling-off hinge used on flasks. Sometimes for smaller work a lighter hinge is used, having one rib at N, with a recess above the groove to let it roll back on O.

At Fig. 19 are side, front, and cross-section views of cast-iron guide strip, to work into the plate shown in elevation and end views, Fig. 20. They can be used in place of wooden guide strips, Figs. 5 and 6. As there is no danger of their burning or being broken very easily; they do not have to be replaced every heat or two, as is the case with wooden strips, and they can be bolted on iron, as well as wooden flasks for deep lifting.

Fig. 21 is a plan or top view of a snap flask (the pins and handles omitted), showing a set of straps and hinges of brass or wrought iron. Fig. 22 is a section of Fig. 21, on a line through from P P. These drawings represent either the cope or the drag. The flask opens at R, and the straps are in one continuous piece each way from R to S. They are about ⅛in. thick, and are put on the top and bottom of each half of the flask, and they bind it firmly together.

An angle at T in one of the straps gives a smooth lap, so they can be riveted together at V V, to form the hinge, and have both halves of the flask fit close together. As the wooden sides of the flask meet at the arrow-point, the hinge end of the straps extend beyond the wood, consequently all loose sand falls free, and does not pack in the hinge joint, as is usually the case. The flask does not twist or spring out of shape. The straps protect the edges from being worn or broken up, and enable the moulder to strike the mould off level, so that the snap-flask weight will bear evenly on top of the mould. W W are sections of the dove-tailed ends of the wooden sides X, fitting into and at right angles with the side Y.

ON AN EFFECT OF LIGHT UPON MAGNETISM*.

By SHELFORD BIDWELL, M.A., F.R.S.

SEVERAL experimenters in the early part of the present century tried to magnetise iron and steel by the action of light,† but I do not know of any recent attempts in this direction, and of late years the thing has been generally regarded as impossible. Under ordinary circumstances there can be little doubt that this is the case; but, if a certain condition is fulfilled, we might, I think, expect to find some evidence of the action of radiation upon the magnetism of iron.

The condition is that the susceptibility of the bar A B to be operated upon shall be greater (or less) for a magetic force in the direction A B than for an equal one in the direction B A. This paper contains a short preliminary account of a series of experiments which have been undertaken with iron bars having this property. Much yet remains to be done, which will require a considerable amount of time, and for which special apparatus must be constructed. In the mean time, the results already obtained appear to possess sufficient interest to justify their publication.

The method of preparing the bars is as follows:—A piece of soft iron rod, which may conveniently be 10 or 12 cm. long and from 0·5 to 1cm. in diameter, is raised to a bright yellow heat and slowly cooled. When cold, it is placed inside a solenoid, through which is passed a battery current of sufficient strength to produce a field of about 350 or 400 C.G.S. units. The iron when removed from the coil is found to be permanently magnetised, and its north pole is marked for the sake of distinction with red sealing-wax varnish. The bar is then supported horizontally and in an east and west direction behind a small reflecting magnetometer, and over it is slipped a coil, which is shunted with a rheostat, the resistance of which can be gradually increased from 0 to 26 ohms. The coil can be connected by a key with a single battery cell, which is so arranged as to produce a demagnetising force inside the coil. The resistance of the rheostat is slowly raised, so that more and more current passes through the coil, the battery key being alternately lifted and depressed until the magnetometer indicates that the iron bar as a whole is perfectly demagnetised. The strength of the demagnetising force required varies according to circumstances: it is generally about one-thirtieth or one-twenty-fifth of the original magnetising force.

After this treatment the iron rod does not differ, so far as ordinary tests will show, from one which has never been submitted to magnetic influences. Nevertheless, as is well known, it possesses certain properties which distinguish it from a piece of really virgin iron. In the first place, the magnetisation induced by a force acting in such a direction as to make the marked end a north pole, is greater than that caused by an equal force in an opposite direction. Again, if such a bar be held horizontally east and west (to avoid terrestrial influences), and tapped with a mallet, the marked end at once becomes a north pole. A similar effect follows if the rod be warmed in the flame of a spirit-lamp. Lastly, if it be placed inside a coil and subjected to the action of a series of rather feeble magnetic forces, of equal strength but alternating in direction, the marked end will generally become a north pole, even though the last of the alternate forces may have tended to induce the opposite polarity.

A rod treated as above described appears to be remarkably sensitive to the action of light. When such a rod is placed behind the magnetometer, and illuminated by an oxyhydrogen lamp about 70cm. distant, there occurs an immediate deflection of from 10 to 200 scale divisions,* the magnitude of the effect varying in different specimens of iron. As the action of the light is continued, the deflection slowly increases. When the light is shut off, the magnetometer instantly goes back over a range equal to that of the first sudden deflection, then continues to move slowly in the backward direction towards zero.

The first quick movement I believe may be due to the direct action of radiation, and the subsequent slow movement to the gradually rising temperature of the bar. With a thick rod (1cm. in diameter) the slow movement is barely perceptible, extending over only one or two scale divisions in the course of a minute, the spot of light becoming almost stationary after the first sudden jump. With a thin rod the sudden effect is generally smaller, while the slow after-effect is greater and may continue until the spot of light passes off the scale.

As a general rule the magnetic effect is such as to render the marked end of the rod a north pole: occasionally, however, it becomes a south pole, but in such cases I have always found that the polarity is comparatively feeble. It may even happen† that the marked end becomes north when certain portions of the rod are illuminated, and south when the light acts upon other portions. This is probably due to irregular annealing and a consequent local reversal of the direction of maximum susceptibility; it indicates that the light effect is local, and is confined to the illuminated surface. In one remarkable specimen, which happens not to have been annealed at all, the sudden effect and the slow effect are in opposite direction. When the light is turned upon this rod, there is at first a sudden deflection of twenty magnetometer-scale-divisions to the left, the spot afterwards moving slowly and steadily towards the right. When the light is shut off there occurs at once a jump of twenty divisions further towards the right before the spot begins to move back in the zero direction

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* A paper read before the Royal Society, March 21.

† Chrystal, "Encycl. Britann.," vol. xv. p. 274, mentions the following names:—Morichini, Mrs. Somerville, Christie, Riess, and Moser.

* The magnetometer mirror was one mètre distant from the scale, and each division = 0·64mm. (1-40in.)

† This has been observed in two specimens.

Some attempts have been made to repeat the experiments with light polarised by means of a Nicol's prism; but, either because the largest prism at my disposal was too small (its aperture being barely 2cm.), or because too much of the radiant energy was absorbed by the spar, I failed to get any magnetic effects whatever with the prism in either position.

[Prof. Silvanus Thompson has quite recently been kind enough to lend me a very large and excellent Nicol's prism. From a few experiments already made with this instrument it appears that the action of the light is quite independent of the plane of polarisation.—March 16.]

There can be no doubt whatever of the reality of the effects here described: they are perfectly distinct, and are at any time reproducible with certainty. The only question is how much of them is primarily caused by the action of light, and how much by mere incidental change of temperature. But taking all the circumstances into consideration, I think the evidence is in favour of the conclusion that the *instantaneous* magnetic change, which occurs when a prepared iron bar is illuminated, is purely and directly an effect of radiation.

USEFUL AND SCIENTIFIC NOTES.

Japanese Yeast.—In one of the recent American Consular Reports the preparation of Japanese *koji* (yeast) is described by Prof. Georgeson, of the Imperial Agricultural College at Tokio. *Koji* is made not only in special factories, but also in *saké* (rice-beer) breweries. The materials used are water, rice of the common starchy kind only, and *tane* (seed or leaven), the spores of a fungus (*Eurotium oryzæ*, Ahlb.) It is this latter substance which, when germinating on the rice, changes a portion of the starch into dextrose and dextrin, and produces the fermentation. The rice is carefully washed, and the thin covering of the seed is always removed. It is then allowed to remain for some hours in water, and having been steamed, it is spread on mats to cool, and when the temperature has fallen to about 100° Fahr., the *tane* is scattered uniformly on the mass, and then thoroughly mixed with it. The whole is then allowed to remain for 18 or 20 hours, covered with mats, after which the rice is spread in a thin layer in a number of shallow, wooden trays, which are taken to the warmest room in the factory, and there left standing for 4 or 5 hours, when the contents are stirred by the hand, and again after an interval of four hours the operation is repeated. On the third day the fungus grows very rapidly, and great heat is generated. Care, however, is taken that the heat does not become too great. This is the usual mode, but there are many other methods.

The Hangchow "Bore."—Capt. Moore, of H.M.S. *Rambler*, has lately described—in a paper read before the China Branch of the Royal Asiatic Society—the appearance and effects of the remarkable "bore" which often occurs in Hangchow Bay. This dangerous visitor is the result of the struggle between the advancing tide in the great estuary and the current of the river. Capt. Moore and his officers on several occasions observed the progress of the wave, and their investigations may be summarised as follows:—The rate at which the bore travels varies from ten to about thirteen miles per hour. The height of the bore rarely exceeds 12 or 14ft., and broken water, in which no small boat could live, follows it for some distance. With the passing of the wave the tide rises many feet in a few seconds; in one instance, observed by Capt. Moore, it rose from 9ft. 4in. below to 4ft. 7in. above mean level. The rush of the bore was so strong that the force of the waves breaking against the broadside of the *Rambler* sent the water into the mizzen chains and the spray on to the poop. The junks in that region are protected by platforms, with narrow steps cut in the sides. To the north of the estuary is a great sea-wall, built to protect the surrounding country from being flooded by these great tidal-waves. It is thirty-five miles long, and it is strengthened, where the bore strikes most strongly, by an elliptical stone buttress, 253ft. long by 63ft. wide. Behind this the junks are drawn up for shelter.

M. UNGERER believes that flowers and the perfumes distilled from them have a salutary influence on the constitution, and, indeed, may be regarded as a therapeutic agency of high value. He says that residence in a perfumed atmosphere forms a protection from pulmonary affections and arrests the development of phthisis. He adds that in the towd of La Grasse, where the making of perfumes is largely carried on, phthisis is rare, thanks to the odorous vapours exhaled from the numerous distilleries.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday evening, the 20th inst., at the Institution of Civil Engineers, Dr. W. Marcet, F.R.S., President, in the chair.

Mr. A. J. Hands, F.S.A., Mr. J. Jackson, Mr. S. A. Jones, Mr. J. E. Middlehurst, and Mr. L. Sutton, F.R.G.S., were elected Fellows of the society.

Dr. Marcet delivered an address on "The Sun: its Heat and Light," in which he said that the source or origin of all meteorological phenomena is the sun, which sends or radiates its heat to the earth through the molecular vibration of the invisible matter connecting earth with space. If there were no air and moisture, we should feel the sun's heat to a much greater extent. After the sun's rays have reached the earth, a portion of the heat they bring with them is absorbed by the earth and terrestrial objects, another is converted into motion, and a third is reflected into space. After describing the various actinometers and other instruments used for determining the amount of solar radiation, Dr. Marcet showed that the temperature of the solar rays falls rapidly when tested at increasing altitudes in a balloon. He then gave an account of some observations made by Mr. Glaisher in the celebrated balloon ascent which he and Mr. Coxwell made from Wolverhampton on September 5th, 1862, when they reached a height of about seven miles above the earth's surface. Regarding the transformation of solar heat into motion, a very interesting illustration is afforded by the radiometer, in which the direct influence of the sun's rays causes a light vane to rotate; while another illustration of the mechanical effects of heat upon fluids is their conversion into what is known as the spheroidal condition. In connection with this, Dr. Marcet showed how, by wetting his hand, he could pass it through molten lead without injury. He also related the case of Henry Hall, one of the keepers of the Eddystone Lighthouse, who, on the occasion of the fire which destroyed the lighthouse on Dec. 4th, 1755, accidentally swallowed some molten lead, but did not die till several days afterwards, when a piece of lead was taken out of his stomach. Dr. Marcet then briefly drew attention to the sun's light, stating that the passage of the sun's light through our atmosphere alters it in kind to a great and remarkable extent. Light can be decomposed into its elementary colours. In connection with this branch of the subject, Dr. Marcet performed a number of experiments, including, among others, that of passing a ray of light through a glass vessel freed from dust, when the ray disappears within the vessel, but reappears on the other side, showing that the power to form light was there, though not the material for this power to act upon. Dr. Marcet concluded his very interesting address by describing the various forms of sunshine recorders.

The meeting was then adjourned in order to afford the Fellows and their friends an opportunity of inspecting the exhibition of instruments opened on the previous evening. The exhibition was devoted principally to actinometers and solar radiation apparatus, and also includes sunshine recorders, several new instruments, and a number of interesting photographs of meteorological phenomena.

Among the instruments shown for ascertaining the absolute heating effect of the sun's rays, were Herschel's, Hodgkinson's, and Stewart's actinometers, Pouillet's and Angström's pyrheliometers, and Secchi's solar intensity apparatus. There were also Luvini's dietheroscope for observing the changes of atmospheric refraction optically, Bellani's lucimeter as used in Italy, and Crookes's radiometer in which the arms rotate with more or less velocity under the action of radiation.

All the various patterns of solar radiation thermometers were exhibited, from the plain black glass bulb maximum to Richard's continuously recording black bulb and white bulb thermometers *in vacuo*.

An interesting collection of sunshine recorders was also exhibited, among which were the Campbell-Stokes and Whipple-Casella burning recorders, and the Jordan and McLeod photographic recorders.

Several new barometers, anemometers, nephoscopes, &c., were also shown, as well as the stephanome, which is used for measuring the angular size of halos, fog-bows, and glories at the Ben Nevis Observatory.

Mr. Clayden showed an ingenious working model of the Atlantic ocean, illustrating the formation of ocean currents in general, and of the Gulf Stream in particular. Some models of very large hailstones, 7in. in circumference, which fell near Montereau, France, August 15th last, were also exhibited.

The exhibition included a very interesting collection of photographs of flashes of lightning, and also a number of photographs of clouds taken in various parts of the world, and views taken on the summit of Ben Nevis.

The exhibition remained open until Friday.

SCIENTIFIC NEWS.

A CATALOGUE of moon-culminating stars for 1889 has been issued by the Bureau des Longitudes, Paris. It has been prepared by MM. Loewy, the "vice-directeur" of the Paris Observatory, and contains over 360 stars down to the 7th mag., arranged in the order of their right ascensions.

The *Journal* of the Liverpool Astronomical Society for February contains an interesting paper by Major E. E. Markwick on "The Opera-Glass for Astronomical Observations," especially useful because it is a paper "by an amateur, for amateurs, and concerning amateur work." A good deal of even valuable astronomical work can be done with a good opera-glass (that known more appropriately, perhaps, as a field-glass is meant), as, to mention one case, our readers will remember has been done by Mr. J. E. Gore. This number of the *Journal* also contains the Report of the Meteoric Section, and that of the section devoted to Variable Stars.

The death is announced from Utrecht of Emeritus Prof. Donders, the famous Dutch physician and ophthalmologist, at the age of seventy-one. By the law of the universities of Holland, no professor can retain his chair after passing his seventieth year; but none of those who were present at the recent "jubilee" greeting of the distinguished scientist could have expected so early a termination of a life which, judging by external appearances, promised many years of useful work. Prof. Donders was, however, struck down a few weeks ago by apoplexy, and the seizures becoming of increasing gravity left no hope.

The death is also announced of Mr. Joseph Woolley, M.A., LL.D., F.R.A.S., formerly principal of the School of Mathematics and Naval Construction at Portsmouth, and subsequently, and for many years, the Admiralty Director of Education, who died at Sevenoaks on Sunday, after a few days' illness. Trained at Cambridge, where he was a Fellow of St. John's College, he was selected in 1848 as the head of the Technical School founded in that year by the Admiralty. When a School of Naval Architecture was again founded, on other lines, at South Kensington in 1864, Dr. Woolley was appointed Inspector-General by the Committee of Council on Education, and he continued to superintend the school until his retirement from active life. In 1850 he published a "Treatise on Descriptive Geometry," which is widely known as a textbook. In 1860, when the Institution of Naval Architects was founded (very largely by his own personal influence), Dr. Woolley opened its proceedings by an address on "The Present State of the Mathematical Theory of Naval Architecture." He enriched the *Transactions* of the Institution with frequent contributions on all current questions presenting any peculiar difficulty. He was a member of the Committee on Designs in 1871, and of other important Naval Committees.

A promising student of botany, Mr. J. Reynolds Vaizey, of Cambridge, has been cut off at a very early age. He had made many contributions to botanical science, the best known of which are "The Transpiration of the Sporophore of the Musci," and "The Absorption of Water, and its Relation to the Constitution of the Cell-wall in Mosses."

The number of candidates for the Fellowship of the Royal Society is increasing annually; this year there are seventy-one, a number considerably above the average. As only fifteen are elected, it might be as well to have a preliminary selection before the list is suspended in the committee-room.

The list of officials for the coming meeting of the British Association at Newcastle-on-Tyne has just been arranged. The president will be Prof. W. H. Flower, F.R.S. The presidents of the various sections are as follows:—A.—Mathematical and Physical Science, Captain W. de W. Abney, F.R.S. B.—Chemical Science, Sir I. Lowthian Bell, F.R.S. C.—Geology, Prof. J. Geikie, F.R.S. D.—Biology, Prof. J. S. Burdon Sanderson, F.R.S. E.—Geography, Colonel Sir Francis de Winton. F.—Economic Science and Statistics, Prof. F. Y. Edgeworth. G.—Mechanical Science, W. Anderson, M.Inst.C.E. H.—Anthropology, Prof. Sir W. Turner, F.R.S. The first general meeting will be held on Wednesday, Sept. 11, at 8 p.m. On Thursday evening, Sept. 12, there will be a *soirée;* on Friday evening, Sept. 13, a discourse on "The Hardening and Tempering of Steel," by Prof. W. C. Roberts-Austen, F.R.S.; on Monday evening, Sept. 16, a discourse by Mr. W. Gardiner, M.A.; and on Tuesday evening, Sept. 17, a *soirée*. The Saturday evening popular lectures will be delivered by Mr. B. Baker. Excursions to places of interest in the neighbourhood of Newcastle-on-Tyne, including, of course, the Roman Wall, are being arranged for Saturday, Sept. 14, and Thursday, Sept. 19.

Invitations are now being issued by the French Ministry of Commerce and Industry to assist at the second session of the Hydrological and Climatological International Congress, which will be held at the Paris Universal Exhibition under Government patronage, from the 3rd to the 10th of October next. M. E. Renou will be president, and the secretary-general is Dr. F. de Rauce, 53, Avenue Montaigne, Paris.

A bibliography of Indian geology—a list of books and papers relating to the geology of British Indian and adjoining countries up to the end of 1887—has been issued by Mr. R. D. Oldham, deputy-superintendent of the Geological Survey of India.

Signor Borelli publishes through the Italian Geographical Society a rough sketch-map of the countries to the south of Abyssinia, which, if it should prove trustworthy, will necessitate a change in the accepted ideas as to the geography of that part of Africa.

Dr. B. W. Richardson, F.R.S., has been experimenting with the graphophone in order to record sounds, and is so satisfied that in a paper contributed to the *Lancet* he writes: "Out of a roll of paper, accidentally used by Laennec, the stethoscope was elaborated, and a new mode of diagnosis, widest perhaps of any, was brought into existence." Dr. Richardson concludes from his investigations that the different kinds of cries indicative of different sensibilities to pain can be rendered diagnostically, and that any sound whatever, indicative of health or disease, and any animal motion that admits of being translated into sound, can now be recorded, made permanent, and reproduced any number of times, for comparison, demonstration, or observation.

Mr. Langdon-Davies's phonopore has, it is stated, been tried practically on the line wire between St. Pancras and Derby, and the phonoporic messages were received and sent without difficulty whilst the line was in use for the ordinary signals transmitted by the telegraph instruments of the railway. The phonopore, it will be remembered, consists of a couple of coils of insulated copper wire, and the number of pulsations is regulated by a vibratory reed.

An electric "lead," or shallow-water indicator, has been devised by two Mexican inventors, and should be found useful by navigators. It is a strong cylindrical vessel, weighted so as to remain upright in the water while hanging freely on the line from the ship. In its centre is a glass or vulcanité tube half-full of mercury, the ends being closed by metallic plates connected to wires which are in the circuit of a battery and bell. When the indicator touches the ground it begins to drag on it, and being thus tilted on its side the mercury completes the circuit, and the bell on deck or in the captain's cabin instantly rings.

The Bell Telephone Co., at Buffallo, N.Y., are putting their lines underground as fast as possible; so evidently they do not think there is any difficulty about the matter.

The Municipality of Paris has offered a prize of 10,000 francs for the best meter for measuring the current supplied in electric light installations, and 2,000 francs each to the five next best meters. The jury consists of MM. Mascart, Hospitalier, Potier, Vaillant, and Lyon-Allemand. The municipality reserves the right to manufacture and use, free of royalty, any meter for which a prize has been awarded, so that it will probably pay anyone who has a really efficient meter to patent it and keep control of it. The following are the conditions to be observed by competitors:—1. The meters to be adapted for continuous, pulsating, or alternating currents. 2. They must be capable of correctly indicating under varying pressure or varying current, strength, or both, and should serve as coulomb, volt-hour, or watt-hour meters. 3. They should be applicable to very small installations, and correctly indicate down to one 10c.p. lamp. 4. Alternate current meters must indicate watt-hours. 5. The competitive experiments will be made with a view to more specially ascertain: (*a*) correctness of indication throughout the whole range of the meter; (*b*) minimum amount of energy consumed in the meter; (*c*) minimum of complication introduced by the use of the meter; (*d*) practical value of the meter as affected by its simplicity, facility for re-calibration, and low cost.

Such exploits as hitching on a wire to current leads and "tapping" telegraph and telephone wires are not unknown even in this country; but the Senate of Connecticut has found it advisable to pass an Act imposing a fine not to exceed 500dols. on any person who shall make a connection, by wire or otherwise, with any telegraph or telephone wire, not owned or leased by such person, for the purpose of obtaining information or listening to the transmission of messages.

At a meeting of the Medico-Psychological Association held at York recently, Dr. Baker, of the Retreat, read a paper on "Ten Years' Experience of the Turkish Bath in the Treatment of Mental Disorders," in which he states that he had found it useful in cases of blood pollution, such as alcoholism and the chloral and morphia habit, as well as in cases of mental weakness due to gout or similar causes. In defective excretion, in hepatic congestion, and the like, the bath is invaluable; it assists convalescence, as after puerperal insanity, and quiets and relieves even in epilepsy and chronic insanity.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

VENUS.

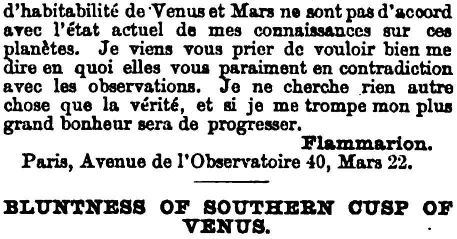
[29761.]—MONSIEUR EDWIN HOLMES déclare dans lettre 29740 dans L'ENGLISH MECHANIC d'aujourd'hui, que les idées que j'ai emises dans *l'Astronomie* du 1er Mars relativement aux conditions d'habitabilité de Venus et Mars ne sont pas d'accord avec l'état actuel de mes connaissances sur ces planètes. Je viens vous prier de vouloir bien me dire en quoi elles vous paraiment en contradiction avec les observations. Je ne cherche rien autre chose que la vérité, et si je me trompe mon plus grand bonheur sera de progresser.

Flammarion.

Paris, Avenue de l'Observatoire 40, Mars 22.

BLUNTNESS OF SOUTHERN CUSP OF VENUS.

[29762.]—REFERRING to my letter of the 5th inst., published in your edition of the 15th, I have been utterly unable to detect the blunt appearance since, though I looked under very favourable auspices on the 9th and 15th. I write this lest any readers of your edition of the 15th should have failed to observe it, and conclude I was mistaken on the 5th.


Mar 5.
Mar. 9.
Mar. 15.

My observations tend to show that the aspect of Venus varies from day to day. That on the 5th I have already referred to; on the 9th the blunt appearance was not discernible; but a perceptible promontory on the terminator was visible—coupled with a distinct darkness of the equatorial position of the planet abutting on the terminator; while on the 15th a new phase presented itself, suggestive of the "square-shouldered" appearance sometimes noticeable in Saturn. The instrument used was a 6in. Calver reflector of very clear definition.

The accompanying rough sketches may illustrate the appearance above noted more clearly than words can. It should be borne in mind that I have exaggerated the point noticed in order to make my meaning more apparent.

Al Fard.

PLANETARY AND STAR MATTERS.

[29763.]—WHAT Mr. Edwin Holmes says (letter 29740, p. 70) as to the tapering cusps of Venus certainly agrees with what was noticed here on the evening of the 11th, and the afternoons of the 9th and 22nd, using powers from 163 to 412.

I was pleased that with the beginning of the new year Mr. Arthur Mee called attention to the falling off of astronomical contributions to the "E.M." Besides the instructive communications, valuable drawings, &c., from so many able observers, the notes of younger observers are always, to me at least, interesting; and I should say the occasional comparing of notes of interest to those engaged, as far as their opportunities allow, in the same pursuit. Experiences are given, I take it, for what they are worth, and for readers to draw their own conclusions, or, if they choose, to respond and criticise. Mistakes may be made, but while there would be no honesty in describing imaginary observations, there would be no warrant in questioning the good faith of those who record to the best of their ability what they suppose they have seen.

If I return to the subjects of my letter (29637, p. 498), it is mainly for the purpose of thanking the several writers for their interesting letters, and to say that in trying to fulfil my offer to endeavour to secure judicial evidence, positive or negative, as to the visibility of Enceladus in the 3¾in., I had the pleasure of receiving a friend here one evening, when there was every promise of a fine night. The sky, however, became hopelessly clouded, and the chance was lost.

I see no foundation for Mr. Sadler's remark (letter 29738, p. 70) that I seemed to have thought at first that the object seen on the two nights was "one and the same star." The object was supposed to be either the same object, and if the same, then probably a satellite, or, if not the same, then *a* star, but not *the* star. I left the telescope to trace Saturn's path on Dien's Atlas Celeste (8th edition); but could find no stars charted within a distance that would serve. The best powers for seeing the satellites on the 3¾ are, according to circumstances, from 100 to 170, but a power of 55 is wonderfully good, though possibly the light of the planet might be a hindrance to some persons. The seeing of the Debilissima by daylight, and not by dark, has also puzzled me, and though I have my own ideas, it would take too much space to enter into the subject, and for more data than I have yet got.

In taking my leave of this subject, for the present, at any rate, I trust I shall not be supposed to be saying I am right, and others are wrong. It is possible that some owners of small telescopes may have unpublished observations tending to corroborate mine or some of them, or may have later. I certainly agree that persons should not waste time in trying to see objects. Conditions are better at one time than another, but observers will not see at the time more than their instrument will show them, though it will show them more at one time than at another, and more under certain conditions than under other conditions.

Hendon, March 25. **P. F. Duke.**

ASTRONOMY AND THE "ENGLISH MECHANIC."

[29764.]—IT will not be unwelcome to many of your readers to see the correspondence column of the "E. M." more diversified with astronomical communications. I could match the story of Jesse S. Nimkey (29742) with another of similar experience, and I believe many others could do the same; but we astronomical readers must remember that there are many others to whom astronomy is "caviare," and we must allow our divine science to teach us divine charity and toleration of others. The possibility of Mr. Duke seeing Enceladus with 3¾ aperture seems hardly to command credence with experienced observers. Mr. Sadler's letter leaves little room to doubt that Mr. Duke must have been deceived by some small star in the neighbourhood. On February 1st Saturn was in R.A. 9h. 20m. 12s. at noon, and N.D. 16° 45′ 38″. I observe on the large map of the S.D.U.K. two small stars, numbered 74 and 79 Piazzi, in R.A. about 9h. 19m. 30s. and 9h. 19m. 30s.; 17° 20′ N.D. Is it not possible that one or other of these stars may have been taken by Mr. Duke for Enceladus? I do not know what is the magnitude of these stars, but I imagine about the 9th. There is a 9th mag. star which Mr. Marth notices in the Ephemerides of the satellites of Saturn, R.A.S. Notices, that will be approached very closely on March 18, as it was on March 10. Its place is 9h. 9m. 12s. R.A., 17° 35·6′ N.D.; it is 9-mag. Mr. Marth recommends that it should be observed on the meridian, so that its occultation or close conjunction may be computed. Transit observers may usefully occupy their instruments in this observation, if large enough.

Would "F.R.A.S." kindly say if the mean equatorial parallax of the sun, at mean distance, has been authoritatively set down at 8·81″, as given by *Nature* (quoted by "W. S.," 67595, p. 448)? In the *Monthly Notices* of the R.A.S., Vol. XLVIII., Feb., 1888, the Transit of Venus Committee gave it as 8·832″. Is this aphelion or perihelion parallax, or a mean between both? If so, this would, I believe, answer to a mean distance of 92,560,000 miles, taking the earth's radius as 3963·3.

John Bone, F.R.A.S.

St. Thomas's Vicarage, Lancaster, March 23.

ASTRONOMY AND THE "ENGLISH MECHANIC."

[29765.]—Being rather more of a "constant reader" than Mr. Mee (p. 70) imagines, I will ask him to define his charge within a reasonable margin. He says there is a "falling off" in the number and interest of astronomical contributions compared with twelve or fifteen years back. That is rather too wide for me. Let Mr. Mee specify any one year, and I will endeavour to convince him that he is mistaken. If Mr. Mee thinks that his letter of January 11 was taken notice of "sympathetically," I have no cause to complain; but I think he must admit that there is a vast difference between the selenographical pictures on p. 357 and p. 461 of the last volume. No one, except perhaps Mr. Mee, would regret the absence of such sketches, pictures, illustrations, or what you like, as that on p. 357 of the last volume. It may be instructive or interesting, but I regret my inability to appreciate it at its value—according to Mr. Mee. **Mimas.**

"JOURNAL" OF THE LIVERPOOL ASTRONOMICAL SOCIETY.

[29766.]—Allow me, Sir, to trouble you for a little space in your valuable medium anent the above subject, and in reply to a letter (No. 29739) by a Mr. Arthur Mee, F.R.A.S., in which appeared what I cannot but help calling uncalled-for disparaging remarks on a publication which has done so much for astronomical science.

Mr. Arthur Mee, F.R.A.S., complains that the L.A.S. *Journal* "is anything but what it was a few months ago, and the past two or three numbers in particular (one or two articles excepting) have been bitterly disappointing." This is, indeed, very strong language. Your contributor evidently seems to feel very keenly the "falling-off," and makes a very vulgar, and, therefore, most uncourteous, comparison between a journal of a society and the English Mechanic. How such a comparison can be maintained is beyond me. The L.A.S. *Journal* depends for its matter upon voluntary contributions, which are read at the monthly meetings of the society and then printed in the *Journal*. It is essentially a private publication, printed for the use of the members of the society. The English Mechanic is too well known for me to explain its aim.

If Mr. Arthur Mee, F.R.A.S., has the courage of the feelings to which he has given so hysteric an expression, why does he not, as a member of the Liverpool Astronomical Society, send us a few papers which could bring on a "revival" and a "turn of the tide"? We would be only too happy to print articles of worth, and I submit it would argue a finer appreciation of a failing, and a greater courtesy of behaviour, if, instead of expressing his "bitter disappointment," Mr. Arthur Mee, F.R.A.S., were to write to the editor, or contribute himself.

Mr. Arthur Mee, F.R.A.S., "earnestly hopes that the society may be kept up to its old standard"—here, then, is an opportunity for the gentleman. I cannot believe him to be unwilling to help, and I therefore ask him, if not to save the standard of the society, at least to contribute to keep it to its "old" position.

I would not have troubled you, Sir, but that so hostile a criticism of a private journal, so publicly expressed, and by a member of the society which publishes the journal, called for an answer as public.

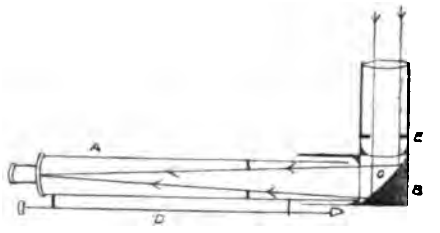
Isaac H. Isaacs (Editor L.A.S. *Journal*).

[This ends the controversy. We may say we have no space to spare for "astronomical discussions" of this sort, which seem to have a charm for Mr. Arthur Mee.—Ed. "E.M."]

MARIUS—REFLECTING TELESCOPE.

[29767.]—Observing sunrise on Marius on March 13th, about 9h., when the whole formation was of that dark brown tinge in which objects appear close to the terminator, I noticed, on the middle of the east wall, a bright white spot, and south of it another smaller one.

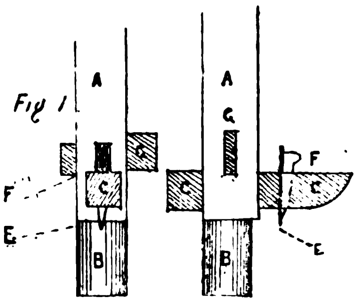
I should like to ask, is it possible to construct a reflector that would possess any advantages over the present form in this way:—A, body of telescope, for an altazimuth fixed horizontally at a convenient height; B, tube bent at right-angles, revolving on A by means of rod and handle, &c., D. At the angle of B is placed a large total reflection prism, C, with its back worked convex so as to throw the light-rays to focus at end of tube A. If possible, this allows of an aperture diaphragm at E, and also of one or more in tube A; therefore, I fancy, likely to give more light and sharper definition.



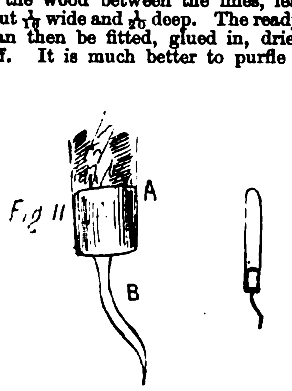
Reading. **G. T. Davis.**

VIOLIN MATTERS.

[29768.]—A correspondent asked a few weeks ago for advice in regard to "purfling" a violin. I send herewith rough drawings of tools used from E. H. Allen's work on "Violin Making." The gauge is used for tracing on the back and belly the *lines* of the purfling round the edge. The gauge should be held firmly against the tables (upper and lower), but cutter must only mark the lines. The cutting is done with a penknife, following lines carefully; then the picker or purfling chisel is used to cut out the wood between the lines, leaving a trench about $\frac{1}{16}$ wide and $\frac{1}{20}$ deep. The ready-made purfling can then be fitted, glued in, dried, and finished off. It is much better to purfle a violin after the instrument is put together (with exception of neck), as any inaccuracies that exist can then be rectified. Also, can any of our fiddle-making amateurs oblige me with sketches of diagrams showing thicknesses of the "Amati" and "Guarnerius" instruments, both back and belly, in each case?



A, stem of gauge; B, rounded end; C, sliding beam; E, steel cutter; F, wedge of wood; G, ditto.



A, wooden handle; B, steel chisel.

Can any of our amateur fiddle makers give a formula for a first-class oil varnish for violins? I have tried that given by J. M. Fleming in "Old Violins," also Mr. E. H. Allen's; but they are too soft, and "flake" off very easily. Have any of "ours" tried amber—with what result?

New Subscriber.

DUODECIMALS VERSUS METRIC.

[29769.]—I was very much pleased to read the letter of "Old Hand" on this subject. My opinion is perhaps of very little value, but I may say that I cordially agree with all therein stated, with the single exception of the suggestion to use the signs ᴒ and ᴓ for ten and eleven respectively; this is a detail the consideration of which may perhaps very well wait until the duodecimal *principle* is finally admitted; but I think the forms suggested, though easy enough to write, look so different from all other figures that they would be a great bar to any serious consideration of the question by practical book-keepers. If I might suggest, I would rather the new figures should be ᘔ (a turned 2) and Ɛ (a turned 3) respectively, as having some slight resemblance to the initials of the *names* Ten and Eleven. **George G. Pole.**

[29770.]—Two perfectly distinct questions are raised by your correspondent, "Old Hand" (letter 29717)—viz., first, the method of representing values below unity; and, second, the base adopted by us in our system of numerical notation.

As regards the first of these, it is surely an indisputable fact that values less than unity are easier to deal with by the use of the decimal point than by expressing them as vulgar fractions. If this is correct, it follows that our tables of weights and measures would be simplified if they could be arranged so as to admit of the decimal point being used with them.

Now this is precisely what the metric system does, and what our English plan does not. Surely this is a very good reason why physicists should use and advocate the metric system entirely apart from its French origin, which has nothing to do with the matter, and also without reference to the "base of notation," which is a different question. Now there are two reasons why workmen do not take kindly to a decimal system—first, they never probably learned much, if anything, of "decimals" at school, while they probably have made some acquaintance with vulgar fractions; and, second, they have always been accustomed to use fractional measures in their workshops, and their eyes and hands have been trained to them. To a person who knows how to handle decimals, and to whom an eighth of an inch has not become by practice any more familiar than a tenth, there can hardly be any question that Whitworth's plan is the readier and simpler method to work with.

As to the other question—viz., the change of the base of our notation from ten to twelve—it is not unfair to remark that the projectors of the scheme show no sign of realising the vastness of the scope of their proposal, or of the enormous practical difficulties attending it. It involves not merely a new mode of dealing with figures, but change in the fundamental conception of what the figures mean, a change which it will be difficult for the popular mind even to comprehend. Is there the slightest chance of the "game being worth the candle"? Let "Old Hand" address himself first to this point, and when he has done so it will be time enough to frame a definite scheme, and to discuss the relative merits of the different bases.

It may, however, be remarked that our reformers will have to devise new names as well as new symbols for the numbers ten and eleven and their multiples, and will have to give the name as well as the symbol of ten to the number twelve. Otherwise, as soon as we get beyond the first eleven numbers we shall find the names as spoken or written parting company altogether with the symbols they represent. Thus:—

Written.		Figured.
Twelve	....	10
Thirteen	....	11
Fourteen	....	12
Twenty-four	....	20

and so on, so that what we represent in figures as 1,000 we shall have to speak of as "one thousand seven hundred and twenty-eight," "which" (to quote Euclid) "is absurd." We may hope, too, that before the system is embodied in an Act of Parliament its promoters will devise some better symbols for ten and eleven than the ones here suggested. The figure six already bothers the printers and others by doing duty for a nine when it stands on its head, and if it has to represent ten by lying on its face and eleven by lying on its back, the confusion will indeed become thrice confounded.

Many persons will probably join issue with "Old Hand" where he asserts that "the mind likes to treat of halves, quarters, thirds, and sixths, and never thinks of fifths." The whole ground he takes here is very doubtful; but if there is any argument at all to be based on the theory of natural mental predilections, it surely tends quite in the other direction. The base ten is beyond doubt the natural one, being founded on the primitive use of the fingers for counting. When a calculator had counted all his fingers he reckoned "one ten" and began again, going on to "twain tens," "three tens," "four tens," and so on. As regards the fractional division into tenths, the very ancient

Jewish institution of "tithes" shows a pretty long pedigree for our decimal system.

Incidentally, too, it would be useful for "Old Hand" to explain what he means when he proposes, by the application of his system, to "ōbviate the present confusion between units of mass, pressure, and weight." Now whether the present nomenclature is "confusion" or not, he seems to land us in exactly the same position when he has applied his remedy. He takes a fresh unit and he calls it by a new name; but he uses this name interchangeably for mass and weight, and does not explain how he would avoid using it in expressing units of pressure as well. No doubt, however, a little further explanation from him would make the point clear. **F. E. C.**

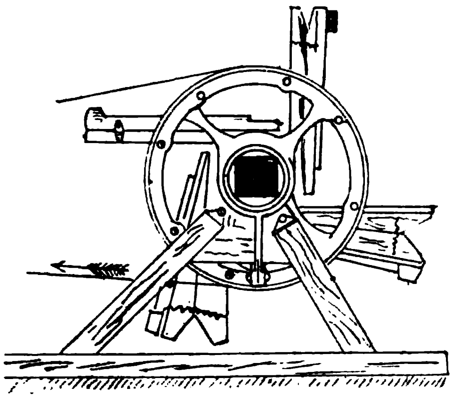
CELLS IN SERIES AND PARALLEL.

[29771.]—In diagram C' of my letter last week there should be three rows of two cisterns in series corresponding to C; three rows in parallel of two cells in series.

W. Perren Maycock, A.I.E.E.

REVOLVING BELLOWS.

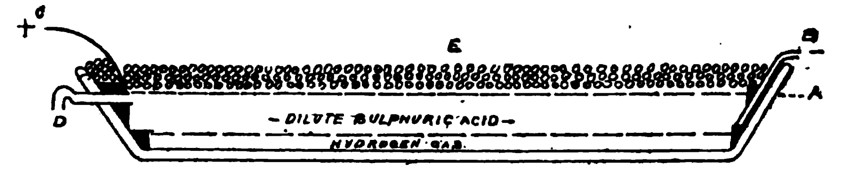
[29772.]—I send illustration of a patent revolving bellows suitable for organs and other purposes, which I have lately seen at work, and can be driven by a gas-engine or other motive power. The advantages claimed by this invention are that over-blowing is rendered impossible, and a constant and steady supply of air is insured. The motive power may be at a distance from the organ, and in large organs, where from two to four men are required, a great saving in cost is effected. The action is as follows. When the bellows are in a vertical position (at top and bottom) no effect is produced by the weights; but when horizontal, the weight which, on the descending bellows is suspended below, causes them to open and draw in air; the reverse action taking place on the bellows ascending, the weight being then at the top, thus closing them and expelling the air.



E. R. Dale, F.S.Sc.

PLATINUM PLATING.

[29773.]—F. W. Mason kindly states in letter 29705 that he will be very pleased to help those who have been unable to obtain a good deposit of platinum. Lately I have been trying to obtain a firm reguline deposit from a fairly cool bath about 80° or 90° Fahr., using Sprague's recipe of sodio-platinic chloride in oxalic acid rendered alkaline with caustic soda, and though I am able with three Smee cells coupled in series to obtain a firm black deposit, I fail to obtain a bright surface. If I perhaps explain the purpose for which I require it, it may help F. W. Mason to understand what I wish to obtain. For the last three years and more I have been experimenting on gas batteries, some of which I have already mentioned in my letters to the "E. M.," and, I believe, have at last made a cell which will work satisfactorily; but there are one or two little difficulties which I am unable to overcome through want of knowledge in the electro-depositing of platinum. If he would not mind referring to letter 29681, p. 13, of this month's issue, he will there find I deposit platinum black on fine copper mesh, and make it the negative plate of the battery described; but owing to the fact of the platinum being a non-adherent porous coating, the copper underneath gradually becomes attacked, and is formed into sulphate, this taking place, I fancy, only on open circuit. This renders copper mesh hardly suitable for the purpose I require, as in a few months the cell is practically useless. Now, platinum wire mesh is most suitable and efficient when treated with platinum black, but owing to the cost (about £5 per cell of 100sq.in.), its use is quite prohibitive from economic grounds, and so I have been trying to deposit on silve wire gauze 100 or 120 mesh—first of all, a bright reguline deposit of platinum, and afterwards a black adherent deposit; the latter I am able to obtain, the former I have hitherto failed in getting, owing, I think, to the bath not being sufficiently heated; and herein lies my difficulty, for the gauze is stretched tightly in a vulcanite frame, which warps considerably on any application of heat above 90°. Therefore, the heat of the bath must lie between 80° — 90°, for it is not possible to fix the gauze in the frame after plating, as the handling and stretching spoil the deposit. What I am anxious to do is, having first placed the gauze fixed in frame in a silver bath, and deposited sufficient metal to bind the crossings of the wire together, so as to obtain a good electrical conductivity throughout the entire plate, which gives it the appearance of a sheet of metal pierced with minute holes, to then transfer it to a platinum bath, and deposit a firm non-porous coating of bright metal, and by adding more cells to fill up the interstices in the plate with a coherent deposit of platinum black. This then, when finished, will constitute the negative plate of the cell, and is placed in the bottom of a glass tray and sealed in there, the positive plate being similar, and placed over it, having on its upper surface, exposed to the atmosphere, a ¼in. layer of platinised granular carbon, or a layer of the new carbon, called polarite, which is said to possess peculiar catalytic properties, so arranged as to be above the dilute acid, the level of which is kept constant by an overflow tube. It will, therefore, be perceived that the positive plate is kept by capillary attraction in contact with the dilute acid, the carbon merely acting as a carrier of oxygen absorbed from the air to the plate below. The accompanying figure will perhaps explain more fully, if the Editor will kindly find room for it.



A is the outer containing cell; B an insulated tube for supply of hydrogen, which also serves as negative pole of the battery; C is connecting-wire from positive plate of battery, which plates are here distinguished by dotted lines, the dark parts on either side being the vulcanite frames; D is the overflow tube, so placed as to keep dilute acid in capillary contact with positive plate; E is the oxygen carrier to positive plate.

I should feel much obliged to F. W. Mason if he would tell me how to deposit a non-porous thick coating on silver mesh in a bath not exceeding temperature of 90°; at the same time I should like to receive his criticism on the above cell, for I have spent so much time and money on experimenting with gas batteries, that I do not feel much inclined to pursue the subject further, and yet my experiments having led me to expect great things from the above, I do not care to give it up without a full trial on a larger scale.

Leamington, March 9. **Alfred Treeby.**

P.S.—In reading over the copy of my letter I see I have omitted to mention the fact that when the above battery is placed in a thorough draught the E.M.F. is absolutely constant from the outset. This I attribute to three causes—(1) the cooling of the positive plate; (2) the preventing of the nitrogen in the air stagnating; (3) the formation of ozone in close proximity to the plate owing to the evaporation. This would, therefore, lead one to suppose a forced draught would be a great acquisition, and by a future development the overflow tube could be done away with by regulating the current of air so as to exactly evaporate the corresponding amount of water formed in the battery.—A. T.

SOME LITTLE-KNOWN PLANTS OF THE FLORA MEDICA.

[29774.]—Meliaceæ—genus Azadirachta.—M. Azadirachta, "Nim" of India, truly deserves to be called the "medicine tree," every part of which, especially the bark, is bitter; the leaves, also, are bitter and nauseous; from the ripe pericarp of the berries a very bitter, fixed oil of disagreeable odour is expressed. Half a century ago this tree was completely naturalised in the South of France and in some of the British Colonies. It is found in nearly every part of India, as villagers have long been in the habit of carrying young specimens, and planting them for protection about their houses. I have even known them travel a long journey to procure a supply of fresh leaves. Europeans equally esteem them, and they were much used in British and native hospitals. A quantity of the freshly-gathered leaves are put into a pot, scalding water poured over them, then placed for a short time on the fire; when at boiling point, the pot is taken off to cool. Tumours, boils, and ulcerous sores, sword-cuts, bullet-wounds, and lacerations, are bathed with this decoction, then a quantity of the macerated leaves are applied in the form of a poultice, renewed twice or thrice daily. The soothing and healing effects are very great. Moreover, this Nim is an insecticide, a quality of great importance in Tropical climates, for it is largely used by the veterinary practitioners, English and Indian; and I have myself employed this fermentation frequently for sore backs and swellings in horses and oxen. The oil is considered anthelmintic, and is also used externally to cleanse foul ulcers, as a liniment in rheumatic and spasmodic affections, and in headaches from exposure to the sun. I had a riding dromedary, a valuable animal—his noserings were of silver wire. I accidentally discovered that the camel-man in charge had bolted, after cutting out the precious metal (only worth eight or ten shillings) from the poor beast's nostrils, now tenanted by a horde of maggots. I anointed every part with the said oil, and the wounds rapidly healed, and remained perfectly free from tormenting flies. During attacks of epidemic cholera Nim tea was found a very comforting beverage when it was used in a British military hospital. In olden times the bark of this Melia was tried as a febrifuge, the supply of quinine being restricted owing to its high price. Hence, Dr. White, of Bombay, administered the melia bark, and found its success nearly equal to cinchona. Dr. Skipton, in the *Calcutta Medical Journal*, related a case of hysteria, in which a decoction of the fresh leaves was used with the best effect. In a much later volume of the same periodical, Mr. Piddington, a zealous botanist, described a crystallised sulphate of the nim bitter principle, which he termed "sulphate of azadirachta"; it was whitish, in the form of minute grains or crystals, and of slightly bitter taste.

The newly-gathered leaves are largely used in India for the protection of carpets and bales of woollen goods, being noxious to insects. At the commencement of every hot season my servants used to take this precautionary measure with my house rugs, and strew them in boxes containing clothing. **Eos.**

A MODEL LOCOMOTIVE.

[29775.]—I quite agree with H. Wake—¾in. scale would be much easier; in fact, I fail to see why the above should be larger. The merit of good model work is, I suppose, that every important part should be well and accurately made; but why so large a scale? The proof of a locomotive is its locomotion. Now, after having made a model weighing about 10 stone, how could its running powers be tested? My idea of a model locomotive is to test the same on a circular railway, for instance, with a fair load; and to do this with the space available for ordinary householders, a ⅜in. scale would be quite large enough.

Have any of our readers tried an asbestos fire, so arranged that the fibrous asbestos is placed over a spirit lamp? Would this plan do to raise steam in a small model? Any information respecting the firebox in a small engine would be of interest to many, no doubt. **R. H. G.**

MODEL ENGINE MAKING.

[29776.]—Replying to H. Wake (letter 29759), a 1½in. scale would be more convenient than ⅛ if the drawings were reproduced to an exact scale of 1½in., and if they were not dimensioned. But all the important dimensions are given in figures, and for the rest it is easy to ascertain the nearest scale to which the illustrations are reproduced, and read off the minor dimensions on that scale. To whatever extent the illustrations are reduced for publication they are reduced in *absolute proportion* from my *full-sized* drawings.

With respect to the ¾in. scale, I do not very well see how to include two sets of drawings in our series of articles. A good deal of the work also is already in the engraver's hands. Besides, for those who would like to work to ¾in. scale it is easy to reduce the dimensions given on the illustrations. To assist such, I will note in subsequent articles the dimensions of principal parts to correspond with a ¾in. scale.

Before undertaking to make a ¾in. scale set, I should want sufficient promises of support to warrant me in undertaking the trouble and expense; and many of the lesser details introduced into the ⅛th scale model would have to be omitted in the smaller one as being too tedious and delicate for amateurs of ordinary skill and moderate patience only.

An advantage in making a large model is that it need not remain a mere plaything, but be utilised with a little adaptation as a motor for a small workshop, driving, say, a lathe and shaper or drill.

J. H.

ODOUR OF ANIMALS.

[29777.]—IN the human family these may be classed as normal, abnormal, and artificial. A Gold Coast negro and a South African Kaffir are hereditary possessors of the skin effluvium. I shall never forget a Fingo housemaid—a Christian, dressed in good European clothing, who bathed often, and ate the remains of our meals. Whenever she had cleaned a room all the windows and doors were thrown open, to ventilate the "goat-fold," as I termed it! The "Markhor," a giant wild goat of the Himalayan Alps, with horns of 44in., and even more, carries the concentrated stink of the whole tribe. A dried skin of this rather rare quadruped will taint every article it touches for a length of time.

The Indian native—the most scrupulously clean of mortals from religious motives—carries his offensive exudation, a weaker and somewhat less nauseous type than the African, the males being usually more redolent than the females. Accidents and diseases are capable of producing the abnormal condition of remarkably evil odours and pleasant fragrance. A young lady who received a serious nervous shock by sudden fear gave out so horrible a fetor from her skin ever after that she was compelled to lead a life of seclusion! In nephritic cases the morbid condition is frequently attended by a strong scent of violets in the urine. The great laboratory of the digestive system, probably by the accident of certain crude substances being jumbled together (as chemical substances have often acted in like manner when commingled in a workshop) has formed strange compounds; in fact, delicious scents are nowadays manufactured from stercoraceous ingredients!

Lastly, curious results follow the administration of certain plants and drugs. I will as briefly as possible describe an instance of each kind. Sulphuret of allyl constitutes the fetid principle of garlic, which exudes through the pores of the skin, giving its nauseous smell to the perspiration of those who are addicted to this condiment, and spoiling the milk of all cows in the North of England where the wild plant grows in the pastures. A ball-room in Tropical lands amid the gay Creoles is ever to be remembered. Tellurium, a rather scarce metal, is capable of producing compounds of a most offensive odour. I quote from a high chemical authority, on the effects of small experiments on persons in good health:—"Within the body of the patient it forms compounds, as sulphur does not unfrequently, which impart to his breath, to the perspiration from his skin, and to the gases produced in the alimentary canal a disgusting fetor, which makes him a kind of horror to every one he approaches, and this lasts sometimes for weeks, though the dose of tellurium administered may not exceed a quarter of a grain. Asparagin possesses an active power on the secretions, as anybody who eats asparagus has noticed in his urine; but for centuries the native druggists of India have employed the fresh roots of *Asparagus racemosus* (a wild species) to increase the milk supply of nursing women. The demand for this vegetable auxiliary is so great that I very rarely found an old specimen of this elegant creeper. The root-diggers have rendered it very scarce, except in remote jungles. The vernacular name is *Soota moolee.*

Eos.

PHRENOLOGY.

[29778.]—IT is now twenty-four years since I bought my first ENGLISH MECHANIC, and all these years, though the opposite of a mechanic myself, I would forego a great deal rather than miss my paper every Friday. I have always read with interest the letters of "A Fellow of the Royal Astronomical Society," and last week I read the following:—

"[29737.]—The paragraph in your 'Scientific News' on p. 29, having reference to Mr. Hollander's attempt 'to furnish a basis for a really scientific phrenology,' suggests to me to remark how utterly the portraits of the wretched creature who blew out his brains in Madrid the other day, tend to falsify the system of Gall and Spurzheim. Benevolence, veneration, conscientiousness, and all the higher moral qualities (as mapped out on the regulation phrenological model heads) are conspicuous in the sketches of one of the greatest scoundrels who has lately appeared, and of whom the world is so happily rid."

On reading which I felt that I must ask you, for the first time in all these years, to allow me a little of your valuable space. I remember once giving my opinion to a workman in a pottery, which caused him to say "You know something of heads, but you don't know much about pot-making." Your very valuable "F.R.A.S." may know a very great deal about the heavenly bodies, &c., but he evidently knows very little about phrenology.

If "F.R.A.S." will get a photograph of Piggot (not a sketch, which is not scientifically reliable), then let him draw a line through the opening of the ear, then draw another line parallel with the first line from the eyebrow, he will find the head very shallow and deficient above the second line drawn. Although the head of Piggot was round and arched from the front to back, the top of head was deficient compared with other parts—that is, his secretiveness and aquisitiveness will be found large, and his conscientiousness small. Then let him draw a line upwards from the most prominent part of the ridge which runs from the opening of the eye, and he will find that the length from that line to the front of the head will be found to measure more than one-third the length of the whole head, indicating that he had far above the average intellect, which, associated with his want of moral restraining power of brain, made him simply a clever, bad man. There is very much of Dr. Palmer's top head in Piggot's, and if "F.R.A.S." or anyone else will carefully measure it as I have pointed out, they will find that Piggot's benevolence and veneration are not so large as they thought. If "F.R.A.S." has never seen "Practical Phrenology," by Bridges, of Liverpool, I would advise him to get it, and he will find that phrenology is something more than the hit-and-miss humbug one comes in contact with so frequently.

P.S.—I was coming from a lecture on phrenology when I saw No. 1 of the ENGLISH MECHANIC in a book stationer's window, and went and bought it, twenty-four years ago. **Mark Moore.**

Phrenological Museum, Morecambe.

THE HAYDON CUTTER-BAR.

[29779.]—THE argument of the writer of letter 29747, not less than his "reasonable" supposition (paragraph two), does seem slightly peculiar. Because a man has one thing bad, therefore all other things, though no way related to the admittedly bad article, and not made by the same people, or coming from the same place, must be bad, too—"worthless imitations," in fact.

Let me at once correct Mr. Hines. I have not "condemned" the Haydon bar—I have said it is an exceedingly handy tool to have, as, indeed, any bar is. What I have said is, With a $\frac{3}{16}$in. cutter it will not bear comparison with a solid tool, and that its great overhang is much against it.

The Westinghouse brake simile shows how utterly the point of my argument has been missed. To make the cases at all analogous, the brakes to be compared should have acted through the same "leaky valves and pipes," and then if, as in my examples, the one failed to give more than half the effect of the other, or produced its effect only by greatly increasing the strain on the machinery and the wear and tear of the line. I do not see that judgment based on that trial could be regarded as unfair. They are tried under the same conditions—i.e., have their power supplied through the leaky valves and pipes. This is fair; the other is not. I gave two examples of the inefficiency of the Haydon as compared to a solid tool. First on my lathe, which, though wretched, is not "trumpery," and on a slide-rest, which, by the way, was not said to be "wretchedly fitted." Here there was no question which did the better work.

Mr. Hines says the overhang of the Haydon is 2in. or 2$\frac{1}{8}$in. That is just what I complain of: that it is that and can never be less. I am asked how often is it that the tool has to overhang 3in or 4in. I say on a 5in. lathe, and with a bar or even with a solid tool of the ordinary section used for such a lathe, that the work done would be very light indeed—little more, I would expect, than scraping—and I presume this overhang is not used by preference, but only when it can't be helped. But really this is beside the question: if one inch of overhang is sufficient, is it an advantage to be obliged to give double that amount? If, with a solid tool, you can do your work with 1in. overhang, will it do it equally well if, instead, you give it 2in.? And, in the latter case, is it not beyond question that the stress is greatly increased on the slides of the rest, so that if there is any weak point in the rest, it is certain to become more apparent?

Thus, just what I have said: if the rest and all fittings are perfect, it is quite able to bear this strain for a time, like the strong young man. But if the strain is unfair and unnecessary, who will say that, in the long run, in one case no less than in the other, it will not tell in the after life.

My second example was taken from trial of the bar and a tool on my planer. Here there was no place, as Mr. H. could have seen had he read my letter, for "his leaky valves and pipes." And here, too, I most distinctly say, the bar could not compare with the solid tool in amount of work or quality either; and, except for flat planing, I think it by no means a generally useful tool on the planer. It cannot do what the bars do with ease and convenience.

I have just been trying a bar by Taylor, of Manchester, which I like much better, and of which some time I may send a drawing. I have found it equal to my best solid tools. It has no objectionable overhang. It is very solid; as it will work with less than ½in. overhang. The cutters too, I think, are of a handier form. The steel of which they are made being of a section more easily formed into such tools as are only with difficulty, and then not quite satisfactorily, made out of the square steel used in the Haydon—e.g., parting tools, right and left end tools, square and V screw-cutting tools.

In conclusion, I may say that I have got much better results with the Haydon by putting a ½in. packing piece under, so as not to allow more than about ¾in. of the cutter to project from the sling.

I may also say that with such journals as the "E. M." in our hands, and such generous and experienced writers as "J. K. P.," who has in back numbers given us a working drawing of this bar, in addition to the information regarding it given by "D. H. G." himself—it is surely rather late in the day, and smells rather strongly of the "quack" I alluded to in my last, to assume, as is done by writer of letter 29747, that the owner of a cutter-bar is quite incapable—without his imprimatur—of assuring himself by a comparison with those drawings that his bar is correctly made; or that, because it has not come from a certain place, it is only reasonable to suppose it is a "trumpery" imitation, or a "poorly constructed" thing, and only fit for the old iron heap.

March 23. **Fredk. Carre.**

THE DANGER OF STOVES.

[29780.]—THE statements made in the extract from the *Lancet* which you gave at p. 69 of last week's issue are of such grave importance, and affect so many, that it would be satisfactory if some of your chemical readers would kindly give us full and exact information on the subject. One knows something of carbonic acid, but not much about "oxide of carbon." Is it produced by all stoves? Suffering from bronchitic trouble, I have burned one of Fletcher's gas-stoves in my bedroom through the night for several winters. Does that produce it? Is it given off by gas and oil lamps also? And how is it that Russians, who cannot do without stoves, and who avoid ventilation, continue to survive if $\frac{1}{10000}$ of carbonic oxide destroys $\frac{1}{8}$th of the blood in the body, and if "even when the apartment in which the stove is heated is well ventilated the atmosphere of the room always contains a sufficient amount to exercise a disastrous influence"?

L. C.

[29781].—THE statements in the paragraph on the above (page 69) are calculated to strike terror into the hearts of those who use stoves, even in shops and other open places, to say nothing of those who use them, as I do, to warm dwelling-houses. But let all such dismiss their fears. I have used stoves, and nothing else but stoves, to heat my rooms for the last twenty-five years. I spend the whole day, from morning till night, in rooms warmed by stoves, and have never experienced the slightest evil effects from them, and have never lost a day from illness during that time. Given a fair draught in a chimney, the escape of carbonic acid or oxide into the room is an impossibility. I have 20ft. of pipe to one of mine, and on one occasion, finding part of the pipe riddled with holes from rust, I feared lest there might be some escape, but a light applied to the holes showed a strong draught *inwards;* however, I had the pipe made good immediately. My stoves are open; what a slow-combustion one may do I cannot tell, but I fancy the French doctors' experience is limited to those and others of a similar kind used on the Continent. Where wood is the only fuel and is expensive, the practice is to light a good fire in the morning, and when it has burned clear, the stove is shut and the damper in the flue is closed, thus confining the heat to the room, but also keeping in the noxious fumes (*vide* Baring Gould's "Germany";) it is no wonder they suffer. In the use of stoves there are three things imperatively necessary: (1) The flue and chimney should be kept clean. (2) The stove should never be allowed to become red-hot, or anything approaching to it. (3) Stove and flue should be thoroughly dusted outside every morning; the burnt dust produces the choking smell so often complained of. I should add that the fireplace into which the flue runs should be closed as nearly air-tight as possible. If this is not done, the whole draught of the chimney is not utilised, and the fumes may escape into the room. **J. A. F.**

REFLECTING TELESCOPES.

[29782.]—FROM time to time we are favoured in the "E. M." with beautiful sketches of Saturn, Jupiter, the Moon, and other interesting views that are to be seen in the heavens; and in many cases the power of telescope is stated, such, for instance, as the sketch of Saturn in your issue of March 22, page 72, by Mr. Geo. P. H. Hallowes. Now these pictures are a puzzle to me; I should like to know how they are done—i.e., by what means is the size of picture arrived at, for I can get nothing like them. My telescope is a Newtonian reflector of my own mounting; my speculum is a very good one of 6¼in. dia., and has been tested by Mr. Wassell himself, and pronounced very perfect; the eyepieces and flat I bought of Mr. Caplatzi. When the telescope has the highest power (Ramsden) it will stand, which gives a very hazy picture, the size of Saturn when compared with the open points of a pair of compasses at 10in. from the eye is not more than ⅜in. in the dia. of the rings, and nothing at all is seen of the divisions; again, when the same power is turned to Jupiter, I can see his belts faintly, but nothing to compare with the sketches said to be seen by a refractor of 3in. aperture. Nor is this entirely my case: a friend of mine has a 6in. speculum similarly mounted, and his experience is worse than mine, and he goes so far as to state that the sketches given in "E. M." and other works are overdone and misleading. I would not say so much myself, but I should like to hear what others have to say who possess reflectors of 6in. aperture. **Reflector.**

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67472.]—**Dead-beat Escapement.**—The way of making a dead-beat escapement, described by "Forres, N. B.," has certainly the merit of simplicity; but is he not overlooking that the dead face of the down pallet would not be at a tangent to the wheel, and if the impulse faces are drawn to a circle the size of the wheel, the angle of impulse is too great. It has been demonstrated both theoretically and practically that the angle of impulse should be small rather than large, and I do not think 2° should be exceeded. G. T. C.

[67680.]—**Colouring Wax, &c.**—Wax and matters of a like nature may be coloured with the following:—Yellow: Use saffron or gamboge, heating for some time, and straining; annatto will answer very well. Magenta: Heat magenta crystals with stearic acid; this will then combine in any proportion. Other shades of red may be obtained by using alkanet root and dragon's blood (in powder). Green: Oleate of copper melted in with the substance to be used. Coloured powders are sometimes used, but they are very likely to settle, even when used with the greatest care. W. H. TUNLEY.

[67755.]—**Electric Bells (U.Q.)**—If Mr. Chadwick will supply fuller information as to the type of the E.R. indicator, the position and number of cells, &c., I may be able to help him. W. PERREN MAYCOCK.

[67784.]—**Lime.**—This is rather a peculiar query. "B. B." says he burns lime out of three varieties of stone, and wants somebody to tell him whether they are suitable for this or that purpose. It seems to me that "B. B." might easily try for himself whether or not the varieties of lime he produces are suitable for building or plastering, or pay some builder to test them for him. The question cannot interest any reader but himself, and it seems to be one of those put by people who would almost get others to eat their dinners for them if they could—they seem so helpless. A. G.

[67800.] — **Celluloid.** — Descriptions of the methods of making celluloid have appeared in back numbers; but as the process is a patent, I do not see what "Bert" can do in the matter. The celluloid is rolled, now, into thin sheets, and for the identical purpose indicated by the querist. See p. 353 last volume. Y. Z.

[67801.]—**Disinfectants.**—Sulphate of iron is a useful disinfectant, both the sulphuric acid and the iron acting on fæcal matters; but in itself it is a deodoriser. The chemical reaction depends on the nature of the solution into which the sulphate is put. SELIM.

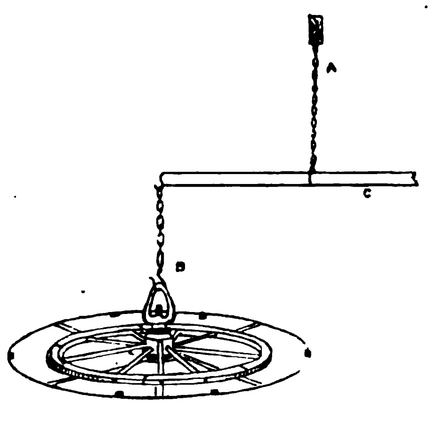
[67826.]—**Broken Tortoiseshell.**—I believe tortoiseshell can be cemented together by simply softening the edges in steam and pressing them together; but a cement often employed consists of shellac and mastic dissolved in spirit and a little turpentine added. M.

[67833.]—**Pedals.**—Organ pedals presumably. There are several diagrams in back numbers—e.g., No. 610. T. P. Q.

[67835.] — **Egg Sectional Turning.**—Must have a model to guide the tool; but see the indices. R.

[67839.]—**Dead-beat Galvanometer Needle.**—Has not this question been answered recently? If not, see Culley's "Handbook of Practical Telegraphy." X.

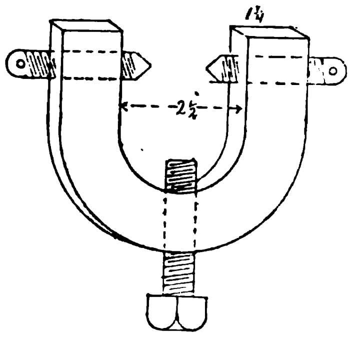
[67831.]—**Cartwheels.**—According to "Young Spud's" request, I send a rough sketch of the platform, which I think explains itself. The chain A is fixed to a beam, or anything safe overhead, to which chain hooks the lever C, on the end of which is the chain B. When it is required for use, put the tire on the wheel, hook on the chain B, raise slightly and turn (as described before), then lower the whole into the water. A and C can be taken down when not in use. WALTER J. PARKER.



[67874.]—**Tracing Fluid.**—Using the number and heading adopted by the "Lydney Dispenser," p. 34, though it has nothing to do with the query of that number, I would point out that his statements about sepia and Indian-ink are as incorrect as the number he gives to his reply. Indian-ink is not the "dried juice or secretion of the mollusc or cuttle-fish called sepia," for Indian-ink is black, whereas sepia is brown decidedly. I do not think sepia has any therapeutical value whatever, and as to Hahnemann and homœopathy, a patient will certainly do as well without sepia as with it. COMMON SENSE.

[67905.]—**Electro-Magnet.**—Many thanks to Mr. Bottone for reply, page 76, to the query, which was not sufficiently explicit. What I want to know is, Whether the electricity evolved from a Wimshurst influence machine can be converted into current electricity capable of magnetising a bar of soft iron similarly to the current from a battery. A reply will very much oblige. X. Y. Z.

[67930.]—**Bicycle Cranks.**—I have sent a sketch of a simple affair which I made for my own use, and which has proved very successful, and with a little care in using will scarcely mark your cranks. W. WOOLDRIDGE.



[67948.]—**Wind-pressure Gauge.**—This is a very ingenious arrangement; but I should make B of flat, smooth steel, ¼in. thick by 2in. broad, and let it pass between two polished steel rollers; then you could do away with the two small steel arms marked J on diagram. To get best effect, F must have at least twice the area of the pressure-plate A. If you put in the smooth ¼in. steel, it will keep the pressure-plate square, with much less friction than the two steel arms you now have. For some of the best anemometers ever designed, see Jamieson's "Mechanical Dictionary," p. 41. F.R.MET.SOC.

[67960.]—**Losing Watches.**—"Puzzled" must be young at the watch trade. Hairspring collet of English lever must be moved round on staff with screwdriver or other suitably pointed tool towards free end of spring, say, $\frac{1}{16}$in., then replace balance and pin in on beat, leaving the regulator on centre of index. Don't know what is meant by spring being pinned in at shortest or longest. In whatever position hairspring is on staff in relation to roller, it must be pinned in so as to have watch exactly on beat, $\frac{1}{16}$in. either way would put it wrong. With Geneve lever an exactly opposite course must be followed. Remove cock with balance attached, place upper side down on board, unpin spring, move it round on staff, about $\frac{1}{16}$in. towards centre of spring, then pin in so as to be on beat. In this case less spring will be through stud after the operation than before it by ½in., with E. lever $\frac{1}{16}$in. more spring will be through. Shall be happy to give "Puzzled" any hints he may require. IRISH HOROLOGIST.

[67964.] — **Dressing Threshing Machine Covers.**—Thanks to "Jack of All Trades" for his reply. Should the cloth be dressed on both sides, and how in the country is the best way to hold them where there is no apparatus for same? What is the best sort of cloth to make them of before dressing? CAMBRIDGESHIRE BOY.

[67980.]—**Recovering $CuSO_4$.**—Copper, and more especially the finely divided copper prepared by precipitation, is soluble in dilute sulphuric acid, if air has free access. Or, if it be desirable to dissolve it more rapidly, it may be tested with hot sulphuric acid. Sulphurous acid is then given off, as shown in the following equation:

$$2H_2SO_4 + Cu = CuSO_4 + H_2O + SO_2.$$

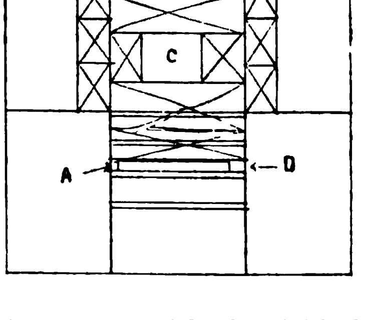
Another very elegant, but stinking, way of preparing pure copper sulphate is to precipitate the filtered but impure acid cuprous solution by means of sulphuretted hydrogen; this throws down the copper in the form of sulphide; if this be now washed and exposed to the joint action of air and water it becomes oxidised to a pure sulphate and can be crystallised from the solution after filtration. S. BOTTONE.

[67992.]—**Water Blower.**—To "AQUARIUS."—I should be very much obliged if you would send sketch of the one mentioned for very small work. The jobs I have in hand are such as can be done with blowpipe on a piece of charcoal. The height of fall of water is only about 15ft. The supply is regular enough, as it comes from a cistern. LUX.

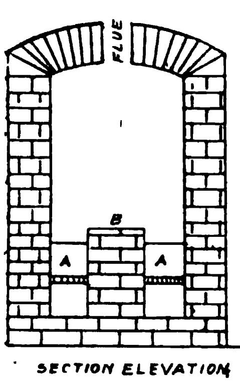
[68016.]—**Carbon.**—Will F. W. Mason, who replied on p. 59, give further particulars? I think my knowledge of chemistry will enable me to follow him. LEEDS.

[68048.]—**Self-Hardening Steel.**—The reply of "Gilbert" on page 77 is quite correct, making due allowance for the terseness of technical detail; but, as it may puzzle the querist and others, it may be as well to reproduce the brief directions issued by the makers. Mushet's special steel, then, should be worked in the same manner as ordinary lathe-tool steel, but it should not be forged when getting cold. It should be heated gradually but thoroughly (a soaking heat), and when forged and shaped it should be put aside to cool, not dipped in water. That is all. Do the forging and shaping during the time the steel retains a good heat, then leave it to cool by itself. A. M.

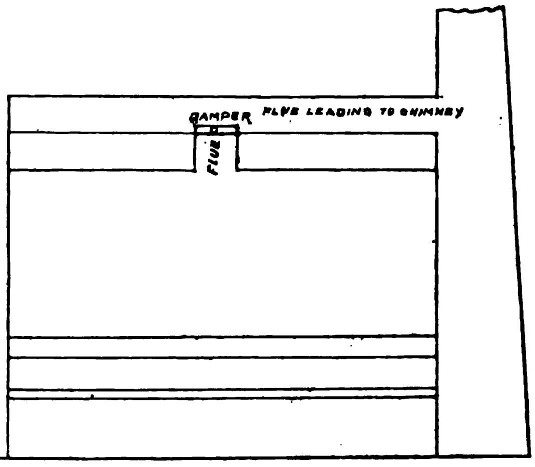
[68060.]—**Smelting Copper.**—If you have a fireplace something like sketch, you must put an iron plate on the top of first bar, at A in sketch, and close up the sides and front of chimney with bricks and mortar, as air-tight as possible, in the way shown at B, but leaving a small hole C, large enough to allow the crucible to be drawn in and out; the crucible must be made of clay or plumbago, &c.; if it was an iron one it would melt with the contents. The iron plate must fit loosely, leaving a space at the sides (D in sketch), to allow a draught to pass through the fire. When you use it light the fire with wood and coal, afterwards put coke on, and put in crucible with copper in, and put a slate or piece of sheet-iron in front, and it will melt. I smelted a lump of iron 4lb. weight, in a clay crucible in a quarter of an hour, with a furnace like this one. R. H. CRAVEN.



[68053.]—**Small Malleable Castings.**—I have sent sketch of annealing furnace: A being fire holes, B is brickwork for annealing boxes to stand on; the front is left until the furnace is full of boxes, then brick up front. The brands of iron that are used are H.C.M., White and Lawn. For small casting, use half of each; the material placed



SECTION ELEVATION OF FRONT



SIDE SECTIONEL ELEVATION.

with the casting is red hematite ore. For light casting you must mix 8 parts of old (or what has been used before) to one of new; if you have no old you must put some in a box with some pieces of H.C.M. iron, and burn in the furnace for 24 hours up to a good red heat; then that will be strông enough for the first time, then you will have to mix afterwards. Coal is the best fuel to use for annealing. The time that is taken for annealing depends on the thickness of the castings: if from a ⅛ to a ¼ about three days, if larger they will take longer. W. W. B.

[68062.]—**Wheel-Cutting.** — "Wheelwright" is not very clear in the expression of his wants. I presume he wants to use the change-wheels of his screw-cutting lathe, so that by one or more revolutions of the screw which moves the slide-rest along for screw-cutting, he can set a train which will move his mandrel just one tooth of the wheel he proposes to cut. This is a simple calculation; but whether he can use a set of wheels rising by five teeth from 20 to 120 is a question of fractions. Suppose he wishes to cut a wheel of 40 teeth, and that the slide-rest screw-wheel is to move round 40 times to one revolution of mandrel, then each revolution of slide-rest screw equals one tooth of the wheel to be cut, then the fraction is simply $\frac{40}{1}$. This must be expanded to suit the limit of change-wheels, such as $\frac{40}{1} = \frac{2}{1} \times \frac{4}{1} \times \frac{5}{1} = \frac{80}{40} \times \frac{120}{30} \times \frac{100}{20}$. The denominators are the drivers, the numerators are driven. These fractions may be placed in any order, and the denominators interchanged one with another if more convenient to their running together. As the above fractions stand, change-wheel 80 would be on mandrel and 20 on slide-rest screw. Thus, 20 runs into 100, 40 – 80, or mandrel 30 – 120. If the slide-rest screw moves thrice (or any other number) to one of the teeth of the 40 wheel, then the fraction is $\frac{80}{1} = \frac{4}{1} \times \frac{5}{1} \times \frac{4}{1} = \frac{120}{30} \times \frac{100}{20} \times \frac{80}{20}$. If the slide-rest screw only moves half-round to each tooth with the first arrangement of wheels, then the number cut will be 80. Fraction becomes $\frac{\frac{40}{1}}{\frac{1}{2}} = \frac{80}{1}$ as above. If the slide-rest screw is to be moved, say, $\frac{1}{10}$ round to each tooth, then the fraction becomes $\frac{40}{10} = \frac{5}{2} \times \frac{8}{5} = \frac{100}{40} \times \frac{80}{50}$, or $\frac{80}{20}$ where 80 is on mandrel, and these are toothed wheels which "Wheelwright" possesses.

Amateur.

[68065.] — **Enamelling Small Articles.** — "D. L." will find recipes for enamels for iron or copper in back numbers, both raw and for calcining and grinding. If these do not suit, he had better say what enamels he wants (that is, what colours), and if he has convenience for grinding.

Potter.

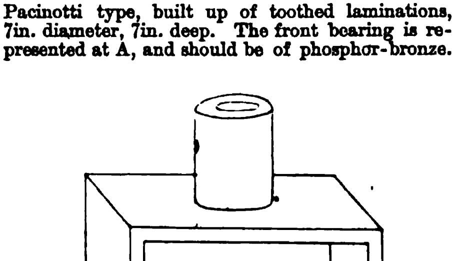
[68066.]—**Measuring Pendulums.**—The length of a pendulum is measured to the "centre of oscillation," which nearly coincides with the centre of the bob, supposing the bob to be either circular or cylindrical in shape. Strictly speaking, the centre of oscillation is a little above the centre of the bob, and differs slightly according to the proportions of the bob and rod of the pendulum; but the rule given is near enough to make the pendulum by, leaving the exact length to be found by timing and regulating afterwards. F. E. C.

[68068.]—**Boiler.**—Cast iron quite unsuitable for such a pressure.
Bristol. T. C.

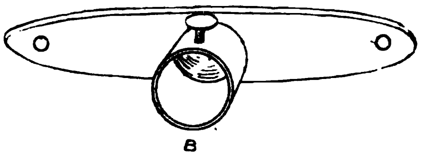
[68083.] — **Fletcher's Bath Heater.** — I am afraid there is no cure for this occasional down draught. I have had one fitted up, and although the maker's instructions in my case were faithfully carried out, it provokingly happens sometimes when I want a warm bath, perhaps particularly, the flue will not act properly; but the gas is blown down out of the holes at the bottom of the heater, and on attempting to re-light it there results an explosion of gas that blows out the light, and the bath for the time being has to be abandoned. I have inquired at the place where it was bought, and they said it was a difficulty they had not been able to surmount, but recommended me to some engineering company who made flues, &c., a special study; but I did not go, for I thought if their plan was worth trying the makers of the heater would adopt it. What I would recommend and what I am going to try, is to have a door like a soot-door inserted somewhere in the flue, and previous to lighting the gas in heater to insert in this door a gaslight or lamp, just to warm the air in the flue, and so induce an upward draught.

T. Heath.

[68081.]—**Dynamo, 40 to 50-Lighter.**—The distance from base of dynamo to centre of shaft is 16$\frac{1}{16}$in. The distance from base of dynamo to the centre of lower field magnet is 4½in. For the armature I should recommend an armature of the Pacinotti type, built up of toothed laminations, 7in. diameter, 7in. deep. The front bearing is represented at A, and should be of phosphor-bronze.

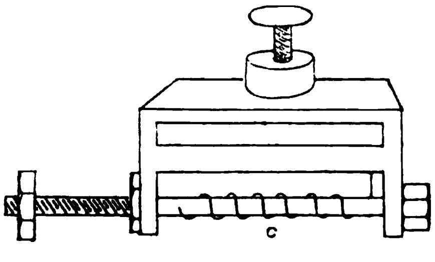


The rocker which supports the brush-holder, and which slips over the nozzle of the front bearing, is figured at B. This should be of brass, the side



B

holes being bushed with vulcanised-fibre washers. The brush-holders which fit into these holes in the rocker should be of the pattern shown at C, and



C

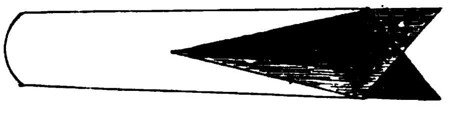
furnished with springs to give an equable pressure of the brushes on the commutator.

S. Bottone.

[68092.]—**Regulating Gas Burner.**—If the querist will write to Parkinson and Co., Penn-street, Belmont-row, Birmingham, he will get exactly what he requires. I have had several in use a long time. F.R.Met.Soc.

[68095.]—**Launch Engines.**—Have your h.p. cylinder 9in. diam., l.p. cyl. 16in. diam., and length of stroke 9in. The boiler of the marine return-tube type, 4ft. 9in. diam. and 6ft. long; propeller 48in. diam., and screw-shaft 3in. diam.
Longsight. J. Stokes.

[68097.]—**Boring Holes in Granite.**—You can make the holes in your granite with a jumper,



made of the best steel, as sketch, used with a hammer. Handy Man.

[68098.]—**Throttle-Valve.**—Make an ordinary wing throttle-valve. It consists simply of a short cylinder with a stuffing-box at side and a valve somewhat diagonally set inside, and which, by means of a lever on spindle projecting through stuffing-box, can be placed more or less in line with the bore.
Bristol. T. C.

[68110.]—**Painting Greenhouse Pipes.**—See answer No. 67096, page 442, last volume. Shellac dissolved in solution of borax as vehicle, lampblack as pigment. F. G. Lloyd.

[68116.]—**Dynamic.**—Be more explicit. Is the weight to slide 6ft. before falling or after, and how far is body to be allowed to fall—10ft. or 1,000ft.?
Bristol. T. C.

[68126.]—**Paris Exposition.**—What you want is a "hôtel meublée" or "maison meublée." Get the latest edition of "Baedeker's Guide to Paris," without which you will not get along comfortably, and you will find many such hôtels mentioned centrally situated in and about the Rue de Rivoli. In the Quartier Latin, on the opposite side of the river, they abound. No meals of any kind are served. Breakfast—coffee, chocolat, milk, eggs, omelets, &c.—can be had at a crèmerie; déjeûner and dîner at Duval's, or at the Exposition. The charge for a room, say, on the fourth or fifth floor (au quatrième ou au cinquième) is, in a good house, 2.50f. or 3f.; service or attendance, 50c. per night, and candles, one or more, at 50c. each; and the garçon, who makes the beds, fetches water, &c., expects 1f. or 2f. per week from each person. Never go where the proprietor of hotel, restaurant, café, or crèmerie knows anything about English, or ten to one you will be overcharged.

Pekin.

[68129.]—**Clay.**—This clay, with careful firing, should make good red bricks. I don't know where this particular clay lies; but there is plenty like it in the east and south midlands. Potter.

[68135.]—**Speculum Grinding.**—"Amateur" is creating in his mind a difficulty which need not exist. Let him work a speculum ever so truly spherical, he will always find the expanded image of an illuminated pinhole at the centre of curvature will be bounded more sharply without the focus than within it. This arises from some diffraction phenomena not well understood so far as I know, but it is the amount and character of this bright bounding ring outside, and the reverse of it within, which to a practised eye are a rough and ready index to the figure of the surface of the speculum. Personally, I never now use an eyepiece, as the shadow test reveals to me all I wish to know as regards the symmetry of a concave surface, and the zonal test supplies the only point in which the shadow-test fails. Now the ability to do this comes from practice combined with judgment, but if this bright ring be anything more, but not much more, than a narrow bright bounding line, then the figure is elliptical; to what extent, and whether regular in its gradations, the shadow-test does not disclose. This bright ring is always present with any elliptical figure, with the parabolic, and with any hyperbolic figure, at least so far as telescopic specula are concerned, and correspondingly, the expanded image within the focus a "tale unfolds" so much, that while a slight nebulosity (to quote the late Dr. Draper's book) shows with a moderately elliptical figure, this develops into flares and streamers with the hyperbola. The eyepiece "Amateur" uses is far too low to be of real service in detecting local errors. I cannot attempt to teach "Amateur" on paper the process of correcting his speculum, but must advise him to read up the "E.M." from Vols. XXIX. to XXXIX. to mount his speculum into a telescope. Buy an A 1 flat mirror, use a reliable eyepiece, and see what definition he gets on some small but well marked object on the moon. If "Amateur" wishes to become a professional maker he must make up his mind to work with undaunted and unremitting perseverance before he can expect to meet with high-class results, such as observers now justly have the right to expect and demand. Sir Howard Grubb has justly said that a good o.g. cannot be made on paper, and the same conditions apply to the making of an A 1 speculum. J. C. LINSCOTT.

[68137.]—**Bending Fire Bars.**—Have them made thinner in the bottom section and deeper, and distance-lugs cast on in the centre to keep them upright, then they will not get drunk.

JACK OF ALL TRADES.

[68137.]—**Bending of Fire Bars.**—I have seen bars bent in a Roby engine in a similar manner. I believe the cause is that the bars rest upon angle iron, with no space behind to let clinkers or other hard substances fall through. The consequence is, that when these substances get behind the bars when cold, there is no room for them to expand when hot. MAR.

[68137.]—**Bending of Fire Bars.**—There are several causes for fire-bars bending. 1. Quality of coal burnt; sulphur in coal deteriorates the bars. 2. Length of bars, which should not exceed 24 to 30in. 3. Bars expanding. 4. Bars being made too light in section. 5. Air spaces between bars being too small. With bars 40in. in length the width at top should be ¾in. full, ½in. at bottom, depth 4in., air-spaces ½in., bars wrought iron. MCGILL.

[68137.]—**Bending of Fire Bars.**—Perhaps it is in the fuel you are using—some heats the bars more than other kinds. Have you two distance pieces on each bar besides the ends? I was recently troubled in the same way with a Lancashire boiler, and thought that perhaps the clinkers got down and prevented the bars expanding endways, so adopted ship bars, or those with a notch at one end and a bevel at the other, for free expansion, and it has nearly cured this case. A little steam in ashpit would help your case.

Bristol. T. C.

[68139.]—**Chemical.**—(1) $Cu''Cy_2S_2$ and $Ba''Cy_2S_2$ $2H_2O$. (2) I have not leisure to reply to this query. Get "Destructive Distillation," by E. J. Mills (Van Voorst). SM.

[68140.]—**Bicycle Chain.**—To clean, boil it in soda and water, put on the machine, and re-oil. Use good cycle oil. EX.

[68145.]—**Washing French Merino.**—If any very greasy patches, take worst out with hot iron between two blotting-papers or more, or rag; then use ox-gall and soft water or urine, well rinse, and dress with weak linseed mucilage; or you may clean with carbonate of ammonia, or ammonia fortis—1oz. to two quarts of soft water.

JACK OF ALL TRADES.

[68146.]—**Marine Steam-Engine.**—"Esca" will find each of his queries fully answered in Seaton's "Manual of Marine Engineering," published at 18s. 6d. MCGILL.

[68146.]—**Steam-Engine.**—As regards proportions, you had better buy Molesworth's "Pocket-book," published at 6s., which may suit you; also Bourne's "Handbook of the Steam-Engine," at same price.

Bristol. T. C.

[68147.]—**Photo. Enlarging Apparatus.**—"Indian" will note in the current number of the "E.M." that the new enlarging apparatus made by Watson and Sons is so constructed that the condenser may be put immediately at the back of the plate, or farther away from it if a smaller negative is to be enlarged from. As to illumination, he could get nothing better than a 40 or 50 candle-power Argand paraffin lamp. The burners alone (No. 3) cost in France or Germany 1s. 8d., and no doubt they can be obtained in India for a half more (I got one in Africa for half a crown), and a tinsmith will make an oil receptacle for his lantern for 1s.

Plymouth. B.Sc.

[68150.]—**Chemical.**—You do not say from what you wish to separate these acids. The distinguishing tests are as follows:—Formic acid, $HCHO_2$, reduces salts of Ag, Hg, Au, and Pt, is not charred by heat, but like oxalic acid, splits up into an oxide of carbon and water. Formic acid, however, splits up into the monoxide of carbon and water, whilst oxalic acid splits up into carbon dioxide and water. Formic acid is solid below 32°. Formic acid may be obtained from oxalic acid; thus:—

$$H_2C_2O_4 = HCHO_2 + CO_2.$$

The best test for an acetate is its odour; if you heat an acetate with H_2SO_4, fumes of acetic acid are given off. This is very characteristic. Again, to a neutral solution of an acetate, add a neutral solution of perchloride of iron. A deep red coloration occurs: this is acetate of iron—$Fe_2 6C_2H_3O_2$. Pure oxalic acid is entirely dissipated by heat; thus:—

$$H_2C_2O_4 = CO + CO_2 + H_2O.$$

A solution of an oxalate gives a precipitate with a soluble salt of cerium, consisting of CeC_2O_4. Chloride of barium gives a precipitate of $Ba_2C_2O_4$ soluble in HCl. Tartrates when heated give off CO_2 and C is set free; the odour resembles that of burnt sugar. A neutral solution of a tartrate gives a white prec. with $AgNO_3$, of $Ag_2C_4H_4O_6$ blackened on boiling, owing to the reduction of the salt. The distinguishing test between a tartrate and citrate is, tartrate of calcium is soluble in KHO (cold); citrate of calcium is not soluble. Salicylic acid may be obtained naturally or artificially, the natural salicylic acid being obtained from Betula lenta or Gaultheria procumbens. Artificially it may be obtained by combining the elements of HC_6H_5O with CO_2. The difference of the natural and artificially prepared is markedly observed, however, when crystals are subjected to microscopical examination. Chemically these are the same—$HC_7H_5O_3$—but therapeutically physicians state they cannot get the same results with the artificial as with the natural acid. Both acids strike a plum-violet colour in aqueous solution with perchloride of iron. Salicin is obtained from willow bark. This, by boiling with dilute H_2SO_4, is converted into saligenin and glucose. Hydride of salycyl, $C_7H_5O_2H$ is at present much used in perfumery to imitate the odour of heliotrope.

FREDERICK DAVIS.

[68151.]—**G.N. Engines.**—My own experience of the suburban engines hardly coincides with that of the querist, and probably there is really no difference of any value in the particulars he mentions, since all suburban traffic engines are the result of a gradual approach to the most useful design, and the G.N. tanks are far more like the usual form than those of the N.L. It has always appeared to me that the G.N. engines are quite as rapid starters as those of the N.L. on portions of the G.N.R. where both work trains at the same speeds—as between Finsbury Park and Enfield, High Barnet, &c.; but very likely T. Robinson has omitted to note that the G.N. trains are always heavier than the N.L. The question of domes has been often discussed in these columns; shortly, their chief disadvantage is weakening the boiler shell, and their chief advantage is that they avoid priming. I have no full information as to part 2 of his query.

Uttoxeter. N. S. R.

[68153.]—**Rhymney and Brecon and Merthyr Railways.**—Both lines have rolling stock of their own; but the L. and N.W. and G.W. have extensive running powers, and work parts of their line jointly with them.

Uttoxeter. N. S. R.

[68154.]—**Soda Crystals.**—Do you mean commercial soda carbonate? That is done by titration with a standard acid, and by pptn. of caustic alkali with barium chloride. It is useless for you to attempt this if you have not studied chemical analysis. SM.

[68154.]—**Testing Strength of Soda Crystals.**—Weigh out about 10 grains of the sample into a weighed platinum crucible or porcelain dish, and heat for twenty or thirty minutes over a flame; place the crucible or dish in a desiccator, and weigh when cold. The loss of weight gives the amount of moisture or water contained in the sample. Transfer the weighed substance to a beaker, wash out the crucible, and dissolve it in a small quantity of water; filter, if necessary, into a ½-litre flask; wash the filter thoroughly, and dilute to the containing-mark, and shake. Take out 50cc. of the solution, corresponding to 1grm. of substance; pour the liquid into a flask, and add standard sulphuric acid, and boil the solution for some time until the carbonic acid is expelled, as this gas gives an acid reaction if dissolved in the solution; add a measure of litmus solution, and finish the titration until a perfectly neutral solution has been obtained. It is then a very simple matter to calculate the alkalinity from the amount of H_2SO_4 taken; if preferred, oxalic acid may be used instead of sulphuric.

F. KNOTT, Analytical Chemist.

Woolwich Arsenal.

[68155.]—**Cycle Chain Wheels.**—To make detachable, fit a steel feather on to the spindle, drill and tap a hole in the end of shaft, put on a washer, and screw up tight with ⅜ screw. EX.

[68156.]—**Lantern Transparencies.**—The proportions given for your developer are quite right, and should give nice rich brown tones; but a red cast points to excessive over-exposure, and a bluish tinge may depend on the accidental presence of hyposulphite in the developer. You will find that pictures that are under-exposed rather than over-exposed come out with the high lights very black, while the more you proceed towards over-exposure the thinner and redder the high lights become. Excess of acid makes the picture hard.

S. BOTTONE.

[68157.]—**Cup and Ball Microphone.** — I hardly know how to advise, as you say you have tried all recommendations; but still I feel that the fault must lie either in loose contacts of the carbons or else excessive battery power. You might make a rough, gridiron-shaped carbon transmitter, and see whether you succeed better with that form.

S. BOTTONE.

[68158.]—**Hot-Water Fitting.**—Querist would be altogether wrong. He must run a separate supply. R. BOTTING.

[68159.]—**The Maoris: their Medicines.**—The shrub is called "Koromiko"; it is a Veronica. The natives, and settlers also, chew the young leaves, or drink a decoction of them, to remedy diarrhœa and dysentry. I do not know whether eating it in health would cause diarrhœa. I think it is what Taylor refers to as "Veronica salicifolia, fam. Scrophulariaceæ," and says it is "disappearing before the horse"; but there is plenty of it left. It is looked on as a sign of good land. There are several varieties. The other (injurious) shrub is "Tupakihi," or "Tutu" (pronounced "Toot"). It is poisonous to cattle, sheep, and human beings—causes delirium and vertigo. Cattle and sheep rush about and stagger. A child I knew ate some of the berries that grew in finger-shaped bunches on thick stalks. In its illness, from which it recovered, it attempted to gather imaginary flowers on the counterpane of the bed. The berries yield a rich, red juice at the slightest touch when ripe, and the Maoris drink the juice without injury, but they carefully strain it through cloth, for it is the seeds that cause the injury. The leaf is dark, glossy green. Taylor says (in "Te Ika a Mani") it belongs to "Fam. Coriariaceæ," and is "Coriaria sarmentosa," and that the Maoris boil the juice with a kind of seaweed like carrigeen moss, which they eat as a jelly. T. F. S. T.

[68162.]—**Stereotype.** — Thoroughly dry your mould, and do not have the metal too hot. In casting a small silver article once, I found I had to pour it several times, until the plaster was actually burnt dry inside; then the metal filled the corners.

T. F. S. T.

[68162.]—**Stereotype.**—A friend has shown me some very good casts of medals in type-metal taken from plaster moulds. The mould is first heated to 200° and then immersed completely in the melted type-metal, moved about so as to start any air-bubbles, and then lifted out full of type-metal. My experience leads me to think that you will succeed by heating the plaster mould, saturate it with wax (to prevent any air-bubbles from coming out of the mould), heat the mould, and pour in the type-metal. W. H. TUNLEY.

[68163.]—**Small Power Engine.**—Such a maker as Hindley supplies exactly what you want, mounted on wheels or otherwise. Have cylinder, 2½in. by 4in.; about, I should say, £25, with boiler.

Bristol. T. C.

[68166.] — **Wimshurst Machine.** — In all probability your varnish is at fault. Perhaps you have a bad sample of shellac, or are using bleached lac, or your spirits of wine has been watered. Use methylated spirits. If you add 1 or 2 drops of castor-oil to each pint of varnish you will much diminish its tendency to split. If the glass is slightly warmed before applying the varnish, and then again directly after, the varnish, if good, will dry like a glass. It is well to varnish the plates before applying the sectors, and to stick these latter down by means of the same varnish applied to the tinfoil. If this plan be followed the plates can be varnished without a brush by flooding, as a photographer coats his plates. In this case a good varnish makes an absolutely even and glass-like coating if dried before the fire. S. BOTTONE.

[68166.]—**Wimshurst Machine.**—The following is the best method for varnishing the glass discs:—First mix your varnish (shellac and methylated spirits) in a bottle having a large neck; the brush ought to be more than 1in. in diameter, and its handle should be fixed in the bung of the bottle; this arrangement keeps the varnish and the brush free from dust. Next make up some simple sort of turn-table, on which you place the disc while it is being varnished. The next step is to wash the discs and dry them; then warm each disc to about the temperature of blood heat, place one on the turn-table, and with the left-hand set it in motion. Take the brush full of varnish from the bottle with the right-hand and bring it on to the disc a little from the edge; move the brush slowly to the edge and then back, so as to finish and to lift the brush off at the centre; let the disc remain a few minutes for the varnish to set, and then finish drying in a warm place. It will then be seen the coating is so even as to be almost unnoticed. If the brush be lifted up from the disc while the varnishing is being done, the surface will be covered with air-bubbles, and look unsightly. Done in this way the varnish lasts for years. J. W.

[68167.]—**Pyrotechny.**—Let your rocket sticks be about 70 diameters of the bore of the rocket case. The rocket and stick should poise about one diameter of the rocket case from bottom or choked end of rocket when tied on to stick. The weight of stick should not exceed ⅝ths weight of the filled rocket-case without the head. AMATEUR.

[68167.]—**Pyrotechny.**—The vital part of the question is the weight, not the length, of the stick. Its function is to act as a counterpoise, to keep the rocket as nearly as possible vertical. When fastened to the rocket, the stick should be of such a weight that the whole thing should counterbalance on the finger when about 2in. from the mouth. Of course, the lighter the wood the longer the stick can be made, and the better guidance will the rocket have on being discharged. American pine is the best. The size for ¼lb. rockets is ⅝in. by ½in. by 4ft. W. PERREN MAYCOCK.

[68168.] — **Losing Watches.**—*Losing.*— Turn the collet (to which the hairspring is attached) very slightly, in the same direction as that to which the loose end of spring points, then pin to the stud so that the watch will be in beat. *Gaining.*—Refer to answer (68128) in last week's issue; No. 2 or 3 will suit your case. Of course, the fault may not rest with the hairspring—one cannot say without examining the movement. If "Puzzled" will advertise his address, I may be able to help him further. CHRONOMETER.

[68169.]—**B-Flat Clarionets.**—The best advice to a learner is "employ a master if possible," as in this case "an ounce of example is worth a pound of precepts," and there is at present no good instruction book published giving details of reeds and what a beginner requires. The C clarionet is best for a beginner, and for every purpose except the highest class of solo and orchestral music. The tempering and adjustment of reeds depend on the player and the mouthpiece, and cannot be learned except from a player of some experience. All modern clarionet players place the reed on the lower lip, as it is easier to manage, and the instrument is easier to hold without fatigue. Further particulars with pleasure. VULCANITE.

[68170.]—**Clarionet or Oboe.**—The oboe is rather easier to learn than the clarionet, but not so useful. The clarionet is the best for house purposes, and one does not tire so soon of its tone; again, it is more healthy to play, as the oboe takes too little wind for easy breathing. Some clarionets have 24 keys and more, but 13 is enough for all purposes, and the Albert model, with patent C sharp, is the best. Low-priced instruments are generally defective or out of tune. Good tone depends on good mechanism and other details. Makers generally select the good ones and sell as good; the defective are sold cheaper, and sometimes at what they will bring. Price in this matter is generally a fair test of quality; but an expert ought to purchase for a beginner, and the expense should not be so great if a second-hand instrument is well choosen. VULCANITE.

[68171.] — **Brown Tiles.** — Try raw umber 4 parts and red ochre 1 part; a small quantity of red lead and borax, I think, you will find an acquisition in fixing of it, about 1 in 20. Try various proportions of ochre and umber until you get the right tint. May be used with a brush.

JACK OF ALL TRADES.

[68171.]—**Brown Tiles.**—Mix 10lb. of the red clay with water, pass it through a fine sieve; to this slip add 1lb. of oxide of manganese, well mix, and dip the tiles as soon as they can be handled from the moulder and before pressing. Try a small lot first, and vary the manganese until you have got the desired tint. POTTER.

[68172.]—**Dynamo.**—To MR. BOTTONE.—Presuming you mean twelve 16c.p. lamps of 48 volts, I think I may safely say you would not get it from a machine of the size and pattern given. If you made a machine similar to that figured and described by me in the "E.M." for Feb. 22 of this year, in reply to query 67760, you would do all you require without any sparking or heating; of course, the size need not be so large. If the armature were a laminated one of 6in. diameter, 3in. deep, with 16 teeth, you could get on it 6lb. No. 14 Browne and Sharpe's gauge, d.c.c. wire, and this would give you easily 55 volts at 1,800 to 2,000 revs. per minute. The field-magnets might be 9in. long, 3in. in diameter, and for a shunt machine should be wound with about 30lb. of No. 21 B. and S. d.c.c. No other resistance but that of the wire must be inserted. Wind the magnets as you like, but remember in coupling these wires together the farther extremities must be so connected as to form a letter ∽. S. BOTTONE.

[68174.]—**To Mr. Bottone.**—Please see my reply to query 68076, which reply you will find under the heading "Unidirection Current Machine" in the "E. M." for March 22. The machine will be of no use for plating, as No. 30 wire is too fine to carry enough current. For plating work the armature should be wound with No. 16 or 14. But you had much better made a dynamo for this purpose.

S. BOTTONE.

[68175.]—**Rubber-faced Type.**—The rubber should be mortised into the metal. SM.

[68175.]—**Fastening Stereo-Metal to Rubber.**—Oxidise the surface before putting on the rubber, then soften the rubber by the vapour of bisulphide of carbon; then apply your solution, and put your rubber in position with pressure, and heat to 240 or 260°. JACK OF ALL TRADES.

[68181.]—**Mechanics.**—Let the length of the string be $2a$, the mass $2ma$, and therefore the weight $2mag$, when g is the acceleration of gravity. In any position, suppose the longer lap of the string to be x, so that the shorter is $2a - x$. The length on one side therefore exceeds the length on the other side by $2(x - a)$, and the weight of this, or $2mg(x - a)$, is the force-producing motion. The mass moved is $2ma$. Therefore the acceleration is $\frac{x-a}{a} . g$. If in this position s be the distance of any point, P, in the longer lap of the string below the fixed point, and T the tension at that point, the mass below P is urged downwards by its own weight and upwards by T, or the downward force upon it is $mg(x - s) - T$. But the mass is $m(x - s)$, and the acceleration, as we have seen, $\frac{x-a}{a} . g$. Therefore $mg(x-s) - T = m(x-s) . \frac{x-a}{a} . g$; whence—

$$T = \frac{m(2a - x)}{a} (x - s) g.$$

To find the tension at the middle point when the laps are equal, put $x = a$, $s = o$. This gives, tension $= mag =$ half the weight of the string. If the chain is just leaving the smooth point, $x = 2a$, and the tension is everywhere zero, as it ought to be, for the string is falling freely. LATRIS.

[68181.]—**Mechanics.**—Let L be the whole length of the chain, and d the difference of the lengths of the two parts hanging down. Then the acceleration is evidently $\frac{d}{L} g$. The tension at the distance a from the end of the longer division of the chain is $\frac{a(L - d)}{L} mg$; m being mass of unit length of chain, and g gravity. DUBLINIENSIS.

[68181.]—**Mechanics.**—Let l denote the length of the chain in feet, m the mass, and w the weight of each foot; and suppose that, in its initial position, one end of the chain is a feet lower than the other. Let P be a point in the chain at a height h above one of the ends, and x the number of feet P has moved through since the beginning of motion. Also, let f denote the accelerating force on the chain, and t the tension at the point P. Then it can readily be shown that—

$$f = \frac{2x + a}{l} . g \quad \dots\dots\dots\dots\dots\dots (a)$$

Hence,

$$t = mh . \frac{2x + a}{l} . g \pm wh,$$

$$. = wh \left(\frac{2x + a}{l} \pm 1\right) \quad \dots\dots\dots\dots (b)$$

The quantity ± 1 is positive if P be on the ascending, and negative if P be on the descending portion of the chain. When P is the middle point, and the hanging ends are of equal length, $a = 0$, $h = \frac{1}{2} l$; and, since there can have been no motion, $x = 0$. In this case, therefore, from the formula (b), we find—

$$t = \pm \tfrac{1}{2} wl \quad \dots\dots\dots\dots\dots\dots (c).$$

At the instant the chain is leaving the smooth point, $x = \frac{1}{2}(l - a)$, which value substituted in (b), gives us—

$$t = 0 \quad \dots\dots\dots\dots\dots\dots\dots\dots (d).$$

Charing. J. R. C.

[68183.]—**Compressed Air.** — The heat you "cooled" from the air when it was compressed has to be replaced by a similar amount of heat when the air expands; hence the lowering of temperature in the surroundings where the air leaves the engine.

T. F. S. T.

[68183.]—**Compressed Air.**—When air is compressed it becomes heated; when it expands it becomes cooled, because a quantity of sensible heat disappears when the gas becomes increased to a larger volume. The air expands as it leaves the engine, and consequently cools the external air. It is on this principle that freezing chambers are now constructed. SM.

[68183.]—**Compressed Air.**—This is exactly the principle on which all refrigerators are made—viz., compress air and remove the heat, then allow it to expand, and then it takes from the surroundings the heat removed, and consequently the surroundings are cooled—even to freezing point.

Bristol. T. C.

[68183.]—**Compressed Air.**—The air when not compressed contains a certain amount of heat, and when it is compressed all this heat is brought together, and the heat is four times greater; then you cool it and bring it as near back as possible to its ordinary temperature again; but when it is released from compression what heat it does contain is divided amongst four atmospheres, which oftener than not brings it below freezing-point. Some freezing machines are made on this principle.

R. H. CRAVEN.

[68184.]—**Cleaning Furniture.**—If the polish really comes off with soap and water, leaving the wood bare, the only way will be to have the furniture repolished by a French polisher. Very likely some polish has been used containing spirit, and unless this is applied with care it injures the French polish. The safest polishes to keep furniture in order are those creamy-white compounds, or else beeswax and turpentine. W. H. TUNLEY.

[68184.]—**Furniture.**—If French-polished, use nothing but a few drops of linseed oil and vinegar; this must be well cleaned off, and all dust removed before using. JACK OF ALL TRADES.

[68184.] — **Furniture.** — Rub your French-polished furniture with a soft flannel dipped in the best crystal paraffin lamp oil; this will take off all dirt and extraneous matter. Finish off with silver or tissue paper, using plenty of it; this gives a fine polish, and clears off the oil. This wrinkle I learnt from back numbers of the "E.M." The same is first-rate for any varnished work, even wall paper, also for cleaning windows. F. G. LL.

[68185.] — **Bacon.** — Whether bacon "melts away" in frying or no depends upon the quality of the meat. That again depends largely upon the feeding of the pig. As a rule, in proportion as the animal has been made fat quickly, so the meat loses its fat quickly in cooking. If you feed your own pigs, give a good variety of food, and use maize-meal only in small quantities. F.

[68186.]—**To Mr. Bottone.**—I should use Pacinotti rings, 1/12 thick, 7in. outside diameter from tooth to tooth, with 16 teeth. Depth of wire channels ¼in., internal diameter 5¼in. wound with three layers of No. 12, about 6lb. Now, calculating the running resistance of 6lb. of No. 12 wire at ¾ its actual resistance, we get 0·5115 of an ohm for the armature; 54 yards should give, at an angular velocity of 1,250ft. per minute, 54 volts; but allowing for amateur slack winding, say, 30 volts, the 18lb. of No. 10 wire coupled in parallels of 3lb. each, becomes 0·0513 of an ohm. Let us call resistance of lamp 0·5 ohm. Total resistance 0·602 ohm. The ampères are therefore 30 volts divided by 0·602 ohms, or 49·9 ampères very nearly. S. BOTTONE.

[68188.]—**Kepler's Second Law.**—To calculate accurately the angle required by "Finsbury" would require more labour than he himself would be likely to bestow on the matter; but it is easy to see that it is about 9° 52′. If the eccentricity of the orbit, instead of being very large, had been very small, as in the case of the larger plants, "Finsbury" could find the angle approximately from the fact that in such orbits the angular motion of the planet is nearly uniform about the empty focus.

DUBLINIENSIS.

[68188.]—**Kepler's Second Law.**—Let A be the perihelion, S the sun, P Q the positions of the planet at the ends of the first and second units of time after starting from A; then, by Kepler's law, the area A S Q is double the area A S P. Being given that, the areas are 2 and 1, and the angle A S P is 10°, we are asked to find the angle A S Q. This problem seems simple; but it is, I fear, incapable of an exact solution, and a reasonably close approximation could be obtained only at the cost of great labour. The method of solution might be as follows:—Expand the expression for half the square of the radius vector of the ellipse in a series, proceeding by powers of the eccentricity, and integrate each term with regard to θ, the true anomaly, adding no constant, that the integral may vanish with θ. The number of terms to be taken will depend upon the degree of approximation desired. In our case the convergence will be very slow, for the eccentricity is large—no less than 0·866. By putting $\frac{\pi}{1B}$ for θ in the expression thus obtained, we get the area as A S P. Call it A. The area of A S Q will be 2 A, as we have seen. The corresponding angle must be found by trial and error. We can see that it will be less than 20°; try 18°, or $\frac{\pi}{10}$. Put $\frac{\pi}{10}$ for θ in the series, and a value will be obtained which will not be far from 2 A. Let the error be a; then the error committed by assuming 18° as the value of A S Q will be got approximately by dividing a by $\frac{1}{2} r^2$, where r is the value of A S Q, corresponding to 18°. This process can be repeated again and again until the desired degree of accuracy is reached. The science of physical astronomy could scarcely have been created, were the true planetary eccentricities as great as 0·866. LATRIS.

[68188.] — **Kepler's Second Law.** — As "Kepler's Problem" is rather a favourite of mine, I will reply to this query, although I am not an astronomer. I had occasion to refer to this subject some time ago—see the "E. M." for Jan. 18th of this year, p. 425, where there is an exact copy of the diagram taken from Tait and Steele's "Dynamics of a Particle" (Macmillan and Co.) The letters and symbols are also taken from that work. In the present case the eccentricity of the ellipse is so great, that we cannot make use of Lagrange's theorem as used by Tait and Steele, so the problem must be solved in another way. If we call the eccentricity e, then $= \frac{\sqrt{a^2 - b^2}}{a}$; in this case a is twice b, so the eccentricity is $\frac{\sqrt{3}}{2}$, or about ·866. As Lagrange's theorem is only workable when, say, the 4th or 5th powers of e are too small to affect the result, we see that it cannot be used in this case. The equations to be used are—

$$\text{sin. } u = \sqrt{1 - e^2} \cdot \frac{\text{sin. } \theta}{1 + e \cos. \theta} \ldots\ldots\ldots (1)$$

$$nt = u - e \text{ sin. } u \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\text{tan. } \frac{\theta}{2} = \sqrt{\left(\frac{1 + e}{1 - e}\right)} \text{ tan. } \frac{u}{2} \ldots\ldots\ldots (3)$$

u is an auxiliary angle (see diagram referred to above), which was introduced in 1837 to expedite the work of solution. nt is the circular measure of an angle (or arc) for any value of t, on the supposition that the radius vector moves round at a uniform rate, whereas θ represents the varying angle made by the radius vector and axis major, as the planet passes along its orbit. Both radii vectores are supposed to make a complete revolution in the same time, and of course both are supposed to work round the same centre, which is the focus of the ellipse (the sun in the case of a planet or comet). We must now find the value of the constant n. We are given $\theta = 10°$, when $t = 1$ unit (say 1 day, as the unit may be anything). Substitute this in equation (1), and put $e = ·866$, and it will be found that $u = 2° 40'$. Substitute this value of u in equation (2), and put $t = 1$, thus we get $n = ·0465 - ·866 \times ·0465 = ·00623$; putting this value of n in equation (2), and putting $t = 2$, we get $·01246 = u - e \text{ sin. } u$, and as u is a small angle, we may for a first approximation put $\text{sin. } u = u$, from which by a simple equation we get $u = 5° 21'$. In order to get a close approximation, equation (2) may be transposed, and the logs. taken, thus—

$$\log. (u - n\,t) = \log. e + \log. \text{sin. } u,$$

and by trial it will be found that $u = 5° 19'$; substitute this in equation (3), and with the aid of logarithms it will be found that $\theta = 19° 39'$ nearly. If from this we deduct the 10° passed over in the first day, we find that the radius vector passes over 9° 39' in the second day. The above does not pretend to be correct to seconds of arc; but it is near enough to show the working. It is necessary to have tables for converting degrees and minutes into circular measure and vice versâ.

Bath. M.I.C.E.

[68189.] — **Pneumatics.** — As the pressure is lowered to half, it is evident half the contents have been removed in ten strokes, and in five strokes the question may be taken to assume it has removed ¼; and, therefore, pressure be ¾ of 30 = 22½in.

Bristol. T. C.

[68189.]—**Pneumatics.**—When an air-pump is worked, the density of the air in the receiver, and therefore the height of the gauge, diminishes theoretically in geometric progression; the ratio being the capacity of the receiver divided by the sum of the capacities of receiver and barrel. It follows that the height after ten strokes bears to the original height a ratio which is the square of the same ratio after five strokes. In our case the gauge fell from 30in. to 15in., or the ratio after ten strokes is one-half. Hence, after five strokes, the ratio will be $1 \div \sqrt{2} = 0·707$ nearly; and the height after five strokes will be $30 \times 0·707$in., or 21·21in. The fall therefore is 8·79in. Latris.

[68189.]—**Pneumatics.**—

Let P = original pressure of air in receiver
Pn = pressure after n strokes
x = capacity of receiver
y = capacity of cylinder.

It may easily be proved that—

$$Pn = P\left(\frac{x}{x + y}\right)^n$$

After ten strokes we shall have—

$$P_{10} = P\left(\frac{x}{x + y}\right)^{10}, \text{ or } \frac{P_{10}}{P} = \left(\frac{x}{x + y}\right)^{10}$$

Also after five strokes—

$$P_5 = P\left(\frac{x}{x + y}\right)^5, \text{ or } \frac{P^5}{P} = \left(\frac{x}{x + y}\right)^5$$

Squaring the latter equation we get—

$$\frac{P_5^2}{P^2} = \left(\frac{x}{x + y}\right)^{10}, \therefore \frac{P_5^2}{P^2} = \frac{P_{10}}{P}$$

Substituting the given values for P and P_{10} in this equation, it becomes—

$$\frac{P_5^2}{30^2} = \frac{15}{30} \therefore P_5^2 = \frac{900}{2} \text{ and } P_5 = 21·218.$$

F. E. C.

[68190.]—**Cement Plastering.**—For yellow, use a wash of sulphate of iron and pale or middle chrome—i.e., chromate of lead; for red, use red ochre with the sulphate, or the ochre alone, or mixed with lime-wash. This can afterwards be gone over with a silicate of soda wash. As to ceiling, you do not say what defects exist. Blood mixed with the plaster improves it for some purpose; cow-dung for others. Hemp, grass, jute, hair, and plaster of Paris, clay, sand, ashes, &c., all have their purpose. Jack of All Trades.

[68190.]—**Cement Plastering.**—"Robinson's patent cement," now in immense demand, appears to me to be calcined gypsum. I have often visited the principal quarry on the high banks of the Eden, where an extensive manufactory is in full work; by blasting, great blocks are extracted, then crushed and burnt. The whole frontage of my house was altered and rebuilt not long ago, using this cement; a fine, snow-white powder, resembling plaster of Paris, which hardens very rapidly when mixed with water, and becomes smooth and strong as stone. Light-houses are using it for this reason: it can be coloured to taste with any suitable substance, vegetable or mineral. There are agents in Carlisle for this product.—*Vide Chambers' Journal*, 1886.

Eos.

[68191.]—**Wounds.**—"L.H." asks for a detailed description and sketch of the manner in which some French schoolboys pierce their breasts, as stated by "Birmingham" in the "E. M." of Oct. 12, 1888. Apart from the stupidity of this utterly useless operation, I must warn "L. H." of its great danger. It is well known by all surgeons that cancer has a strong affinity for cicatrices, and a cicatrice in the breast would be a dangerous possession for anyone, whether or not they had a cancerous diathesis. I am sure the surgeon of the "Lycée, near Toulouse," was quite unaware of this disgusting boys' trick, or it would have received well-merited punishment.

Plymouth. B.Sc.

[68193.] — **Punkhas.** — I think "MacJute" would find one of the small hot-air engines made by the Britannia Co. suitable for working punkhas. They work very easily with hardly any attention, and only require a lamp to heat them, and an occasional bucket of cold water to replace that which has become warmed. T. F. J. T.

[68194.]—**Ice.**—"Mack Jute" will notice that query 68183 exactly answers his requirements. See my reply thereto.

Bristol. T. C.

[68194.]—**Ice.**—The smallest-sized compressing engines for freezing chambers (as made by Hall, of Dartford), require 16H.P. I should advise you to write to him. Sm.

[68195.]—**Largest Locomotive.**—This query is rather vague; but I suppose "J. M. C." will accept weight as an indication of size. According to an article by Forney, in *Scribner's Magazine* (1888), the "Decapod freight" (ten-coupled with leading "pony" truck) weigh, roadworthy and without tender, about 67 tons. The L. and S.W. and L.T. and S. radial and bogie tanks (ten wheels) are not so heavy as above; but in the States there are large tanks with six-coupled steam bogie, and six-wheeled trailing bogie under bunker which may exceed in weight the decapods of the Northern Pacific R.R. Apropos of American railways, it would be interesting to have confirmed a statement in a paragraph quoted from the *Railroad Gazette* in our current number—viz., that "a passenger train has been averaging 58 miles per hour for a run of three hours, including several stops." Details would be of great interest. Is the train drawn by a "decapod"?

Uttoxeter. N. S. R.

[68197.]—**Chinese Oiled Silk.**—Use finely-ground and washed yellow ochre, with precipitated chalk for cream, and flake white with precipitated chalk and a little ultramarine blue; or, better, good lampblack. These must be ground in oil—ochre one, chalk three—or according to tint required. The same proportions will do for white. Be careful of the black, as very little is required to kill the enemy yellow. Jack of All Trades.

[68198.]—**Lap of Valve.**—If the lap is broken off it will give the engine more lead, so it will take steam earlier at one end than the other, which you may readily find out by putting valve of other engine in central position and out of gear, and then putting crank at little before dead centre, and find if both ends are alike. But how often do you get "lap broken off"?

Bristol. T. C.

[68198.]—**Lap of Valve.**—This will depend on how much might be broken off; possibly you would not find as much of it when only ⅛in. as you would ¼in. Providing "Driver" was suspicious on coming to a standstill, and knowing the position of the lever in the rack when the edges of the valves are in line with the edges of the ports, he will find if steam, more than usual, comes through the chimney. Very seldom that the pistons hold so tight. 1, mean for the regulator to be opened at same time; 2, been standing—you may tell by her sluggish movements on starting something was wrong in the cylinder, because one would be absorbing the power the other was giving out by the steam on opposite directions on the pistons; 3, and the exhaust to it may easily be detected; 4, on finding which side it was, which you may do by placing your hand on each cross-head for a stroke or two by the thumping which will take place every other stroke. You cannot do everything by moving the gland; take down that side of motions.

Jas. A.

[68200.]—**Coating Accumulators.** — This is what I always use, and find excellent: red lead 10lb., sulphuric acid sp.g. 1·840 14oz. by weight, nitric acid 2oz. by weight. Mix all together in a glazed earthen vessel out of doors, and take care not to breathe the vapours. If too thin, add a little more red lead; if too thin to spread easily and adhere, add more sulphuric acid. Remember this, it draws moisture from the atmosphere, and becomes much thinner than at first. Score, scratch, punch holes, or otherwise roughen the surface of your lead plates. Besmear their surface well with this composition, using a wooden spatula to spread it on with. Rear up the plates to dry in a warm dry place.

S. Bottone.

[68201.]—**Bevel Wheels.**—You cannot do what you require properly without having two new wheels, the bevels of each of which if produced would meet at the point of intersection of both centre lines of shafts. A is really the largest and smallest to run with B.

Bristol. T. C.

[68201.]—**Bevel Wheels.**—If you will read the article on "Gearing" in Vol. XLVI. p. 499, you will see the reason why it is not possible to do what you require correctly. You may make a slight departure from the correct bevel by making C a bastard wheel; but the gear cannot be accurate. The amount of the alteration in size will depend entirely on the deviation from accuracy which you will tolerate. You may, perhaps, make eight or ten teeth difference; but the proper course is to make a *pair* of new bevels. J. H.

[68202.]—**Motor.**—To Mr. Bottone.—It is just possible, if the slits are very wide, or if the magnet poles touch each other, or if the battery is too weak for the motor to stop in the position indicated. A design for a self-starting reversible motor will shortly be given. S. Bottone.

[68203.]—**Motors.**—To Mr. Bottone.—If required to run any length of time, say, half an hour, No. 9 would be better, as it would not heat. The commutator must not be of solid brass. On the contrary, it must be in the form of a stout brass ring, screwed on to a solid wooden cylinder by lateral screws, which must on no account reach near the spindle, which ring must then be divided by fine saw-cuts, at two equi-distant points in its diameter; the length may be 1in., the diameter ⅜in.

S. Bottone.

[68204.]—**H.P. of Portable Engine.**—Running at 90 revs., you would get about 38lb. mean pressure, which would give 21H.P.

$$\frac{86·6 \times 7 \times 38 \times 90}{3 \times 33,000} = 20·8.$$

McGill.

[68204.]—**H.P. of Portable Engine.**—Let A = area of cylinder in square inches, P = average pressure of steam on piston in square inches, R number of revolutions per minute, S stroke of piston in feet. Then—

$$\text{H.P.} = \frac{2 \times A \times P \times R \times S}{33,000}.$$

Longsight. J. Stokes.

[68204.]—**H.P. of Portable Engine.**—

$$10\tfrac{1}{2} \times 10\tfrac{1}{2} \times ·7854 = 86·6\text{sq.in.}$$
$$\tfrac{14}{12} \times 2 \times 90 = 210\text{ft. per minute.}$$
$$50\text{lb. cut off at } \tfrac{3}{4} = 40\text{lb. effective}$$
$$\frac{86·6 \times 210 \times 40}{33,000} = 22\text{H.P.}$$

Bristol. T. C.

[68205.]—**Lantern.**—The probable cause of the coloured corners is that your source of light is not in the focus of the condenser. Try changing the position until the screen is uniformly illuminated.

Sm.

The Liquefaction of Gases by Electricity.—An electrolytic method of liquefying gases has been described by H. N. Warren in the *Chemical News*. Strong hydrochloric acid is introduced into a combustion tube, bent at right angles, so as to cover two small platinum plates fused into the closed end of the tube; a plug of asbestos, saturated with concentrated sulphuric acid, is placed at the bend; the open and shorter arm is then fused up and immersed in a freezing mixture. On the passage of a current through the plates gas is evolved and liquefies at the other end; but on removing the tube from the freezing mixture and discontinuing the current the liquefied hydrogen chloride is reabsorbed by the water. The experiment may then be repeated. Other compound gases behave in a similar manner. When acidified water is decomposed in this apparatus, and a platinum plate covered with platinum-black has been fused in the short end, explosions occur there at intervals, and small quantities of water form, containing hydrogen peroxide, and having an ozonised odour. With chromic acid and water the blue oxide of chromium is obtained. The method has also been applied to the liquefaction of oxygen and hydrogen, and the latter is said to have been "decidedly liquefied."

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

67538.	Dynamo, p. 429.
67547.	Choreutoscope, 429.
67562.	L. and S.W.R. Goods Engines, 429.
67577.	L.C. and D.R. new Bogie expresses, 430.
67786.	Race Game, p. 507.
67809.	Solid Couplings, 508.
67815.	High and Low-Angled Lenses, 508.
67816.	Limelight, 508.
67825.	Oleaginous Water, 508.
67832.	Motive Power, 509.
67834.	Pulverising Metals, 509.
67840.	Scaffolds, 509.
67843.	Value of Constant, 509.
67844.	Magnetic Machine, 509.
67847.	Ivory Thimbles, 509.
67848.	Heat Rays, 509.

QUERIES.

[68206.]—**Parish Law.**—In a parish where there is a board of surveyors of the highways annually appointed by the vestry, it was determined by the surveyors to improve the main parish road by making a new road through the outskirts of a village in the parish. They, however, found their powers did not extend to borrowing the necessary money to carry out the work, and consequently applied to the guardians forming the sanitary authority of the district, including the parish, to borrow it for them. This the sanitary authority succeeded in doing from the Government after several visits of the Government Inspector appointed for that purpose. As the matter proceeded, considerable opposition was made to the carrying out of the work, and finally the sanitary authority had it carried out themselves; but, although I am not certain on the point, I believe this last step was also taken by them at the request of the board of surveyors of the highways of the parish. The following questions now arise out of this matter. Can the board of surveyors of the highways of the parish under these circumstances legally refuse to include in the highway rate the amount necessary to meet the interest, &c., due to the Government on the amount borrowed of them, and the amount due for legal expenses, &c., attending the carrying out of the work, or can the overseers of the parish or any other party make a special rate on the parish to meet the outlay? The special rate in this instance is felt to be a case of great hardship to the householders, as they (although they are nearly all merely pedestrians and have no horses or carts to wear out the roads) will have in that case to pay four times as much proportionally as the farmers who occupy the land and who cause nearly all the wear and tear of the roads, and the increased number of whose vehicles of every description made the new road absolutely necessary for safety. I should esteem it a very great favour to be afforded early and reliable information on the above points.—Rusticus.

[68207.]—**Battery.** — Will Mr. F. W. Mason, S. Bottone, or any of "ours" please give me a little information as to Bunsen battery? 1. Could I increase the surface of the two zincs, one on each side of porous pot to do away with zinc which is at the bottom of cell? 2. I use sulphuric acid, chromic acid, and water for porous cell; sulphuric acid and water for outer cell, but can only obtain current sufficient to light a lamp for a minute or two. Is this due to bad acid, or improper mixture? Will you give me quantities of each to be used? 3. The porous cells which I have keep cracking, and I have had to get several new ones, which has been rather expensive. I have tried to make one myself, but on taking mould box off, I found a piece broken out which had not set. I used plaster of Paris mixed with water to a paste. Should I have had anything else mixed with it?—Nimrod.

[68208.]—**Dynamo.**—I have made a small dynamo (Edison type). F.M., upright cores and yoke are of wrought iron, ½in. thick and 3in. wide. The pole-pieces are of cast iron, each 4in. by 4in. by 2in., with a nearly semi-cylindrical cavity, so that, when placed with ⅛in. between, a tunnel 3½in. diam. and 4in. long will be formed. The joints of yoke piece and the ends of core pieces on the pole-pieces are simply filed flat and held together by ¼in. tap screws. The pole-pieces are also screwed down on base plate of cast zinc, which is ⅝in. thick. The upright core pieces, 5in. high, are covered with 8lb. of d.c.c. wire, 20 gauge, about seven or eight layers having been first well taped. The armature is made of two wrought-iron pipes. Sockets fitted end to end, so as to form a cylinder, 4in. long and 3in. diam., and 14 pieces of ½in. by ⅜in. wrought iron are riveted on to 4 cogs, and about 1lb. of 19 gauge d.c.c. wire is wound in the channels. It is fitted with brass spiders to a steel spindle with the usual commutator. I shall be glad if Mr. Bottone or some other authority will give an opinion on it. I rather fear the joints being mere contacts will be detrimental, and I fear the F.M. is not large enough. I only want to run two or three small lamps and charge some small accumulators. Will it do this, and what speed will be necessary?—J. M.

[68209.]—**Shunt Dynamo.**—I have castings for a dynamo of which are the sizes:—Armature 7½in. diam., 4in. wide, 1in. thick, cog pattern, in 12 sections, and wound with 3lb. No. 16 c.c. wire, about 20ft. 6in. in each coil. The pole-pieces are cast iron, 9in. high, 4in. wide, and massive, weight 28lb., with wrought iron poles, 7in. high, 2in. thick, and I propose to wind them with 9lb. of No. 20 c.c. wire. Is this size right for a shunt machine in relation to the armature resistance? What is the speed to drive it at? What its probable output will be. I have some 45-volt lamps, which I should like to use, and 16c.p. Will they be suitable, and how many lamps will it light?—Armature II.

[68210.]—**Electrical Query.**—In S. Thompson's work on p. 233—"To bring Q units to pot. V requires Q V units of work . . . if pot. is nothing to begin with *half* Q V units of work." Why is this? Again on p. 234—"If there are two Leyden jars, and if the inside of one is raised to pot, V, and its outside is joined to inside of second jar whose outside is joined to earth, then the difference of pot. of outer and inner coating of either jar is only half V." Can't understand this either. I am afraid my ideas of potential are incorrect.—Pot.

[68211.]—**Apochromatic Lenses.** — I have just bought a ⅛ pf Ziess (No. 16), aperture ·95, and am disappointed. I expected to get black and white images of diatoms, and can only do so in part by using a large-angled cone of light with the ach. condenser, which distresses the eye. When the aperture is reduced a lot of colour (blue) and a little red appears. I am here speaking of coarse objects, such as arachnoidiscus, and comparing it with a 1-5 of Beck's that I had for 20 years. On testing its resolving power with a 1-6th of Zeiss (D D) ap. 82, it is only slightly superior. The glass is undoubtedly a fine one, as it ought to be when the price is considered. What is the experience of any one of our readers who has used these apo. lenses?—F. Paine.

[68212.]—**Lines.**—Would "Engineer, Govan," or some other friend give me to know what is meant by lines of force—that of the dynamo—in a simple form?—J. A.

[68213.]—**Punch and Judy.**—Could "Showman" or any reader give a description of the dolls used in the above? I have made some, but find I cannot work them to make them look right. I made the heads with a piece to come down under the necks, boring a hole through the lower part for the forefinger to pass through when in use, using the thumb and second finger for the arms. I find this arrangement does not work well, as I cannot get my hands in quick enough. I am aware that I could purchase dolls, but prefer to make them myself. I suppose there are books with dialogues in. I was in the same fix as "Showman" regarding the squeak, and after nearly swallowing the pieces of tin and tape several times, I put it by as taking too much time to manipulate. Can any of "ours" give a description of a few conjuring tricks or anything likely to amuse youngsters? If anyone could, I feel sure it would be welcomed by many readers.—W. Walker.

[68214.]—**Steam Tricycle.**—Having been successful with a Serpollet boiler which I made to work a small engine, I am thinking of fitting a larger one on to a rear-steering tricycle, burning petroleum spray for fuel, and condensing exhaust to use over again to save carrying too much water. I shall be grateful if some reader will tell me what size cylinder would give sufficient power to drive it at about 10 miles per hour on the level. The weight of machine being about 100lb., rider 132lb., motive power and fittings 100lb., total weight, say, 350lb. How much petroleum would be consumed per hour, so as to give heat equal to that of ⅞sq.ft. of coal fire on a furnace grate? I propose coiling boiler inside a cone shape copper casing, but do not quite see the way to burn the petroleum. A sketch of a suitable arrangement will oblige. Would it be best to run engine fast and gear it down, or drive direct? I hear that a license can be obtained for driving a tricycle by steam. Is this true?—A. C.

[68215.]—**Fastening Horsehair.** — Would some correspondent inform me if there is any other method used to secure the ends of horsehair together without knotting them, in order that they may drive small ferrules such as used by watchmakers to run cylinders into watches?—T. V. Gateshead.

[68216.]—**Harmonium.**—I am desirous of enlarging my harmonium, which has one and a half rows of reeds and nine stops. I am attaching pedals, but would like a bourdon, or some stop put in to play an octave lower than the instrument will already play. I should also like another row of keys and some imitation pipes for the top of the instrument, but do not know how to go about the work to have it done the cheapest way. Can any of your readers enlighten me?—W. A. Parry.

[68217.]—**Screw-Cutting.**—Will "T. C., Bristol," say how I can cut square threads on spindle with a hand slide-rest? If I cannot, say how I can make a pair of contracting and expanding dies, to screw, say, from ¼in. to ⅝in., to fix on to spring rest or to slide-rest, or how can I rig an arrangement up?—Wat.

[68218.]—**Bicycle.**—Will any reader kindly say how many revs. per min. a 54in. bicycle makes running at eight miles an hour?—Wat.

[68219.]—**Dynamo.**—Will Mr. Bottone say how fast a dynamo must run to light a 5c.p. lamp? Also is there any advantage in a high voltage over a low voltage? Will a high voltage require more power than a low voltage?—Wat.

[68220.]—**Balloon.**—Can I erect, inexpensively, apparatus with which to inflate a small passenger balloon from coal, being far from a town?—J. M. B.

[68221.]—**Rusty Water.**—Can any reader suggest a remedy for rusty water in hot-water apparatus? It has lately been refitted with new wrought-iron boiler and pipes, and whenever any water is drawn from any of the taps it is very rusty.—H. Spink.

[68222.]—**Cement.**—Will any reader kindly inform me how to make a cement for brick or stone that will resist the action of dilute sulphuric acid?—Mosaic.

[68223.]—**Achromatic Condenser.**—I wish to employ my ¼in. objective as a condenser to my microscope when I work with the ⅛ objective. I will thank some friend who will tell me how to arrange it. Beneath the ¼ I shall require a plano-convex lens, and I wish to know what should be its diameter, focus, and its distance below the ¼in. Also what kind of diaphragm to use with it.—E. B. F.

[68224.]—**Hydraulics.**—As a pupil in a borough engineer's office, I am anxious to obtain a sound knowledge of hydraulics, more especially as applied in connection with sewerage and waterworks. Would any reader kindly advise me of a comprehensive and practical book (or books) referring to this subject?—Logarithm.

[68225.]—**Cloudy Objective.**—I have what I believe to be a microscope objective, as it is mounted and screwed the same. The inside nearest the tube is hollow, and the end outside like a bull's-eye. The colour is opal and almost opaque. It looks something like a pearl. Will any kind optical reader tell me the use of it?—Ignorant Optics.

[68226.]—**Prevent Horses from Slipping.** — Could some kind reader tell me of a portable fitting to prevent horses from slipping on the stones, as the water carts make them greasy and very dangerous, and sometimes through the dryness they are irony, and some horses are very nervous? Driving ten horses a day, would be glad of an idea.—Tramcar Driver.

[68227.]—**Electro-Plating.**—A few weeks ago I made some silver-plating solution. I dissolved coin silver in nitric acid and precipitated same with sodium chloride, and then dissolved the silver chloride in a strong solution of cyanide of potassium. When the greater part of chloride was dissolved there appeared a dark metallic kind of powder. What is it? I tried to see if it would dissolve in nitric acid, but it only fizzed up and did not appear to dissolve.—Puzzled.

[68228.]—**Leaky Portable Engine.**—Will some friend kindly favour me with a few practicable (yet simple) hints as to stopping the tubes leaking? They do not leak very much, but I always think a stitch in time saves nine. The tubes that leak are at the firebox end, and, as I have plenty of time on hand, I should like to stop the leakage myself, as I am fond of engine work. I believe I saw a few hints in an old number of the "E. M." I had in the house two or three years ago, but I cannot find it now. I have looked carefully over a few numbers of the "E. M." I have by me; but perhaps some fellow-reader will lend a helping hand.—Rd. J. Merry.

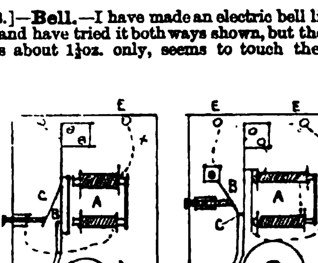
[68229.]—**Electric Indicator.**—I have an electric indicator, and I wish to put an ordinary galvanometer in the circuit. I tried one in the circuit that I have, but when the push was pressed the bell would not ring, although the flag on the indicator worked all right. I should like to know what is the cause of the bell not ringing. I have large No. 2 Leclanché cells on, to that there is plenty of battery power. The wire on coils of galvanometer appear the same gauge as on bell and indicator coils. Should like to have an answer on this, as I want the galvanometer in circuit, so as to see if there is any leakage when all the pushes are open. My wires are c.c., and are stapled across the ceiling and along the walls, and I am going to have the house whitewashed and the walls papered. Will the wash do any harm or the papering over them—i.e., the wires?—Wrexham.

[68230.]—**G.W.R. Automatic Vacuum Brake.**—Will "T. C., Bristol," or some other engineer please say what is the atmospheric pressure on the automatic vacuum brake of the G.W.R. when the brake is full on? The pipes, I think, are about 2in. internal diam., and what is the difference in the pressure on the brake blocks of the Westinghouse and the automatic vacuum? The pipe of the former is much smaller than the latter, and it appeared to me that the Westinghouse stopped a train in shorter time than the automatic vacuum when the train was going at the same speed in each case.—Wrexham.

[68231.]—**Injection of Petroleum into Steam Pipe.**—I have an ordinary portable engine with tubular boiler, and steam pipe for the exhaust steam discharging into the funnel. I want to mix petroleum with this exhaust steam for a purpose. How can it be done? If I mix petroleum with the water pumped into boiler the vapour of it will doubtless mix with the steam. But will there be any danger of an explosion? Could I get the petroleum into the exhaust pipe by using Giffard's patent injector?—E. C. U.

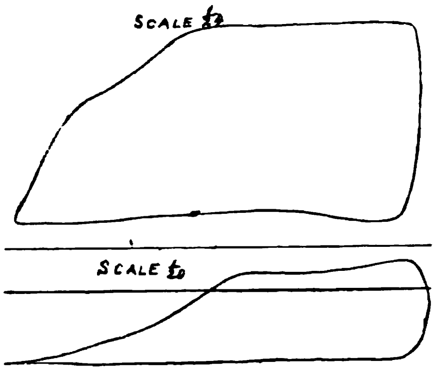
[68232.]—**Lens.**—1. What should be the focal length of a Barlow lens suitable for a 3in. o.g. of 42in. focus? Is it necessary that it should be an achromatic combination, and what distance from the field lens of eyepiece should it be placed? 2. How can I find focal length of a concave lens? 3. Is there any advantage in Klein's Star Atlas over Proctor's smaller? 4. How can I calculate the focal length of lenses, flint and crown, for making telescope object-glasses of any given length? For instance, what should be the focal lengths of the lenses to make a 3in. o.g. of about 30in. focus?—F. S. A.

[68233.]—**Bell.**—I have made an electric bell like one in sketch, and have tried it both ways shown, but the hammer which is about 1¼oz. only, seems to touch the bell and then return, bringing no sound out at all. The magnets are soft iron, ¼ diam., 2½ long, wound with No. 30 c.c. copper wire, and soaked in paraffin wax. I put on about six layers. I employ two Leclanchés, and the magnets will lift the armature nicely. Would any reader tell me how to improve it? In sketch—A magnets, B armature, C place of contact, D bell, E terminals, F wires of connection.—Experimenter.



[68234.]—**Charging Accumulators from Small Dynamo.**—I made a small dynamo to attach to my bicycle, and it lights an 8-volt 5c.p. lamp very well, but of course when my machine stops my lamp goes out. Now, I want to make a small accumulator to be charged by the dynamo, and burn the lamp from there if possible. I should like the cells to take a charge sufficient to burn lamp for about 15 minutes when standing still or going slowly, as now when I am in the traffic I have no light. Would any reader put me right as to what size cells I want and how to charge, as I have a small accumulator which I can charge very well with a battery, but will not take anything from the dynamo? The dynamo has a laminated H armature, wound with No. 22 s.c. wire, with same on the fields.—A Cyclist.

[68235.]—**Engine Query.** — Will "Glatton" or "T. C., Bristol," work out the following calculations for me in plain figures, as I am sure it will instruct all of our readers who are only advanced as far as the inquirer? Diam. of cylinders, h.p., 18in.; diam. of cylinders, l.p. 22in., stroke 3ft., revs. 60 per min., boiler pressure 65lb.



What I want to know is, how much steam is used per hour? Also the amount of water used per I.H.P. Also as a heat engine, if the boiler pressure was increased to 75lb., what would be the saving?—Young Engineman.

[68236.] — **Candle Making.** — Being desirous of making my own candles (tallow) so that I may save the manufacturers' profits, would any kind reader answer the following question? The price of tallow. Is anything mixed with the tallow? How to arrive at the size of them, so that a certain number shall make a pound, 12 or 16, &c. I suppose there is no other way of making them than by dipping.—E. Humphrey.

[68237.]—**Electro-Magnets.**—To "J. H."—Thanks for reply. The magnets in circuit at the same time would be constantly varying in number, and also the length of time. For instance, supposing 20 of the magnets were in circuit, it might be necessary to have other 10 in addition put on, the original 20 still remaining in circuit. Any further information will be much esteemed by —An Old Reader.

[68238.]—**Press.**—I have a fly-press, Rhodes' make, for stamping covers, &c., but it works very unsatisfactorily, instead of turning a nice smooth edge as it should do. Could anyone tell me how to alter the stamps and dies to make a good job? I want to make several thousand tins. —J. D. C.

[68239.]—**Lifting Water.**—I want to raise about 7,000gal. per 12 hours a distance of about 600yds., and about 150ft. high. Will "T. C." or others kindly give me diam., thickness, and best sort of pipe necessary, and the most suitable pump for forcing the same? I have engine power available, but would like to know what H.P. it will take, and the pressure on the pump per inch.—An Old Reader.

[68240.]—**Electro-Motors: How Made, &c.**—Would Mr. Bottone say whether 2¾in., the size given for the length of pole-pieces in the motors described under the above heading in last week's "E. M.," is correct? Would he also oblige with the following particulars? Thickness of F.M.'s, thickness of yoke, and the distance between the pole-pieces. Should the diameter of the tunnel in which armature rotates be ⅛in. larger than that of the armrture?—Amateur.

[68241.]—**Valve.**—Would some of our many readers help me—perhaps "T. C., Bristol"? I want to work a valve under extreme pressure, and I want it so arranged as to give me the advantage of an open port—i.e., throw wide open instantaneous. Sketch would greatly oblige.—One Anxious to Know.

[68242.]—**Wimshurst Machines.**—I am thinking of purchasing one of these from Messrs. King, Mendham, and Co., and should be glad if those who have used these machines can tell me if there are any difficulties in using them for the ordinary experiments—e.g., making a person's hair stand on end when on an insulating stool. Are the Leyden jars dispensed with for these experiments? It looks to me as if an unpleasant shock might be taken? Can sparks be drawn with the knuckles without more shock than in ordinary machines, say 1in. to 2in. long?—Glatton.

[68243.]—**Explosives.**—I have model engine said to have been worked by explosives. It is like a small brass cannon standing on end, with two iron rods placed one above the other and passing horizontally through the side of cannon to the cisterns outside, said to have been filled with chemicals. These rods work in and out and have a notch on the side, so as to carry the chemicals from the cistern to the cannon, where both coming in contact causes an explosion, which drives a fanner fixed out in front of the mouth of the cannon. What are the chemicals most likely to have been used?—Donald McDonald.

[68244.]—**White Wood Furniture.**—Could any reader tell me if there is any work on joinery, &c., where I could get instructions for making ordinary white-wood furniture, such as kitchen dressers, sets of drawers for bedrooms, &c., or where I can find any information on the subject?—Geo. H.

[68245.]—**Telephones.**—To Mr. Bottone.—I have a pair of mechanical telephones that have been working very well till lately, when the line wire broke and it was replaced with a new wire, which is a little thicker than the old wire. I think it is composed of three strands of No. 24 galvanised steel, and it has never worked to give satisfaction since, and there is a continual humming, so loud as to make the head ache very bad. Is the wire too tight, or not tight enough, or is it too thick? The length of wire from insulator to insulator is about 200yds.—F. P.

[68246.]—**Tainted Well Water.**—During the hot dry summer of 1887 I was induced, owing to the lowness of the water in my well, to have it thoroughly cleaned out and a layer of chalk put at the bottom. The water, though previously exceptionally sweet and good, has since had an unpleasant putrid smell, and is unfit for drinking and cooking purposes. Charcoal has been thrown in several times without any effect. The depth of the well is about 35ft., light loamy soil, and clay subsoil, and fed by side permeation. Can any of your readers explain the cause and suggest a remedy?—Clericus.

[68247.]—**Optical.**—I have found that if I so turn my head, when reading ordinary type with spectacles, that the rays pass to either eye over the nose or nearly so, the other eye being closed, the type becomes very markedly more distinct, whereas if the rays are caused to reach either eye from the other side—that is, to pass through the outer edge of the lens, the type is hardly legible at all, and these effects are greater or less according as the ray passes through the glass at a greater or less distance from the centre on either side. Can any reader kindly explain this? I am near 70, have excellent sight, but use 12in. focus spectacles for reading. There is, I suppose, a slight increase of magnifying power when the ray comes slanting, but this will not account for the different effects at the opposite sides of the lens.—L. C.

[68248.]—**Fixing Camera Fittings.**—To James Thompson.—I am making a camera from your instructions and have bound the case with eight brass corner bands. Not seeing my way clear to fix supports and clips of reversing frame outside on account of the bands being in the way, I made the reversing frame without the overlap and fixed the clips inside the case, but they would not act. I then tried springs, and they also failed. Could you recommend me what to use? I should like something to fix outside case, if possible. Could easily alter reversing frame.—Puzzled.

[68249.]—**Fans.**—I shall regard it a favour if any reader will inform me what formula or rule is used for calculating the amount of air (say in cubic feet) that is drawn through the two inlets of a common centrifugal suction fan. I wish to replace ten small fans by one large fan. The ten small fans are of the following dimensions: —Diam. 24, R. 6000, 4 radial arms, 22½in. long, 5in. wide, two inlets in fan casing 9½ diam.—Retford.

[68250.]—**Dynamo.**—Will Mr. Bottone say if the motor described for driving sewing-machines can be run as a dynamo? If it can, please say what c.p. it would give. Also could I fit a lamp on a piece of wood, the lamp resting on brass wire driven in the wood in a circle just to rest the lamp on, so I could carry it about my workshop which is about 12ft. square?—Amateur.

[68251.]—**Horizontal Engine.**—I am sorry "T. C., Bristol," had to refer back for information through my query being so vague, but I will try and explain what I want. Please say what size box bed I shall want for compound engine, high and low-pressure combined. The size of cylinder for high-pressure is 1½in. bore and 3in. stroke, and the size of the low-pressure is 2½in. bore and 3in. stroke. The cranks I shall set at quarter angles. Please give sketches of bed, crank shaft, flywheel, and valves. From centre of piston to centre of valve of high-pressure is 2in., and of low pressure 2⅜in. I want to work it at 300 revs. per min. Please say what travel, lap and lead I shall want for these; also weight and thickness round the rim of flywheel.—Amateur.

[68252.]—**Japanning.**—How is this done? I want to do some tin deed and artist's colour boxes I have had made.—T. Heath.

[68253.]—**Standard Element.**—Will some one please describe the use of this instrument?—T. Heath.

[68254.]—**Bichromate Solution.**—What is really the proper proportion of acid, bichromate, and water for making this battery solution of maximum strength? If I use 3oz. bichromate to the pint, as advised in some books, half of it crystallises out when the solution gets cold. What is the use of that?—T. Heath.

[68255.]—**Lunar Photography.**—I have a good 3in. aperture telescope (refractor); also a Rayment's patent double extension camera (½-plate), Beck's 7in. focus lens. Will some one tell me how to arrange instruments for taking instantaneous photographs of the moon?—Clericus.

[68256.]—**Dynamo.**—Will any of our electrical friends kindly help in the following? I have a dynamo wound with 4lb. No. 16 B.W.G. wire on magnets, and 1lb. No. 18 B.W.G. in six sections on armature. How should this be connected up? Also what lamps will it light and if it would charge accumulators?—Mechanic.

[68257.]—**License to Grind.**—Am I compelled to have a license to grind with the common grinding machine in the streets, as I only do a little when short of work? I don't carry anything for sale. Has the hawker's license anything to do with it? I may add that I have never been asked for it by the police; other people say I should have one.—Travelling Dick.

[68258.]—**Grinding Plug Taps.**—Will some of your correspondents kindly inform me of the best method of grinding plug taps? I have tried flour of emery, brick-dust, and fine sand, but have generally failed. A film of brass forms here and there. Would some other lubricant than water prevent that?—Dicky Sam.

[68259.]—**Cylinder.**—Will any reader kindly tell me what plan to adopt so as to prevent water from entering h.p. cylinders, as it causes a cracking noise as engine starts? Is it possible for it to enter while blowing through, or would it accumulate through night owing to leaky valves?—J. L.

[68260.]—**Dynamo.**—I have just finished a dynamo. Wound fields with 8lb. c.c. wire, armature with 1lb. 18 c.c. wire. It is a Siemens alternate armature in 12 sections. I can get but little current from it. Will Mr. Bottone kindly tell me how many lamps and what voltage it should light?—A. W.

[68261.]—**To Mr. Bottone.**—I am wishing to light up a small shop window with two incandescent lamps for four hours every night. What form of battery will be the most economical in working, as it will be required constantly?—Marlow.

[68262.]—**Power of Engine.**—Would some of our engineering friends say what power will be got from the following? An upright engine, 8in. diam. of piston, 24in. stroke, 73 revs. per min., pressure of steam 40lb. per square inch.—Dorbel.

[68263.]—**Exhaust Pipes for 1H.P. Engine.**—Would "T. C., Bristol," kindly say the best size of steam and exhaust pipes for a 1H.P. engine working at 50lb. pressure? Also the throw and lap of eccentric with lap and lead of valve on both sides—that is, the steam and exhaust sides to get the best results, likewise the cut-off, with size of ports, with dimensions of horizontal governor for same.—Ex.

[68264.]—**Brick Making.** — Will any reader, acquainted with the soil of East Kent, give suggestions and information as to construction of kiln for burning red bricks?—F. Paramor.

[68265.]—**Modified Battery.**—To Mr. Bottone.—Would you kindly inform me the E.M.F., &c., of above battery, mentioned in your book "Electric Bells," on p. 120, and for how long it will run?—Experimenter.

[68266.]—**Paper.**—How is the oil paper made for the cyclostyle?—Experimenter.

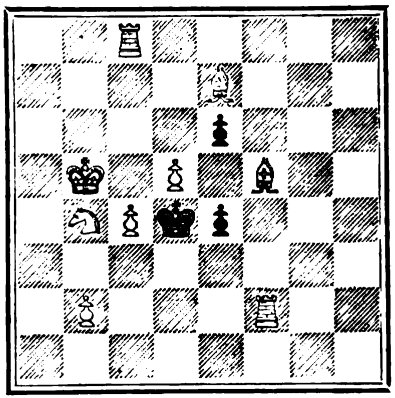
[68267.]—**Asbestos Paint.**—Would any of your readers be kind enough to furnish me with the ingredients for making asbestos paint?—E. Spencer.

CHESS.

All communications for this department must be addressed "Chess Editor, English Mechanic, 332, Strand."

PROBLEM MCXLII.—By J. P. Taylor.

Black.



White. 9 + 3

White to play and mate in two moves.

Solution to 1,140.

(This problem requires a B. R at Q 8 and a B. P at Q R 2 to avoid other solutions).

White.	*Black.*
1. R takes P.	1. P takes B (*a*).
2. Kt-Q 6 (dis ch).	2. K takes R (best).
3. Q-K 8 (ch).	3. K moves.
4. Q mates.	
	(*a*) 1. K takes R (*b*).
2. Q-K 8 (ch).	2. K-B 4.
3. Q-K B 7 (ch), &c.	
	(*b*) 1. R takes P.
2. Kt-Q 5 (ch).	2. R takes Kt.
3. Kt-Q 6 (dis ch), &c.	

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,139 by W. L. Martin and Janus.

J. G. Hankin, A. Bolus, and A. Jarvis.—See above notice with regard to 1,140.

W. L. Martin is entered for A section, G. A. Macbeth (A), Fr. Fernando (A), C. Reader (C).

A. Bolus.—Thanks for problem.

W. Tallusall.—In your attempt at Mr. Gorgias' problem K can move to K 3 on second move.

In section C, sui-mate two-movers may be set.

Mr. Rowland's "Chess Annual" is out at last, and a very useful and entertaining book it will no doubt prove to the chess player. He has followed the same course as Mr. Bland several years ago, in giving the laws of the game, and a list of the clubs in the United Kingdom and abroad. This list is suggestive in several names of places that do occur and several that do not. Exeter, Bedford, Yeovil, Lichfield are conspicuous by their absence, while such small places as Bromley, Hailsham, Penarth, &c., have their chess club. The inference to draw is that these small places contain some player of eminence and energy who sets the thing going. One fact is cheering: the list is much larger than it was when the last manual was published. We have two complaints to make with regard to this little work. We trust the defects will be remedied next year. One is that the laws of correspondence play are not given. So many games are now carried on in this way, that it would be of advantage if these rules were added. The other defect is that in the solutions of the four-movers only the first move is given. To have given the first two moves would have occupied but little more space, and would have made all the difference to the average solver. A good many students would like the first two moves given to a three-mover, but this is not indispensable. We should have mentioned that the book contains one hundred of the prize problems of 1888, printed on neat diagrams; also a list of chess periodicals and publications containing chess columns. The price is 2s. 6d., and the work can be obtained of Mr. J. B. Rowland, of Victoria-terrace, Clontarf, Dublin.

ANSWERS TO CORRESPONDENTS.

**** All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 332, Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 27, and unacknowledged elsewhere:

A. GRAY. A. J. Pool.—T. A. Wilson. C. Langevin.—Antares. Phaethon. John Maxwell. F. W.—G. Dixon. I. Q. Engineer, Govan.—An Old Reader.—Carpenter. Stereographic. Student. G. S., Scotland. Country Millwright. Reader.—A Fellow of the Royal Astronomical Society. Electromaniac.—G. P. Jenkins. C. A. Jones. W. Van Eys. Ophiuchus. X. Y. Z. P. H. Kempthorne. R. McLaren. Lux.-Acier. T. F. S. T.

A. J. GREENHILL. (If you can refer to early volumes, you will find a design for a bridge across the English Channel. The idea is quite feasible indeed, there would be no difficulty in building such a bridge but the question is: Would it pay? There would be no danger to shipping beyond that now prevailing, as vessels would have to avoid the piers as they do rocks—with this advantage, that the piers would show lights indicating their position. The cost of such a bridge would be enormous, and altogether beyond any hope of paying good interest on the capital. It could, no doubt, be built much easier than a tunnel could be driven under the Channel.) M. F. (Why not look up your back numbers for electro-motors; but, once more, please understand that a Leclanché cell is not suitable for such work. A Leclanché answers admirably for ringing bells and other intermittent work; but it is not a constant battery, and is not suited for driving an electro-motor. Use a Bunsen or a chromic-acid battery. See indices for full information by reference to back volumes.)—A. G. (The information required has been given in recent numbers; but much more can be found in back volumes. The water-motor mentioned is a good one, we believe.)—Pt. (You are quite correct. If it has been patented, the specification will give all particulars of Bellite, and you can procure the blue book from the Patent Office. Probably you will find all needful details in back numbers.)

WALTER J. PARKER. (A valid patent can be obtained for an improvement on an existing patent; but, of course, only the "improvement" is protected by it. We do not understand what it is you wish to do. Protection can be obtained for a little more than a pound, and a full patent for a little more than four pounds; but you must be the judge whether it is worth while to take out a patent. The question is, would there be sufficient demand for your improvement to recoup you for the expenditure.) EXPERIMENT. (Your signature is the best answer that can be given—"Experiment" again and again. By referring to the advertisements, you will easily see where you can get asbestos.) A. S. H. (It is impossible to say what pressure model boilers will stand. Test them by the cold method, or by filling quite full and heating up, loading the valve heavily. If the boiler stands 200lb., say, without the valve lifting or the joints leaking, it will be safe to work at, say, 50lb. See indices.)—MONOGRAM. (Make the pad for the stamps of several layers of flannel, and add a little glycerine to the inks used. The aniline inks are the best for the purpose.)—E. B. FENNESSY. (The Eiffel Tower has been described in a hundred or so papers. The dimensions have been given.) E. B. F. (Of what value would any opinion be from those who have not seen the "elephant man"? and what interest would it have for our readers? It is a remarkable case, and is in good hands. Details will, no doubt, be published at the proper time.)—PHONOGRAPH. (We do not think they are on sale yet. When they are, no doubt they will be advertised; but see Hints No. 4 above.)—MX. (Such a book as you require was noticed so recently as p. 22; but any bookseller can supply you. As to the medical magneto machine, see recent back numbers.)—J. BARBER. (The Smee or Daniell is the best battery for plating. See the index of the last volume, published in the No. for March 15.)

VERNON. (We do not know of such a work. It is unlikely that works dealing with details of a manufacture would be published; the demand is too small.)—THOS. R. JONES. (No work of the kind. See previous answer, and Hints No. 5 above.) F. R. S., Edin. (We do not think there is any better solution for making experimental soap-bubbles than that described by Mr. Boys in his paper published in No. 1203. It is composed of one part by weight of oleate of soda and 40 parts of distilled water. When solution is complete, one-third the volume of glycerine is well mixed with the oleate solution, and the whole is placed in stoppered bottles and allowed a week to settle. The liquid is then syphoned off, and clarified with a few drops of ammonia.

H. G. C. P. (All your questions are answered in the textbooks and in back volumes. See Proctor's "Moon," as one work, and read up the subject; but much information can be obtained by constructing rough models, and testing the questions experimentally.)—S. J. H. (1. From the Leeds Forge Co. 2. The [illegible] is published by Bell and Sons, York-street, Covent-garden.)—DOOR BELL. (See the articles on "Electric-Bell Fitting" in Vols. XLVI. and XLVII., and numerous replies in back numbers. What is it you mean by an "ordinary door-bell"? The bell must be adapted to the purpose.)—ANDREW. (We do not know, and no one is interested in such a question except the "tradesman.")—L. (See indices. Rubbing over with bread will, as a rule, take off much of the dirt from vellum.)—VOLT. (Why not try, if you cannot make the plates of glass. It is absurd to ask what length of spark would be given; the machine must be made to determine that.)—B. B. (The question is too wide. What are the properties of the "other such chemicals" besides the ammonia—which is, by the way, a gas? You may find some useful hints in back volumes; but proper plant should be provided for such storage.—W. DOUGLAS. (Invert the barometer, and shake the mercury down, tapping the tube gently on the floor. The tube may also be warmed to drive out the air. If that does not do, the barometer must be emptied, and the tube and mercury cleaned—a process described many times.)—BOILER. (The statement is not ours, but that of the writer of the letter, who claims to be the inventor. See pp. 500, 524.)—FELIX. (You will find recipes in back volumes; but we suppose it is the chloride of platinum solution or the nitrate of silver process that you mean.)—LIBRA. (Reserve the rights, if you wish to. The usual method is to append "all rights reserved" as a warning. Publish simultaneously in both countries.)—TYMPANUM. (It is not likely that what you suggest can be done, and it would be most inconvenient to have wires leading to the ears. There are several artificial eardrums to be had; but a surgeon would be the best to advise.)—PLANER. (There are plenty of small planers in back numbers, one on p. 23 of the last volume, for instance. See the "five shilling" lathe-planer in No. 1,152; the articles on "Hand-Planing Machine Construction," in Nos. 1,131, 1,133, 1,139; and the indices generally.)—DYNAMO. (For details of construction of dynamos of nearly all the small sizes see indices of recent volumes. Probably you will find what you require by referring to the index of the last volume.)—GUNNER. (As the articles are "special," it is a matter for experiment as to the best mixture and the best time and temperature. The art of vulcanising rubber has been frequently described.)—W. W. (Guttapercha is soluble in bisulphide of carbon, mineral naphtha, benzol, chloroform, &c. See indices.)—H. C. P. (Hughes, "Waterworks for the Supply of Cities and Towns"; Slagg, "Sanitary Work in the Smaller Towns and in Villages," both published by Crosby Lockwood and Son, will give the information needed; or perhaps Colyer's "Treatise on Water Supply," &c., E. and F. N. Spon, will suit you).—SUBSCRIBER. (No.)—G. PINNINGTON. (We have really no space to spare at present.)—D. B. W. (Discussed recently. Dr. Allinson, in the *Weekly Times and Echo*, decidedly disapproves of saccharin as an article of food.)—JOHN ASHWORTH. (The heated air from iron stoves is injurious for *all* purposes. The best means of getting a Turkish bath at home is by using a lamp or gas-burner in an inclosed wooden cabinet with a seat in it, under which the lamp is placed, the top of the cabinet having a hole in it for the bather to put his head out of. These are made by one or two firms; but any carpenter could construct one.)—I. Q. (Yes, book-post rates; but if you inclose private letters they will be overcharged, and then we shall refuse them).—RICHARD ARMAN. (In type.)

The curative powers of **Harness' Electropathic** BATTERY BELT cannot be too widely known. It is the only bona-fide genuine galvanic belt recommended by thousands (see testimonials) as a simple, natural, and speedy cure for all Rheumatic and Nervous affections, Impaired Vitality, Liver and Kidney Diseases, Ladies' Ailments, &c. Pamphlet and advice may be had (gratis) personally or by letter, on application to Mr. C. B. HARNESS, Consulting Medical Electrician, the MEDICAL BATTERY COMPANY (Limited), 52, Oxford-street, London, W. (corner of Rathbone-place).

Paper.—The *Paper Makers' Circular* says that the new epoch on which we are entering will surely be known as "the age of pulp." Beyond esparto grass, straw, and wood, few fibrous substances have as yet practically taken the place once occupied exclusively by rags; but if we should ever exhaust the sources from which we now obtain our supplies there will assuredly be no lack of substitutes. East Indian ramie, pineapple fibres, bamboo, bagape (the refuse matter from sugar canes), peat, braken or common fern, flags, rushes, seaweed, tan and hop stalks, have all been proved capable of yielding pulp. In Scotland hollyhock stems have been made into paper; in Ireland the mallow, red clover, hop vine, and yellow water iris have been turned to the same use. In Demerara good paper has been made from the plantain. In France a patent has been granted for making paper out of leaves, which have been cut, pressed into cakes, and reduced to pulp by being steeped in lime water. Clearly our paper mills have plenty of material in reserve.

Fletcher's Sensitive Flame Burner.—Messrs. T. Fletcher and Co., of Warrington, are introducing a new sensitive flame burner, produced by a special adjustment of the smallest of their Argand Bunsens. If this burner is lighted, and then turned down until the inner green ring of flame disappears, the flame is found to be exceedingly sensitive to even ordinary conversation; but any loud noise, such as a clap or cough, extinguishes it. The burner is well adapted for illustrating the phenomena of sensitive flames, but it is not well suited for lecture experiments in large rooms, as the flame is so transparent.

THE temperature of food and drink should be as nearly as possible the same as that of the blood. Iced water and ice cream are injurious to the stomach, and very hot tea or coffee, especially if swallowed quickly, is equally injurious.

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5s. 6d. for Six Months and 11s. for Twelve Months, post free [illegible] part of the United Kingdom. For the United States, [illegible] 25c. gold; to France or Belgium, 13s., or 16f. [illegible] Brindisi, 15s. 2d.; to New Zealand, the Cape, the West Indies, [illegible] Nova Scotia, Natal, or any of the Australian Colonies, 1[illegible].

The remittance should be made by Post Office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary news[illegible] post, but must be remitted for at the rate of 4d. each to cover [illegible] postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, [illegible] delphia, are authorised to receive subscriptions for the United [illegible] for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. [illegible] Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the [illegible] the subscription. If back numbers are required to complete [illegible] they must be paid for at the rate of 4d. each copy, to cover [illegible] stage.

Vols. XXVI., XXX., XXXII., XXXIV., XXXVI., XXXIX., [illegible] XLI., XLII., XLIII., XLIV., XLV., XLVI., XLVII., and XLV[illegible] bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers [illegible] do well to order volumes as soon as possible after the conclusion [illegible] each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most [illegible] back numbers can be had singly, price 2d. each, through any [illegible] seller or newsagent, or 2½d. each, post free from the office [illegible] index numbers, which are 3d. each, or post free, 3½d.)

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Subscribers receiving their copies direct from the office [illegible] requested to observe that the last number of the term for which [illegible] subscription is paid will be forwarded to them in a PINK WRAPPER as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

Holloway's Pills.—These pills purify the blood and act most powerfully on the liver, stomach, kidneys, and bowels, thus giving tone, energy, and vigour to the whole system. They [illegible] wonderfully efficacious in all ailments incidental to females, [illegible] or old, and as a general family medicine for the cure of most com- plaints are unequalled.—[ADVT.]

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good value offered for all kinds of **Instruments** and Collections of Apparatus of Scientific nature.—CAPLATZI, [illegible] Exchange, Chenies-street, Tottenham Court-road.

"**English Mechanic**," Vols. XXXVI., XXXVIII., and XLVII.; 71 numbers of Vols. XXXIX. to XLVIII. Offers [illegible] under.

Half-plate **Camera**, two single dark slides, with [illegible] and ¼-plate carriers. Offers to the value of £1.—ROBERTS, Photographer, West Barnet.

Slide-rest wanted, 4½ or 5in. centre. Exchange ENGLISH MECHANIC, Vols. XXXVIII. to XLV., bound.—J. DICKSON, 31, Spring-gardens, Edinburgh.

Model **Steamer Hull**, complete deck fittings, 6ft. long, 9in. beam, tail shaft propeller; winner of seven prizes. Exchange.—EVANS, Chapel-road, Garston.

New ½H.P. **Horizontal Engine**, first-class finish, on solid mahogany stand, polished flywheel, cylinder 2½in bore, 4½in stroke.—COLLINS, Eaton-place, Tonbridge.

New vertical **Launch Engine**, link motion, reversing gear, lagged cylinder, 4in. bore, 5½in. stroke, with brasses to bearings, crosshead, connecting rod. Exchange.—Above.

Printing Press, Albion foolscap folio, wooden stand. Hand or small Treadle Machine in exchange.—Apply AMATEUR, c.o. Alder, Engineer, Gallowgate, Newcastle-on-Tyne.

Scientific **Books** (modern), Electrical, Microscopical, &c., wanted in exchange for good ELECTRICAL and other APPARATUS. Will send on approval.—A. B., 10, Wade-street, Halifax.

Vols. X., XI., XII. "**English Mechanic**," well bound, cost 25s.; Vols. I. to XII. "Design and Work," unbound, good, cost 47s.; Organ Bellows, 20 by 19in., 12s. Wanted, 3in. Slide-rest, Bicycle Suit.—COOK, Newman's-road, Sudbury, Suffolk.

Medical Coil, very powerful, six powers, regulating tube, switch, handles, improved bichromate battery, complete, quite new, highly finished. Offers to 50s. value.—Address below.

Wimshurst (pretty) **Machine**, new, 17in. discs, 4 jars, latest pattern. Photo. and particulars, 4 stamps. Exchange to £4 value.—RANDLE, Melton-street, Kettering.

Electro-Plating.—Several gallons of Cyanide of Silver Solution, in excellent condition, and a round Glass Bath.—Address below.

Camera, mahogany sliding body, stereoscopic Camera, with rising front, will take 5 by 4, as well.—HENDY, Launceston, Cornwall.

A 16in. **Wimshurst Electrical Machine** for ½ or ¼ Instanto Camera, or offers.—DIXON, Photo., Cum[illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 5, 1889.

ELECTRIC-BELL CONSTRUCTION.—VIII.

By F. C. Allsop.

An indicator movement of the pendulum or self-replacing form is shown in Fig. 49. This is one of the best forms of this movement, and being simple can be constructed at a very small cost. Unlike most indicator movements, it does not require a metal base on which to fix the different parts, the wooden back of the indicator case being all that is necessary. Fig. 50 shows an end view of the movement, which consists of the electro-magnet *a* with the armature *b* fixed opposite its poles. This armature, which carries at the bottom the vane *c*, is suspended from the post *d* by the thin steel spring *e*. When a current circulates through the coils of the electro-magnet, its armature is attracted and held against the poles, being retained in this position so long as the circuit is closed. When now the circuit is broken, the current ceases, and the armature and vane, impelled by the spring *e*, swing away from the poles of the magnet, and continue to swing backwards and forwards for a few minutes, finally returning to their normal position as shown in Fig. 49. Although these movements may be made to work fairly well when in the same circuit as the bell, the addition of a relay to the indicator for closing the bell circuit will be found to effect a wonderful improvement in their working, as the makes and breaks of the circuit by the bell, not being in unison with the swing of the vane, hamper its movement. When a relay is used a good swing of the vane is obtained, but if the indicator is in circuit with the bell the movement of the vane becomes more of a tremble than a swing.

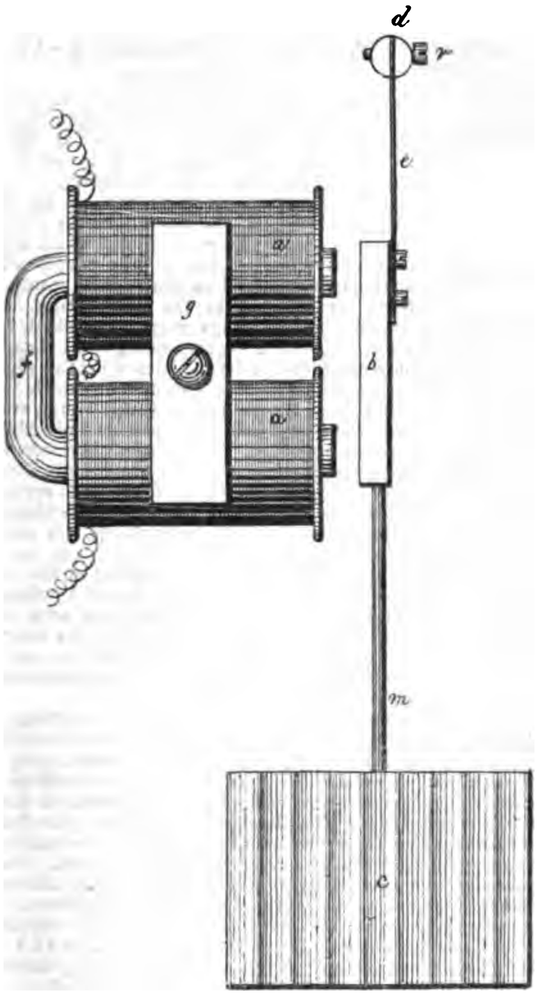


Fig. 49.

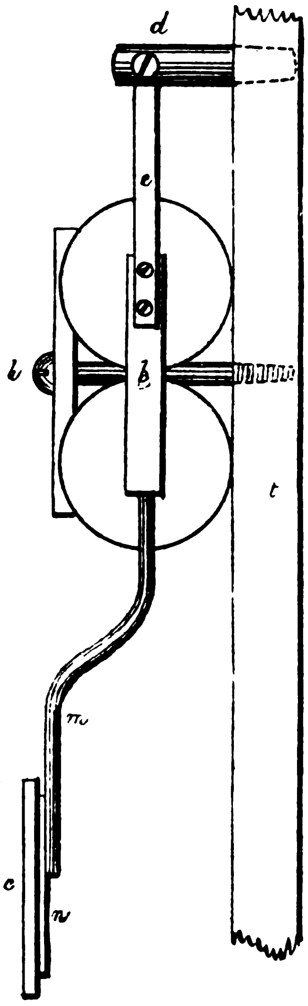


Fig. 50.

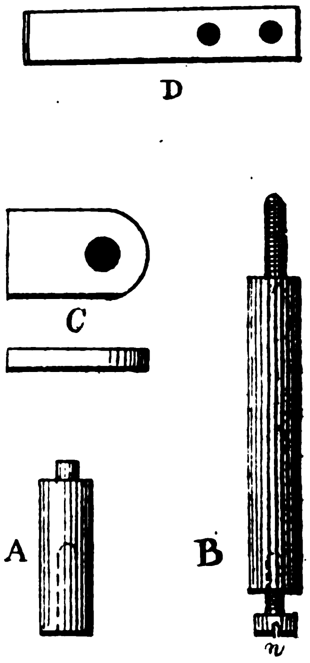


Fig. 54.

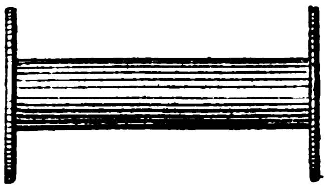


Fig. 55.

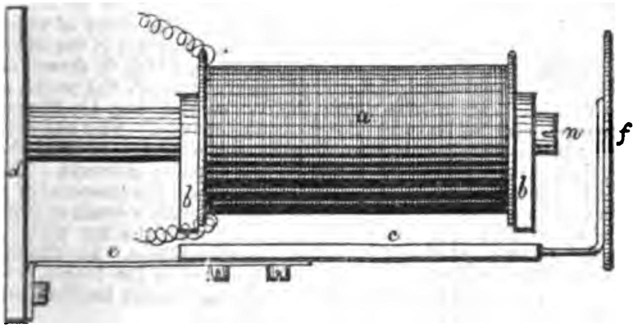


Fig. 51.

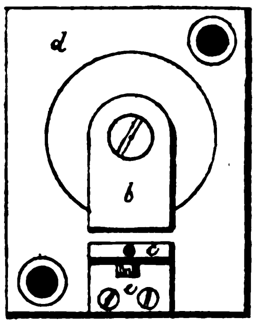


Fig. 52.

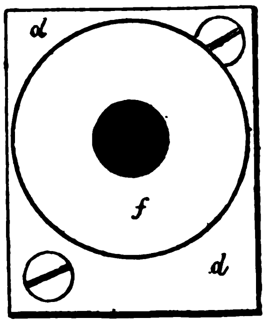


Fig. 53.

Out of some 5-16 soft iron rod the magnet core *f* should be forged, on the ends of which are afterwards slipped the two boxwood bobbins, these bobbins being of the same size as those illustrated in Fig. 38, A (Article VI.) The clamp *g* is made out of ⅜ by ⅛ strip iron or brass, and has a hole bored in the centre for the round-head screw *h*. The armature *b* should be filed up out of some ¼ square iron rod, or it may be made from French iron, which is to be obtained from most metal merchants. This iron is quite bright on the surface, and requires no filing up, it being only necessary to cut it off the right length, thus saving a great deal of labour in finishing. Next the spring *e* should be made, being cut off a piece of clock spring of the size shown. Three holes must be drilled in it (for which purpose it must previously be softened at the point where the hole is to be bored), two at the bottom by means of which it is screwed to the armature and one at the top, where it is attached to the post *d*. This post, which should be cut off some 3-16 brass rod is tapered at the bottom, and has a slot cut across at the top. At right angles to this slot a hole is drilled and tapped for the screw *r*, which, when screwed up, secures the spring to the post. Into the bottom of the armature screws a piece of brass wire, bent to the form shown in Fig. 50, to the bottom of which is soldered the thin brass plate, *n*, that carries the vane *c*. The bobbins having been wound with No. 22 B.W.G. double silk-covered wire, we can now proceed to put the movement together. The spring *e* is first fixed to the armature *b*, into the bottom of which is screwed the rod *m* carrying the brass plate *n*. The armature is then held against the back *t* of the indicator case, in such a position that the brass plate shows through the perforation in the dial of the indicator, when the proper place for the post *d* may be marked. A hole is now drilled at this spot, into which is driven the tapered point of the post. The top of the spring *e* is then placed in the slot in the top of the post, and the screw *r* run up to secure it. To fix the magnet coils, the round-headed wood-screw *h* is passed through the hole in the clamp *g*, and the magnet coils being held against the back of the case, the screw is screwed into the woodwork, the point passing between the two coils. Care must be taken, however, previous to screwing down the clamp, to fix by means of a little Prout's elastic glue a layer of paper to the underside of the clamp, in order to prevent the metal short-circuiting the two bobbins. By slackening the screw *h* the bobbins can at any time be adjusted to the best position. The indicator movements being all in place, we next fix on the vanes to the brass plates *n*. These vanes, which may be either of cardboard, with black lines ruled across at intervals of 3-16in., or, better still, of corrugated silvered glass, as shown in Fig. 49, are affixed to the brass plates by some Prout's glue. The silvered glass vanes are much to be preferred to the cardboard ones, as not only is the slightest movement readily detected even at a distance, but they will show up well in dark situations where a ruled cardboard vane is useless.

A form of the pendulum or self-replacing indicator, devised by Messrs. Jensen, which has the advantage of requiring very little space, is shown in Fig. 51. In this movement the same shape electro-magnet *a*, as is used in their well-known bell, is adopted opposite the poles *b*, *b*, of which is the armature *c*, fixed at one end to the base-plate *d* by the spring *e*, and carrying at the other the cardboard vane *f*. The action of the movement is the same as that described above, the vane *f*, in the centre of which is a black dot, being set swinging by a current circulating in the coils of the magnet.

The base-plate *a* is cut out of some $\frac{1}{8}$in. sheet brass, into the face of which is fixed the supporting rod, Fig. 54, A, also of brass. This rod is turned down (as shown) at the one end to fit into the base, it being fixed either by riveting or soldering, and at the other is drilled and tapped to receive the threaded part of the iron magnet core, Fig. 54, B. The other end of the iron core is drilled and tapped for the screw *n*. Two pole-pieces, Fig. 54, C, must be filed up out of some soft iron, and a hole drilled through one end as shown. Fig. 55 shows the boxwood bobbin.

In fitting the movement together, the supporting-rod (Fig. 54, A) is first fixed into the base-plate *d* in the manner previously described. The screw *n* is next screwed out, and one of the pole-pieces placed on top of the core, the screw being afterwards replaced and screwed down firmly. The boxwood bobbin, having been previously wound with about 2oz. of No. 24 B.W.G. double silk-covered wire, is then slipped over the core, the bobbin being followed by the second pole-piece. The threaded part of the core is then screwed into the end of the supporting-rod, and the whole screwed tightly down. The spring *e* (and Fig. 54, D) is next fixed on to the armature *c*, into the end of which screws the brass wire *m*. The top of this wire is bent at right angles to the bottom part, and soldered to a thin brass disc, attached to the front of which is the cardboard vane *f*. The bottom part of the spring is then screwed into its position on the back plate. As the movement occupies a very small space, a great number can be put into one indicator case without increasing it to an inconvenient size—a great desideratum in indicators for hotels, &c., where there are a great number of movements.

(*To be continued.*)

FIREPROOF NON-CONDUCTING COMPOSITION.

An improved fireproof non-conducting composition has been patented in this country by Mr. H. W. Johns, of New York, the object of which is to produce a cement, filling, or packing, especially adapted for use as a boiler or pipe covering, and as a lining or filling for walls, safes, refrigerators, refrigerating cars, waggons, &c. For such purposes it is necessary that the filling or lining compound as a whole should be practically fireproof, although not necessarily absolutely so; that it should be as light in weight as possible; and that it should be porous—that is, having numerous air-cells. The patentee has found that sponge, using preferably the cheap varieties or scrap, when disintegrated or divided as by cutting, picking, or otherwise reducing the size of the pieces, serves the above purposes with exceedingly satisfactory results, and especially so when combined with a due proportion of asbestos to add to its tenacity and fireproof qualities, and suitable filling or body-giving material, such as infusorial earth, kaolin, &c., to give the compound the needful density, adding also, when used as a plastic mass applied with a trowel, other suitable adhering or cementing substance, such as plaster of Paris. The following proportions produce very good results: About 10lb. of finely divided sponge, 15lb. of asbestos, preferably in long fibres, although the shorter varieties or granular asbestos may be used, 70lb. of infusorial earth, 40lb. of kaolin; 10lb. of plaster of Paris. Instead of the plaster of Paris, any other suitable cementing or binding material may be employed in such proportions as may be desired; for example, lime, and instead of the infusorial earth or the kaolin, any other suitable filler may be used alone or mixed with the other fillers. Magnesia is very useful for this purpose, acting well as a filler and being exceedingly light in weight, and moreover possessing some adhesive properties. When the fireproof quality is not essential, any other suitable non-fireproof fibrous substance, such as hair, may be substituted for the asbestos. The above compound may be wetted with water to make it into a plastic state for application with a trowel, or equivalent means, wherever such application is desired, or it may be used dry as a filler for instance, in which case the extra adhesive material may be omitted if desired, but it is preferable, even when dry, to employ plaster of Paris, lime, or magnesia. The proportions above given are not arbitrary; they may be altered as desired, and are capable of great variation, conforming to the desired use, and, in fact, when the covering or lining will be subject to much jar or heat, it is preferred to increase the quantity of the fibrous and fireproofing materials; thus, for instance, for covering locomotive boilers, the proportion of asbestos fibre is much greater than above stated. The matter of proportion will, however, be readily determined by those familiar with this art, when the special occasion shall arise. In the employment of the asbestos and sponge in these products, the patentee avails himself of a discovery of the peculiar "adhesive attraction," so called, which exists between the tentacle-like barbs or lashes of common sponge and the fine silk-like fibres of asbestos, whereby, when the sponge is brought in contact with the asbestos, it lays hold thereon with great tenacity, and when pressed together to even a slight degree, their subsequent separation is very difficult, thus the effect of the union of these two substances in the cement-like mass is to firmly bind and hold the same together—better, in fact, than though the sponge were not present and an excess of asbestos or other straight fibre were used, because the sponge particles being usually somewhat larger than the asbestos particles, the binding effect on the mass is similar to that which would exist if common cow-hair in plaster had enlargements or knots formed in it, which would prevent the slipping of such fibres in or through the mass when dry.

A MODEL LOCOMOTIVE.—IV.

The Springs.

We now take the springs, simply as a matter of convenience, because they form an essential portion of the axle-box fittings. Actually, they will not be put in place until the boiler is ready to be set in position.

The use of springs is to furnish an elastic cushion to deaden the shocks due to the rapid transit of a heavy body over a road which is more or less imperfectly formed. The weight of the engine is transmitted to the springs, whose supports are attached to the frame-plates. The stresses on the springs vary from instant to instant, causing a corresponding and incessant movement of the horn-plates upon the edges of the axle-boxes. The concussions which would result from the rolling of a rigid body over an unyielding road are thereby largely absorbed by the elastic springs. Necessarily, however, there is a large proportion of the weight of a locomotive, as the wheels, axles, &c., which are of the nature of a dead load, and cannot be thus sustained. The importance of springs can scarcely be overrated. M. Morin found that, on good turnpike roads, in vehicles going at the rate of nine miles an hour, the resistance to traction was twice as great without springs than with them; and Zerah Colburn estimated that the wear and tear of tires and rails was probably as much for one ton of the dead load of the engine as for two tons of that hung on the springs.

There are two principal forms of springs, the plate, and the volute. The first-named are oftenest used, but the second are largely employed in situations where space is contracted, and also according to the judgment of the designer. The plate springs again are placed above or below the axle, according to circumstances, and are also very variously attached. In our model I place the leading springs above the axles, because there is ample room to do so. But the size of the driving and trailing wheels will not permit us to place their springs in a corresponding position without bringing them into contact with the boiler, and I therefore show them underhung. In the first case they are supported at the two ends, and loaded in the middle; in the second they are supported at the middle, and loaded at the ends.

The forms of the springs for the model are shown in Figs. 11 and 12. The plates of which they are composed are held together in the centre by means of the buckle D, which is shrunk on while hot. A pin passing through the centre of all the plates (Fig. 12), or nibs (Fig. 11, E) prevent them from sliding endwise. Nibs and corresponding slots F, cut near the ends of the plates, keep them from slipping sideways. The springs used in actual practice are composed of a larger number of plates, usually a dozen or more of $\frac{7}{16}$in. or $\frac{1}{2}$in. in thickness; the top plate is often $\frac{1}{16}$in. thicker than the others. The dimensions of springs are given as the length, unloaded, the amount of camber, the breadth, and the total depth of plates.

Many coupled engines have the springs of the coupled wheels united by means of an equalising or compensating lever. It is not necessary to introduce these into our model, but as the work is but slightly increased by their employment, I will explain and illustrate their construction and purpose, and so leave them to be included or omitted. Where this connection is not made, it is evident that each spring has to entirely sustain the stresses due to the shocks which it receives. But when a compensating lever is attached to the contiguous hangers of the two springs, and pivoted at its centre, then, when an excess of stress is thrown upon either spring, the tendency

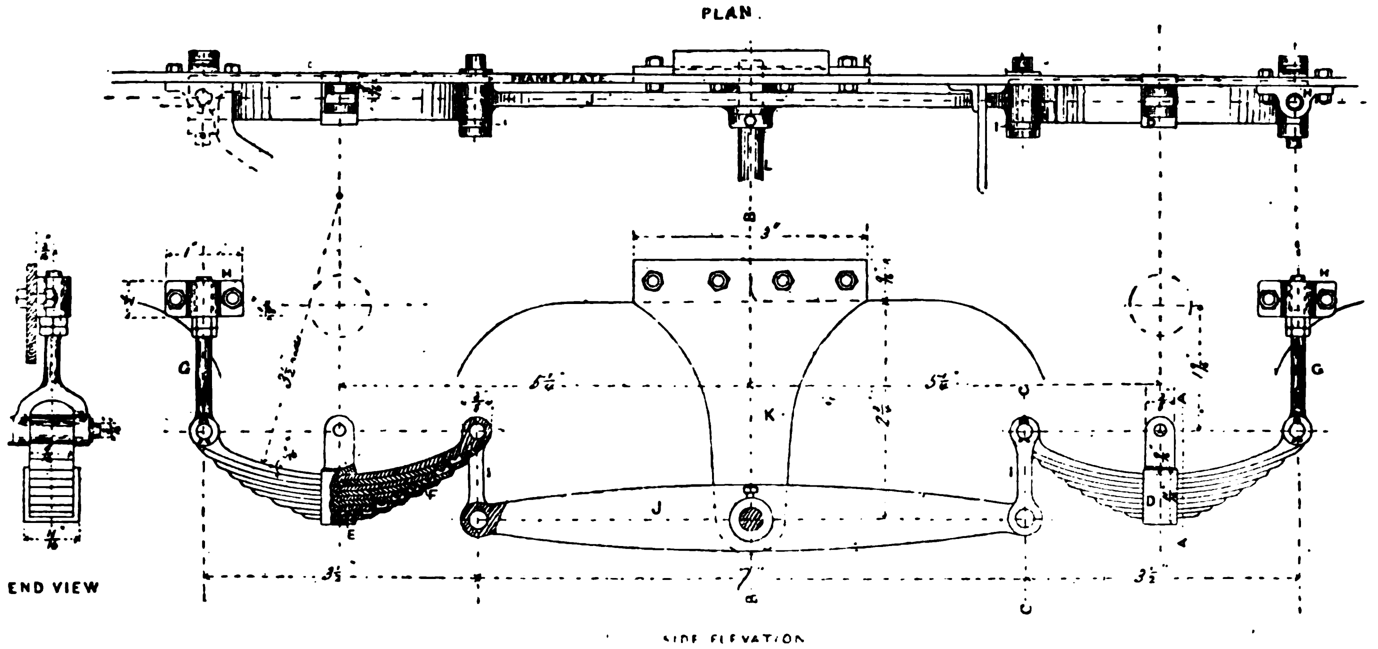


FIG. 11.

is to communicate a portion of that stress through the lever to the other spring, bringing the unequal forces into equilibrium. Practically, the centre of the equalising lever becomes the point of support of the load, no matter how widely the stresses vary on the two axles. The points of suspension of the extreme hangers become the fulcra around which the ever-varying forces are made to play by the action of the lever.

In reference to the details of construction, Figs. 11 and 12 give views of the driving and trailing springs with their attachments. The actual work had better be done by a good smith. For those who wish to undertake the task, I may offer the following notes:

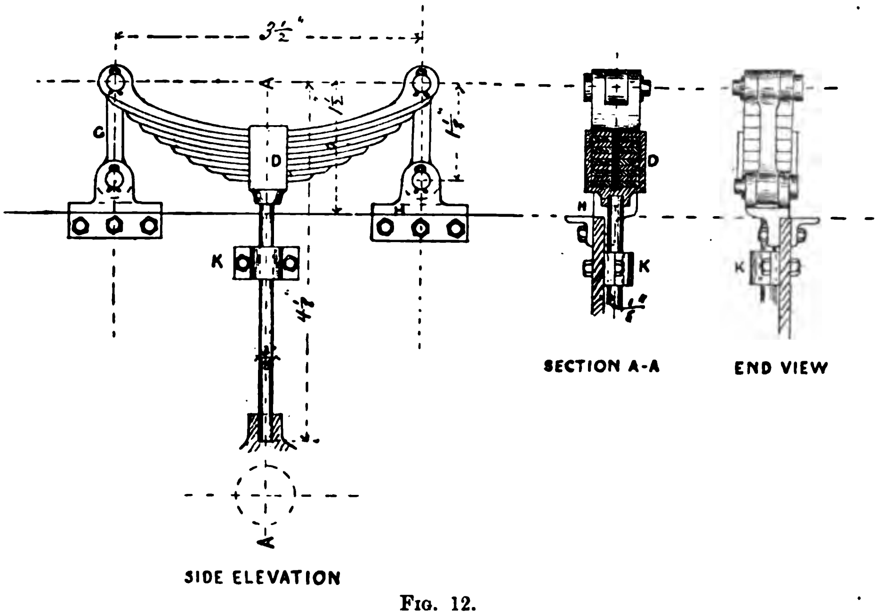
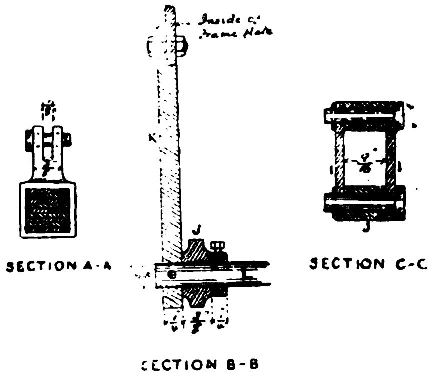


FIG. 12.

Procure the best "spring" quality of steel, of suitable section; cut it off to length, and, while hot, bend all the strips, except the top one, to curvatures slightly in excess of those shown on the drawing—say, by $\frac{1}{16}$in. Bend the top one to a correspondingly smaller curvature. In the top one, pieces for the bosses will have to be welded on, or a thick bar will have to be drawn down between the bosses. Holes will be drilled for the pins, and the bosses finished with the file. Near the ends of each plate, except the bottom one, stamp a nib with round-ended punch, resting the spring upon a suitable bolster (Fig. 13) the while. Immediately beyond this, a little nearer to the ends, punch or drill, and file out a round-ended slot to take the nib of the plate immediately above (Fig. 11, F). By this device the plates will be prevented from moving sideways in relation to one another. Through the exact centre of each plate we may drill a small hole, say, 3-32in. in diameter, through which the buckle-pin will be thrust presently, confining the plates endways, or we can adopt an alternative method—punching nibs over a bolster, each nib then entering into its corresponding depression on the plate beneath. This will be the best plan for the underhung springs, and is shown in Fig. 11. The same method, or the pin, may be used for the leading springs, Fig. 12. Afterwards the plates can be tempered as follows:—Heat to a red colour and quench in water or oil. Then taking them in the tongs, pass them backwards and forwards in a clear fire, removing them now and then for a moment. Rub a bit of hazel chisel-rod along them. The temperature at which the wood bursts into flame is the proper temperature for quenching. The plates may afterwards be polished, if good appearance is desired, or left black. After this, the buckle D, made of wrought iron, and already fitted with a forked attachment and turned pin to the hanger of the keep, will be shrunk on. The increased curvature given to the springs will cause a corresponding increase in their total depth when laid together. But when pinched up and the bridle shrunk on, their elasticity will maintain the ends in close contact.



The outer ends of the driving and trailing springs (Figs. 11 and 12) will be carried by the hangers G, and brackets H. The latter are of wrought iron, bolted to the framing with tight-fitting turned bolts. Sometimes the brackets upon opposite sides are forged in one with a cross stretcher, so connecting the two frame-plates. The hangers G are a slack fit in their holes. There are nuts and lock-nuts for adjusting the tension of the springs. There is no need to place nuts above, because the pressure of the frames is always downward upon the hangers. The lower ends of the hangers are forked to embrace the ends of the top plates of the springs, to which they are united with a turned pin. Or, they may be fitted into a recess cut in the bosses

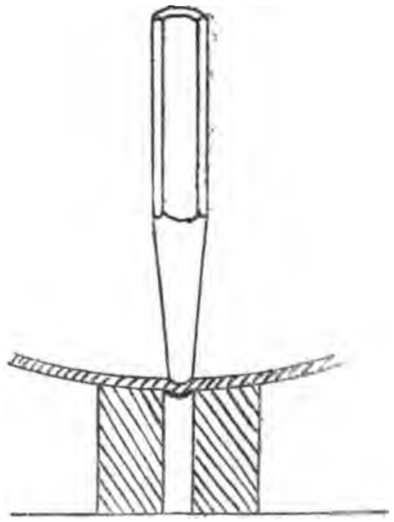


FIG. 13.

of the plate, as in Fig. 12, a rather more compact arrangement. Suitable dimensions are given, and the nature of this portion of the work scarcely calls for comment.

The inner ends of the springs are attached to links, I, whose lower ends are pivoted to the ends of the compensating levers J. The levers are of wrought iron, properly bossed up at centre and ends. In a model we may use malleable cast iron, for which a pattern will be required, if the bossing up of a forging is thought too troublesome. The levers are pivoted on the wrought-iron brackets K, bolted to the framings. The brackets are steadied, and the levers carried on the cross-shaft L, secured in the brackets with set-screws. Separate collars pinched with set-screws maintain the levers in position sideways. Ample dimensions are given.

The leading springs are shown in Fig. 12. These are of the same dimensions as the others, but their mode of attachment is different—not necessarily so—but I want to illustrate diverse methods. There is an advantage also in adopting the form of brackets there shown. Keeping the brackets near the top of the framing, and making them of the form shown, we do not encroach on or crowd the space properly required for cylinder feet and covers. To prevent crowding on the boiler also, I show the top hanger bosses fitting within the bosses of the top spring plate, instead of embracing them as in Fig. 11. A common alternative plan is to form hooks on the top of the hangers to embrace the spring ends.

The bracket, Fig. 12, K, bolted within the framing, is a guide to the buckle rod or thrust pin. It will be observed that there is no means of adjusting the tension on the leading springs. This is sometimes provided, sometimes not. The attachments made between the inner ends of the driving and trailing springs and the compensating levers are also often provided with adjusting nuts and screws; but they are not essential, and we omit them from the model.

J. H.

VIBRATIONS OF DIAPHRAGMS.*

THE telephone and phonograph show conclusively that the human voice is able to set certain bodies in active vibration. These vibrations may be detected by touch, but they are not discernible by the unaided eye. It has been shown that the force which produces them is able to perform a considerable amount of work. A telephone diaphragm is able to vibrate sufficiently to transmit speech, even when heavily weighted. A diaphragm, when placed in a horizontal position and damped by a 5lb. weight suspended from its centre, transmitted speech equally as well as one not so damped, the only difference being a considerable loss in the volume of sound.

Mr. Edison some years since devised a piece of apparatus known as the motophone, in which a diaphragm vibrated by the voice was made to rotate a wheel at a high velocity. In the phonograph the cutting stylus, which is moved by the diaphragm, exhibits, when in action, something of the power of the voice, and the engraving on the cylinder of the phonograph shows the complex character of the vibrations of the diaphragm, but on so small a scale as to be difficult of observation.

The use of the apparatus shown in the annexed engravings is, first, to show by means of the lantern that the telephone diaphragm vibrates, and, second, to exhibit by the same means the character of the vibrations.

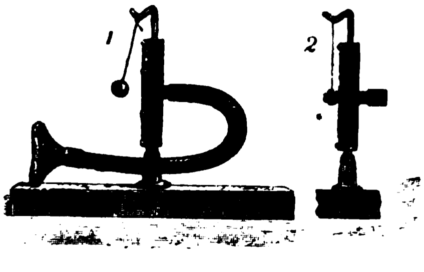


Fig. 1.—Experiment Showing the Vibration of a Diaphragm.

In Fig. 1 is shown a telephone diaphragm arranged upon a standard and adapted for projection. This apparatus is shown in section in Fig. 2. To the top of the diaphragm cell is secured a hook which supports a small metallic ball opposite the centre of the diaphragm by means of a fine silk thread. The ball hangs normally in contact with the diaphragm, but when sounds are uttered in the tube attached to the cell, the diaphragm is vibrated, its motion being made manifest by the repeated repulsion of the ball.

In Fig. 3 is shown an instrument for tracing upon a smoked glass a record of the movements of the diaphragm. A wooden frame is supported by a standard secured to the base-board. The face of the wooden frame is grooved to receive the smoked glass plate, which is held in the groove by four spring clips, so that it may be moved up or down after each tracing, preparatory to making a new one. In one edge of the frame are inserted two parallel rods, which are further supported by a standard attached to the base. The standards are made adjustable to adapt the instrument to lanterns of different heights. The arm which supports the diaphragm cell is provided with a sleeve which slides freely on the upper rod, and it is furnished at its lower end with a fork which partly embraces the lower rod. By this arrangement the diaphragm cell is truly guided while the tracing is being made, and at the same time the construction allows of tilting the cell whenever it is desirable to remove the tracing point from the surface of the glass. The diaphragm cell consists of two chambered recessed discs fastened together with screws, and clamping between them a thin iron diaphragm. The upper disc is apertured and provided with a flexible tube terminating in a mouthpiece. To the centre of the diaphragm is attached a stud, which is pivoted to the tracing lever, the lever being fulcrumed in a rigid arm projecting downward from the cell. The free end of the tracing lever carries a fine cambric needle, which lightly touches the surface of the smoked glass when the cell is in the position shown.

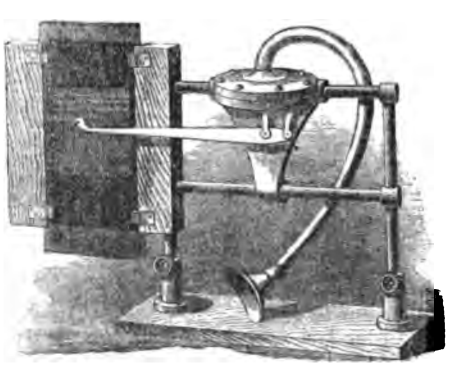


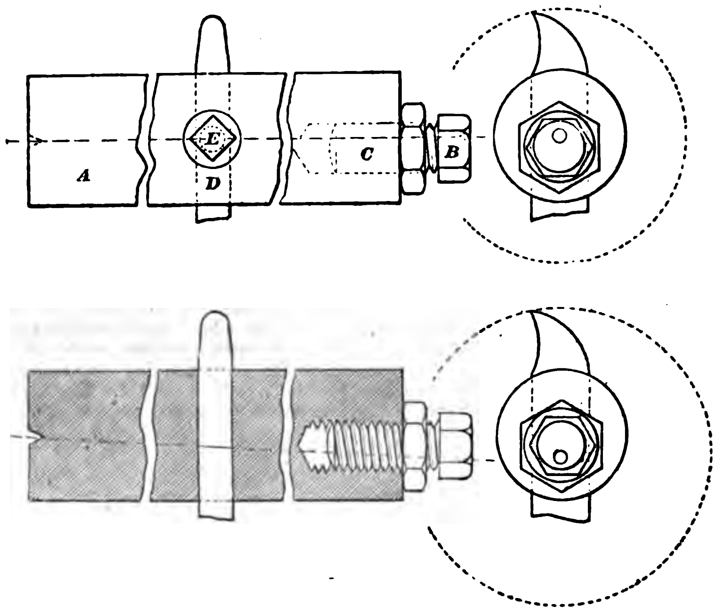
Fig. 3.—Phonographic Recorder.

The tracing lever is made of a thin bar of aluminium, which can spring laterally, but which is very rigid in the direction of its motion.

When used the apparatus is placed with reference to the lantern so that the opening of the wooden frame will come within the cone of light in front of the condenser. The smoked glass is focussed on the screen, the diaphragm cell is placed near the wooden frame and held in one hand, while the mouthpiece at the end of the flexible tube is held at the mouth by the other hand. Now, while a sound is made in the mouthpiece, the diaphragm cell is quickly but steadily drawn along, so as to cause the tracing needle to traverse the smoked glass. A sinuous line will be formed upon the glass, which will be characteristic of the sound uttered, and this line will appear upon the screen as it is formed. By tilting the diaphragm cell and moving the smoked glass, and then returning the cell to the point of starting, the operation may be repeated. It will thus be seen that, by means of this instrument, a sound may be produced and analysed at the same moment.

A GOOD BORING BAR.

THE following description of a useful boring bar has been sent to the *American Machinist* by Mr. F. E. Valiquet. The improvement consists of the bar A, in the end of which is the bolt B, put in $\frac{3}{16}$in. out of the centre of the bar. In the head of the bolt B there is a centre in line with the bar A (that is to set the bar true when you want it so); turning the bolt B causes the bar to run eccentric, raising the tool D from the centre and causing it to bore the hole larger. The check-nut C holds the bolt B in place. E is a bolt holding the tool in position, or a key might be used instead. I have, says Mr. Valiquet, used this bar, and prefer it to driving the tool with a hammer, especially when cutting V-threads. With a little practice the proper cut can be given, while with a hammer we do not know how much we move the tool. Of course, any distance may be taken for the eccentricity. I have taken $\frac{3}{16}$in. because that is the distance on the bar I have used; but I think less eccentricity would be better in most cases.



New Use for Tin Cans.—Scraps of tinned iron have long been a waste product, whose application, for any purpose worthy of the intrinsic value of the metals contained in them, has been an unsolved problem. It is true that scraps of this kind have been cast, but the hardness and granular structure render the metal fit only for use as weights. Also, to a slight extent, the tin has been removed by electrolytic processes. "But," the *American Manufacturer* says, "there has not been any definite use of this product as a material manufacture until its recent use for nails. Scraps of tin are cut by dies into rectangular bits, with a length of about three times their width. These scraps are then fed from an automatic hopper between dies, when they are squeezed first to square form, like a nail, and then headed. Nails of this kind are well fitted for many purposes, being free from tendency to rust, also light, very rigid, and capable of being driven into the hardest wood without buckling."

Sharpening Files.—Files can, it is said, be recut by cleaning them in acidulated water between two plates of carbon, and closing the circuit so as to form a real voltaic cell. The hydrogen liberated clings to the points of the teeth of the file, protecting them from further action; but the cutting action proceeds freely over the remainder of the file. This process speedily brings back the teeth of an old file to the original shape and dimensions, and does not merely sharpen them, but practically recuts the file, without necessitating either softening or re-tempering the metal.—This "invention" comes from America; but we don't think it is practised in an American shop where they really use files.

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* By GEO. M. HOPKINS, in the *Scientific American*.

SCIENTIFIC NEWS.

THE comet discovered by Mr. Barnard on Sept. 2, 1888, will, according to Herr A. Berberich, be about twice as bright in June and July as at the time of discovery, and will probably continue visible in powerful telescopes until October. In this month and May it is in Pisces, passing into Aquarius; but the N. Dec. will not be more than 3°, even when greatest, at the beginning of June.

A series of drawings of Jupiter, made at different times during 1881-86 with the 3ft. reflector at Birr Castle by Dr. Boeddicker, has been recently issued in the *Transactions* of the Royal Dublin Society. The drawings have been reproduced by a photo-mechanical process, and will be welcomed by all students of what is called the "Jovian surface." It is, however, certain that more reliance will be placed in future on photography for the delineation of celestial objects, as a check on the drawings of observers at the telescope, for it is clear that changes in the appearances of the planets are very rapid, comparatively speaking, and drawings made at the same time as photographs may lead to a better understanding of the phenomena which cannot be examined closely.

Solar phenomena may also be better understood by the photographic results being compared with eye observations; for although photography is an invaluable assistant, it would be unwise to trust it to the exclusion of drawings made by expert observers. Prof. Tacchini has communicated to the Paris Academy of Sciences a note on his observations of the solar surface made at Rome during the latter half of 1888, in which he states that a considerable increase in the number and extent of the spots was noted in September, followed by a notable diminution in October. A minimum of spots is prognosticated for this year; but it seems that protuberances augment as the number of spots decline.

Dr. A. Galle calls attention to the near approach which the small planets Clytie and Nemesis will make to each other during the coming summer, the proximity being greatest on August 15

The Directors of the Ben Nevis Observatory have applied to the Association of the Glasgow International Exhibition of 1888 for a grant from the surplus funds. It is time that this observatory should be rendered independent.

The death is announced of Charles James Blasius Williams, M.D., F.R.S., a distinguished student and teacher of pathology and clinical medicine. Dr. Williams was born in 1805, and graduated at Edinburgh; but he studied also at London and in Paris, where he was a pupil of Laennec, Audral, Gay Lussac, and others, being one of the first, if not the first, to practise in London with Laennec's discoveries in auscultation. He was elected a Fellow of the Royal Society in 1835, Fellow of the Royal College of Physicians in 1840, and later on Censor, Gulstonian and Lumleian lecturer to that body. In 1839 he was appointed Professor of the Principles and Practice of Medicine at University College Hospital, attracting large classes of students by the scientific character of his lectures, and his skill in diagnosis. Dr. Williams was also consulting physician to the Hospital for Consumption and Diseases of the Chest, Brompton, and may be regarded, with the late Sir Philip Rose, as one of its founders. He was the first president of the Pathological Society, and later on president of the Royal Medico-Chirurgical Society, and in 1874 he was appointed Physician Extraordinary to the Queen. He retired from practice in 1875, and afterwards resided principally at his villa at Cannes, visiting England only in the summer.

The deaths are also announced of Prof. L. Noiré, one of the foremost of German philosophers; and of Mr. Henry Swan, curator of St. George's Museum, Sheffield.

At the annual general meeting of the Chemical Society last week, Mr. W. Crookes, the president, delivered an address on "Recent Researches on the Rare Earths as Interpreted by the Spectroscope," in which he expounded at length his theory of "meta-elements."

The Easter excursion of the Geologists' Association will be to Lyme Regis and Weymouth, under the direction of Messrs. W. H. Huddleston and Horace B. Woodward. April 19 and 20 will be devoted to the former place—notable for its blue lias fossils; and April 22 and 23 to Weymouth, where the chief attractions are the coralline rocks and Kimeridge clay. The long excursion of the association in August will be to North Cumberland.

At a recent meeting of the Ophthalmological Society, Mr. Edridge-Green read a paper on "Colour-Blindness and Colour-Perception." He holds that the colour-perception centre of every individual is able to appreciate a certain number of units of colour—these units corresponding more or less closely to the bands of the solar spectrum. The average number of units is six—namely, red, orange, yellow, green, blue, and violet; but persons of unusually good colour-perception possess a seventh—indigo or dark blue. In people with colour-perception below the average, one or more units of colour are wanting; orange is the first to disappear, and is replaced by a widening of the red and yellow bands. Such an individual would belong to the five-unit class. Blue was the next band to disappear, the violet then extending to the normal blue-green junction. Mr. Edridge-Green gives the following "laws of colour-perception":—1. An individual can have no conception of a colour which does not form one of his psycho-physical colour units, or a very apparent modification of one of them. 2. If the colours belonging to two adjacent units are mixed, an impression of both units is obtained, which is plainly perceived as a mixture. 3. If two colours not adjacent are mixed, the intermediate colour will tend to be brought before the mind, or white will be the result in the case of pure light, grey where there is partial absorption. 4. If any number of colours are mixed, the resulting impression will be that of a unit, a modified unit, or white.

At the annual meeting on behalf of the Temporary Home for Lost and Starving Dogs, Battersea, Dr. B. W. Richardson referred to the admirable treatment the dogs received at the home, and dwelt upon the fact that five dogs affected with rabies had been taken off the streets. He also stated that 100,000 dogs had died peaceful deaths in the lethal chamber at Battersea, and that he had constructed a lethal muzzle for dogs which could be used in the streets by the police, and also a similar muzzle for horses.

The Croonian Lecture before the Royal Society, which is to be delivered by M. Roux, of the Pasteur Laboratory, has been fixed for May 23.

The Botanical Society of France has invited foreign botanists to attend a Botanical Congress in Paris during the latter half of August. The secretary to the organising committee is M. P. Maury, 84, Rue de Grenelle, Paris, who will give all information.

Dr. Kückenthal, of Jena, has been commissioned to make another journey to the Arctic regions for the purpose of zoological study in Spitzbergen, where he will stay during May to September.

In the *Mineralogical Magazine* the address of the retiring president is printed, in which Mr. L. Fletcher, of the British Museum, analysing the causes to which the unpopularity of mineralogy may be attributed, points to the refinements introduced of late years in the chemical and crystallographic departments of the science, and especially to the fact that mineralogy has been almost completely excluded from our educational system. The cheering signs of a renaissance are to be found in the growing popularity of microscopic petrography, for the proper study of which a knowledge of mineralogy is essential. Mr. Fletcher argues in favour of the introduction of crystallography into the training of every chemist and physicist.

The electrical method of purifying sewage was exhibited last week by Mr. William Webster, who, by permission of the late Metropolitan Board of Works, has erected at Crossness, an experimental station capable of treating 12,000 gallons per hour. The plant which Mr. Webster has laid down at his personal expense consists of a dynamo, a steam-engine, a shoot, and a couple of precipitating tanks fitted with iron electrodes. The current in passing sets free chlorine and oxygen, which act powerfully on the organic matter of the sewage, and that, carried at first to the surface, subsequently settles as a precipitate or "sludge" in the tanks, the effluent being "perfectly innocuous." The system is feasible on the face of it, and it is stated that the cost would be that of 8H.P. per 300,000 gallons, and the consumption of iron plates about 470 tons per annum to treat 10,000,000 gallons of sewage per day. The working cost is, in fact, estimated at 13s. per million gallons when carried out on so large a scale as would be necessary with the sewage of London; but to that must be added interest and depreciation, as well as the cost of dealing with the "sludge."

The Copper Syndicate has done good work unintentionally. As everyone knows, copper is a better conductor of electricity than iron; but there may be such conditions as render it cheaper to use iron for the leads, and it is certain that the high price to which copper was raised induced some of the electrical engineers in America to try iron, and it is not unlikely that they will continue to use it, though copper at a low price is obviously better than iron, if only because it lasts longer—a view of the matter which we expect has been overlooked by some of those who are working the electric railway "boom" in America.

That the Americans are going ahead with electric railways is clear; but although few data are available for calculation, the Daft Co. have such faith in their system as used on the New York Elevated Railway, that they are constructing an electric locomotive which will be capable of hauling eight loaded passenger cars. The power of any locomotive depends ultimately on its adhesion, and that varies with the weather, being only about 30 per cent. of the weight in the best conditions; but sufficient information has been gained (by trying experiments) to lead to the conclusion that in all weathers the electric locomotive will beat the steamer for adhesion, whenever the current is led by the rail.

Mining for rubellite is extensively carried on in parts of Burmah. It is a pink variety of tourmaline, and is extensively used in China for ornamental purposes.

Colouring Matter of Muscle.—This subject has received much attention since Kölliker, in his work on histology, published in 1850, first described it. A few years afterwards Valenciennes and Frémy found a peculiar colouring matter in the muscles of the trout, to which they applied the name of "salmonic acid." Kühne, ten years later, came to the conclusion that the colouring matter of muscles was identical with hæmoglobin. After the lapse of twenty years it was again investigated by Krukenberg and Wagner, who, partly from its spectrum and partly from other considerations, regarded it as identical with rhodopham. Very recently McMunn has contributed a long paper to the *Philosophical Transactions*, in which he has given in detail the results of his investigations on this subject, and endeavoured to show that in a large number of animals belonging to both the vertebrate and invertebrate series the tissues contain a special colouring material, which he names histohæmatin, whilst the muscles possess a special colouring matter named myohæmatin. The spectrum of histohæmatin closely resembles that of hæmochromogen, but that of myohæmatin is peculiar. Ludwig Levy has now published (in Hoppe-Seyler's *Zeitschrift für Physiologische Chemie*, Bd. xiii. Hft. iv.) an article containing the results of many experiments, from which he concludes that the substance named myohæmatin by MacMunn is not a colouring material proper to muscle, but is a product of disintegration of hæmoglobin, and that its spectroscopic characters, as well as its mode of origin and its reactions, demonstrate that it is hæmochromogen.—*Lancet.*

THE boring of the long tunnel on the Rhondda and Swansea Bay Railway, between Treherbert and Abergwynfi, in Glamorganshire, which is to connect the Rhondda Valley coalfield with Swansea, has been completed by the contractors, Messrs. Williams Jones and Co. The tunnel is 3,400 yards in length, and although, from the great height of the mountains, no intermediate shafts could be sunk, when the advanced headings met, the lines were so perfect that no divergence could be detected, and the levels agreed to within half an inch. Mr. Yockney is the engineer.

CELERY acts upon the nervous system, and it is a cure for rheumatism and neuralgia. Tomatoes stimulate the liver, and spinach and the common dandelion (prepared in the same way) have a direct effect on diseases of the kidney. Onions, garlic, and olives promote digestion, by stimulating the circulatory system, with the consequent increase of the saliva and gastric juice. Raw onions are also regarded as a remedy for sleeplessness, and the French believe that onion soup is an excellent tonic in cases of debility of the digestive organs.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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THE SPECTRUM OF THE AURORA—PROF. YOUNG'S "GENERAL ASTRONOMY"—THE REPORT OF THE KRAKATOA COMMITTEE OF THE ROYAL SOCIETY—ARTIFICIAL HORIZONS—ERRATA—γ^1 ANDROMEDÆ—THE GREAT GATESHEAD REFRACTOR—THE LIVERPOOL ASTRONOMICAL SOCIETY—DISTANCES OF THE FIXED STARS—KEPLER'S SECOND LAW—A NEW ASTRONOMICAL SOCIETY—ENCELADUS—THE SOLAR PARALLAX FROM THE TRANSITS OF VENUS—PHRENOLOGY—BARLOW LENS—FINDING THE FOCUS OF A CONCAVE LENS—STAR ATLASES—THE ACHROMATIC OBJECT-GLASS.

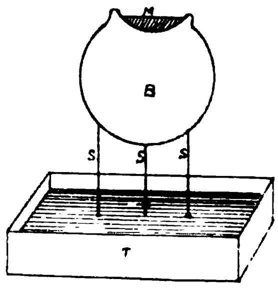
[29783.]—THE anonymous author of the article on Mr. Lockyer's meteoric hypothesis in the February number of the *Monthly Notices* of the Royal Astronomical Society tells us, categorically, that "the principal line in the aurora spectrum is shown to be in all probability the remnant of the manganese fluting at λ 558." As a very large number of people are in the habit of taking for gospel everything they read on such authority, I would invite particular attention to a paper read before the Royal Society on March 7th by him who is *facile princeps* among British spectroscopists, Dr. Huggins; in which it is shown, in a way that must convince every impartial observer, that the principal line in the auroral spectrum is *not* "the remnant of the brightest manganese fluting at λ 558" at all, but has a totally different origin.

By the way, in that admirable work just published, the "General Astronomy" of Prof. Young, of Princeton, U.S., it is very noteworthy that a certain "magnificent" hypothesis is practically pooh-pooh'd (of course in a polite fashion), although the question of cosmogony is discussed with all the ability to be expected of its eminent author. Apropos, for example, of the "collision theory" of temporary stars and those of the type of Mira Ceti, Prof. Young says (p. 484): "The fundamental idea that the phenomena of the temporary stars may be due to collisions is not new. *Newton long ago brought it out to some extent, and discussed it*" (the italics are mine); "but . . . it seems impossible that collisions could have been frequent enough to account for the number of temporary stars actually observed." Furthermore, an estimate of the value of the hypothesis that the collision of sparse meteorites renders the magnesium in them luminous, and so produces the bodies we know as nebulæ, will be found on p. 508 of Prof. Young's fine book, one of the most original that has appeared since the immortal "Outlines" of Sir John Herschel.

Up to within a week or two ago, my knowledge of the contents of the Report of the Krakatoa Committee was wholly derived from a review which you published some little time ago. Recently, however, a friend, eminent in the meteorological world, has kindly lent me the volume, which I have been reading with no little interest. I say this, perhaps, the more disinterestedly from the fact that I began its perusal with a distinct prejudice against any report of a committee established to support a foregone conclusion. Confining myself here to the optical phenomena exhibited during the series of years beginning with 1883, I must confess that while impressed with the mass of evidence adduced to show that they had their origin in the eruption of Krakatao (*not* Krakatoa, as it is erroneously called in the volume before me), I am not convinced by it. Reading the essays by Mr. Rollo Russell and Mr. Archibald, it is difficult to resist a feeling that both these gentlemen, so to speak, hold briefs for Krakatao, and that while giving all legitimate prominence to facts which tell in favour of their hypothesis, they minimise those which are adverse to it. Mr. Archibald's treatment of the testimony of Mr. Neville (then Mr. Neison), the Government Astronomer at Natal, affords a good illustration of this. So notable was the afterglow in February, 1883, that Mr. N. actually took the pains to make a water-colour sketch of one on the 8th of that month, The eruption of Krakatao, be it noted, occurred *in the following August*. Now, no one who knows anything of Mr. Neville (Neison) is ignorant of his training and ability as an observer; and hence to talk, as Mr. Archibald does, about "his *ipse dixit*" concerning the identity of the February glow in Natal with the subsequent August ones, and (in a civil way) to throw doubt upon his dictum that the phenomenon was practically in abeyance between September 15, 1883, and January, 1884, simply because Mr. Ballot (300 or 400 miles away) did see the afterglow during the latter period, seems to me to be putting the construction of a pure advocate upon the evidence. To me, as an outsider, believing that both Mr. Neison and Mr. Ballot were speaking the truth, this would rather seem to point to the local character of the phenomenon. Then, again, Colonel Ward's very definite observations on carefully recorded dates from May to the beginning of August, 1883, at Munich are treated in a way wholly incommensurable with their importance. I feel, in studying this part of the volume, much as I have often done in listening to a very able counsel who had several most damaging facts to explain away. Coming, now, to my own experience, I should like just to say that the extraordinary daylight haze which prevailed after August, 1883, did not cover the whole sky, but was confined to a definite region round the sun; in point of fact, its boundary was perfectly traceable on the blue sky by simply hiding the sun with the hand. Within the region referred to it was curiously opaque. I do not believe that I saw, or could see, the planet Mercury for eighteen months or two years. Now, had Krakatao dust been the cause of this curious obscuration, it seems to me that it ought to have extended all over the sky, and that bright stars in the Northern heavens ought to have been equally invisible with those immersed in the haze surrounding the sun, though, as a matter of fact, they were not. Perhaps I cannot sum up the impressions left on my mind after the study of the very able argument of Messrs. Archibald and Russell, better than by an illustration derived from a familiar Cambridge story. It is that of the undergraduate who, on being asked how he had got on with rather a stiff proposition in the examination room, replied that he could hardly say that he had proved it, but that he flattered himself that he had made it appear exceedingly probable to the examiners. For myself, I feel in the condition of one of the examiners referred to.

In letter 25330 (Vol. XLII. p. 488) I figured and described a form of reflecting mercury-trough or artificial horizon, devised by M. Gautier, which exhibited some manifest improvements on the old open, metallic vessel. In practice it has since been found that this still, to a small extent, transmits the vibrations of the earth; and I see, from No. 2 of the *Proceedings* of the Société Astronomique de France for the current year, that M. Mailhat, while preserving the general form of the instrument, claims to have largely increased its efficiency by certain modifications in its construction. In the apparatus as now made by MM. Secrétan and Mailhat a canal or groove surrounds it, and a silvered plate wetted with mercury is placed at the bottom of the cistern. The tension of the mercury incident on the junction of the comparatively large quantity in the exterior groove with that just covering the plate, reduces the latter to a very thin film, without destroying its horizontality; and this condition of things offers great resistance to oscillations, whether caused by wind or by tremors in the soil. By constructing the cistern of vulcanised indiarubber instead of brass, the weight is reduced to about $\frac{1}{4}$th of that of the trough in its original form; thus rendering it exceedingly portable for the traveller.

Talking about artificial horizons, here



is one of the most remarkable forms that I have so far ever come across. It has been devised by that well-known Belgian savant, and occasional contributor to these columns, M. Ad. de Boë, of Antwerp, and is described by him in *Ciel et Terre* for March 16th, 1889. It consists in effect of a small hydrogen balloon, B, of from half to a whole cubic mètre in capacity, so constructed as to carry on its top a small quantity of mercury, M. It is maintained in equilibrium by three filaments of silk, *s s s*, fastened to three small discs, so weighted as to float in a cistern of tar. The inventor claims that by this arrangement all effects of terrestrial tremors are annihilated. I shall be very curious to learn how this contrivance will work.

On seeing letter 29737 (p. 70) in print, I note that, as of aforetime, the compositor has, in places, done me much evil. *Imprimis*, in paragraph two, "radiatory streaks" appears where I wrote "radiating streaks." Next, in paragraph six, "as of the highest authority," should be "as that of the highest authority." Furthermore, "compiler," in paragraph nine, should be "writer." As I never saw the book in my life, I am ignorant whether it is a compilation or whether it is original. Finally, in the concluding paragraph, "might be taken to be its centre of gravity," should read "might be taken to be a point *just* below its centre of gravity."

In the interesting and important List of Double Star Observations by Mr. S. W. Burnham (referred to in your "Scientific News" on p. 69, I find him saying, under the head of γ (presumably this is meant for γ^2) Andromedæ, "1888·6. Only a slight elongation in the direction of 120° with 2,700 on the 36in.," whence it would appear that superposition, or something akin to it, is about to take place with this remarkable pair. Now, one of the components is blue and the other yellow, and the colour of the light emitted when the stars are actually superposed might enable us to determine which of the two it is which is the nearer to us.

I am sincerely pleased to read, too, on p. 69, that Mr. R. S. Newall has apparently acted on Terence's advice, "atque ex aliis sumere exemplum sibi," and has followed up Lord Crawford's princely donation to the nation by his own noble gift to the University of Cambridge. Assuredly the Great Refractor will be there utilised in a manner which the mere climate and atmosphere of Gateshead has hitherto prevented, had no other cause been in operation. The names of the Syndicate alone afford an earnest of the legitimate use to which the monster telescope will be put. Let us hope, as we may well believe, that it will now be the means of advancing astronomical science, and of increasing our knowledge of the visible universe.

In connection with the letters of "Mimas" (29708, p. 50) and Mr. Mee (29739, p. 70), I can scarcely feel that the Liverpool Astronomical Society has lately been proceeding in a way calculated either to extend its usefulness, or to tempt correspondents to transfer their communications from the columns of the ENGLISH MECHANIC to the pages of the *Journal*. Formerly regular reports of its meetings used to appear in these columns and in those of your excellent contemporary the *Observatory*; but for some considerable time past these have ceased. Why is this? Are the powers that be ashamed of what they are doing?—is this a covert way of rendering the Society practically an absolutely local one—or what? I cannot, and will not, believe that such men as Elger, Davies, Denning, Gore, Herbert Sadler, Monck, and Backhouse can either countenance or connive at any attempt of this sort. Moreover, the most curious reports reach my ears as to the manner in which things are conducted. I am told, I hope under some misapprehension, that the name of that thorough astronomer, the Rev. T. E. Espin, was *struck out* of the list of members! And, again, I learn, in a very roundabout way, that the library of the Society is kept in a fashion which would somewhat astonish the donors of many of the really valuable books it contains; in point of fact that, covered with dust and dirt, the books are stored away on two shelves in an upper room of a second-hand bookshop! Looking through the Catalogue, I should myself have thought that the Society might have contrived to purchase a good roomy bookcase at an auction (if they could not afford a new one), to stand in their meeting room and hold the works for which they are indebted to so many astronomers of position and eminence. I would venture to hint that if this allegation is true, and the truth becomes generally known, the fountain of munificence will dry up very speedily indeed, as far as donations of books is concerned; and hence shall be only too glad if it can be authoritatively contradicted.

I do not quite see what Mr. Blacklock is driving at in letter 29741, p. 71. I think it quite possible that there are other stars in the sky at the same distance from us as α Centauri, or as 61 Cygni; but they may be of all sizes, some of them, perhaps, so minute as to require large telescopes to discern them at all. All that modern astronomers say is that magnitude, *per se*, affords no criterion of distance, as erroneously supposed by Sir William Herschel.

"Finsbury" sets his brother "astronomical readers" a very pretty little job indeed in query 68188, on p. 80. If he is unfamiliar with the Calculus, he might rough out his problem graphically, by drawing a circle outside of his ellipse, having the semi-axis major of the latter for radius, and then dividing this circle into equal areas about that focus of the ellipse in which we suppose the sun to be placed. Lines perpendicular to the major axis from the points of division of the circle will cut the ellipse in points which, joined by lines from the focus, will divide it into equal areas, and then the angles between the radii vectores may be measured by a protractor. In this way he will find that the angle described in the second unit of time is about 9° 45′ or 9° 50′.

It is a well-known fact that many men have had their attention directed to the study of astronomy by the apparition of a conspicuous comet. A cognate effect has obviously been produced in California by the occurrence and observation of the total solar eclipse of January 1st, for to-day's post brings me the first number of the *Publications* of the Astronomical Society of the Pacific, containing an account of the institution of that association and a copy of its by-laws. When I say that it numbers among its members such men as Barnard, Burnham, Burckhalter, Hill, Holden, Keeler, and Schaeberle, together with numerous others whose names are less familiar on this side of the Atlantic, I do not think that I need expend much space in pointing out the service to astronomical science which such a society may, and must, render.

Whatever object Mr. Duke may have mistaken for Enceladus, it can assuredly not have been a star of the 9th magnitude, as suggested by Mr. Bone in letter 29764 (p. 92). Why, a 9th magnitude star is visible with 1in. of aperture!

In reply to the question put to me in the same letter, the equatorial horizontal parallax of the sun has *not* "been authoritatively set down at 8·81;" unless my querist is content to accept *Nature* as an "authority"! The value quoted from the annual report of the Council of the R.A.S. in 1888, as that arrived at by the Transit of Venus Committee, is a fairly probable one, and as likely to be true as any of those derived from the observations of 1874 and 1882. I can say no more. Certainly we have learned by this time that the Transits of Venus are by very far from affording the most trustworthy means of determining the Solar Parallax. The *Nautical Almanac* adheres to that of 8·848″. The parallax is always computed at the earth's mean distance from the sun, so that if we accept it as being 8·832″, we must be at a mean distance of 92,559,800 miles from the centre of the Solar System. The eccentricity of the earth's orbit on this scale in miles would be 1,552,338; so that in perihelion we should be 91,007,462 miles from the sun, and in aphelion 91,112,138 miles.

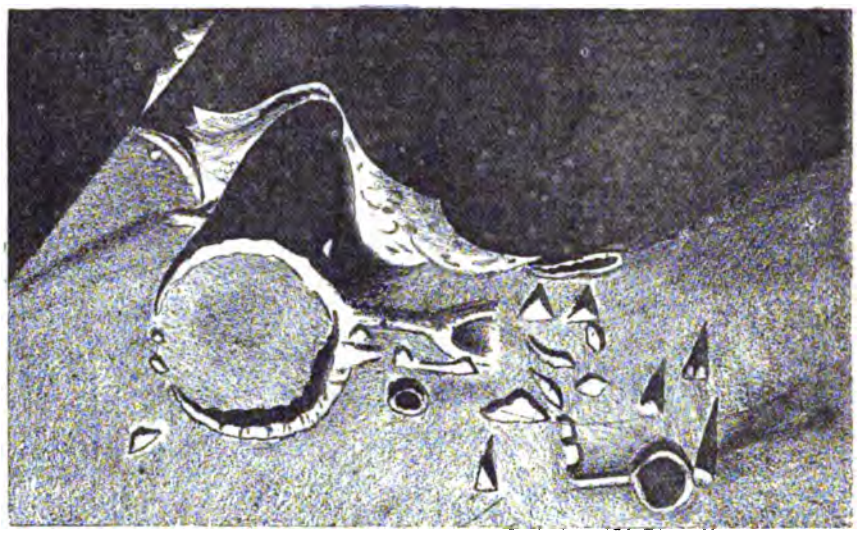
Would Mr. Mark Moore (letter 29778, p. 94) be surprised to hear that I wrote the paragraph on which he comments with "Phrenology made Practical and Popularly Explained," by Frederick Bridges (London: Sampson Low and Co., 1857)—open on the table before me? I think I am almost as familiar with the contents of that work as Mr. Moore can possibly be. As your correspondent obligingly recommends a book for my study (that I happened to know it from cover to cover is a mere detail), may I urge him to read Dr. Charlton Bastian's "The Brain as an Organ of Mind," in the International Scientific Series? Where are photographs of Pigott in profile as well as in full face obtainable?

Query 68232, p. 100, apparently emanates from someone who has made the acquaintance of the English Mechanic very recently indeed, inasmuch as some of his questions have been answered five, some ten, and some twenty times in these columns at the very least. I really hardly like to ask our Editor to waste his space by the admission of so many and so frequently-reiterated replies; but I will trust to his good nature, and do what I can for my new brother-reader, "F.S.A." Premising that the real use of a Barlow lens is to amplify the magnifying power of a telescope for the purpose of measuring double stars, and that it invariably impairs, more or less, the definition of any really good telescope, I may begin by informing your correspondent that it is a *negative* combination, consisting of a convex flint lens and a concave crown one. It is generally placed some 4in. or so from the field-lens of the eyepiece, between that and the object-glass. As for its focus, that depends upon the amount of magnification required, concerning which I may quote a letter from Barlow himself to Dollond, reprinted in the *Philosophical Transactions* for 1834. "In order," he says, "to render it achromatic, it is only necessary to make the foci of the lenses proportional to their dispersive powers, as in the object-glass itself, except that here the crown lens must be concave and the flint lens convex. Suppose, for example, the compound lens is to be placed at a distance *d* from the focus, and that the (size of the) image is to be doubled, then the focal length of the compound lens must be $2d$; for $\frac{1}{d} - \frac{1}{2d} = \frac{1}{2d}$. Again, δ being the dispersive ratio, we have $f = 2d(1 - \delta)$ = focal length of the crown lens and $f' = \frac{2d(1 - \delta)}{\delta}$ = focal length of the flint lens." Having said which, I must reiterate that a Barlow lens is only of use for micrometrical work, and a snare and a nuisance for mere planetary or stellar observation. In the next place, I have answered "F.S.A.'s" query number two pretty recently here, and am greatly tempted to refer him to some of your later volumes. However, once for all, he may measure the (negative) focus of a concave lens by first cutting a circular hole in a piece of paper, and sticking this on to his lens, which will now virtually become a circular one of the diameter of the hole—say, 1in. Now on another card he must describe a circle of 2in. in diameter, and let the sun shine through the 1in. concave lens on to this second card, which he must shift to and fro until the circle of light exactly fills the 2in. circle. The distance between the lens and the card will then be equal to the (negative) focus of the former. Thirdly, Klein's atlas is superior to Proctor's for telescopic stars, of which it contains so large a number; but for naked-eye stars and their identification, and that of the constellations, Proctor's is decidedly the better of the two. Each has its own special use. "F.S.A.'s" concluding question cannot be answered here, as the forms of object-glass vary, and everything depends upon the refractive and dispersive indices of the component discs of crown and flint glass. He had better study some such work as that of the late Sir John Herschel on the telescope, published by A. and C. Black; or, perhaps better still, as a popular exposition, read an article by the lamented Prebendary Webb on pp. 579 and 580 of your XIII. volume. It is contained in No. 336, and if "F.S.A." cannot obtain the volume, it would repay him to offer a handsome price for this single number.

A Fellow of the Royal Astronomical Society.

LUBINIEZKY.

[29784.]—The accompanying view of Lubiniezky, taken with a 3¾ Wray, 220 e.p., on March 11th, about 7 p.m., shows some detail that I do not see later, though it does not lose in interest as the formations to the N.E. of it come into view. On the 9th I fancied the floor of Hyginus appeared convex, or as if there was a mount. And on the 13th, while the W. wall of Marius was still of a dark brown tinge, there appeared a white spot on centre of E. wall, and another a little to the S. of it, both extending right across the portion of wall that was visible.



Reading. **G. T. Davis.**

VENUS.

[29785.]—M. Flammarion (letter 29761) says I have declared his ideas not "*in agreement* with the actual state of his knowledge," and asks me to say "in what they appear to me in contradiction with observation."

If he will kindly refer to letter 29740 again, he will find I did not say this, but merely "are not warranted" by actual knowledge. I think this is somewhat different. To assert that the moon had a large ocean on the other side would neither "be not in agreement" with actual knowledge, and still less "in contradiction," but certainly would not be warranted by observations.

I trust I did not imply that M. Flammarion sought anything but the truth. It would ill become me to enter into controversy with so eminent a man; but as he asks a direct question, I feel I must reply. The conclusions I think not warranted by the actual state of our knowledge are those as to the relative powers, intellectuality, &c., of the inhabitants of Mars and Venus as compared with those of the earth. M. Flammarion says, if I remember rightly (I have not *L'Astronomie* before me as I write), that there is all probability the inhabitants of Venus, whatever else they may be, have sensations less delicate and lively than ours, and are our inferiors in an intellectual point of view; that without doubt they have less nervous sensibility—less of *finesse* of sensations. It is scarcely doubtful that Mars is inhabited by beings more advanced than we; less heavy (*lourds*), and without doubt more intellectual. I do not think the actual state of our knowledge warrants these conclusions. In fact, I think we are absolutely without any knowledge whatever. There are further remarks in the same vein; but I have written enough to answer M. Flammarion's question, and as much as the Editor will find space for.

I in no way depreciate *L'Astronomie*, and in all probability I have caused some to refer to the original article upon Venus, and thus have rather served the ends M. F. is anxious to forward than hindered them. I only wish our English astro. journals would approximate more nearly to this French publication. Especially I would hope to see the journal of the L.A.S. rivalling it in range, illustration, paper, and contents. They certainly manage this better in France.

Edwin Holmes.

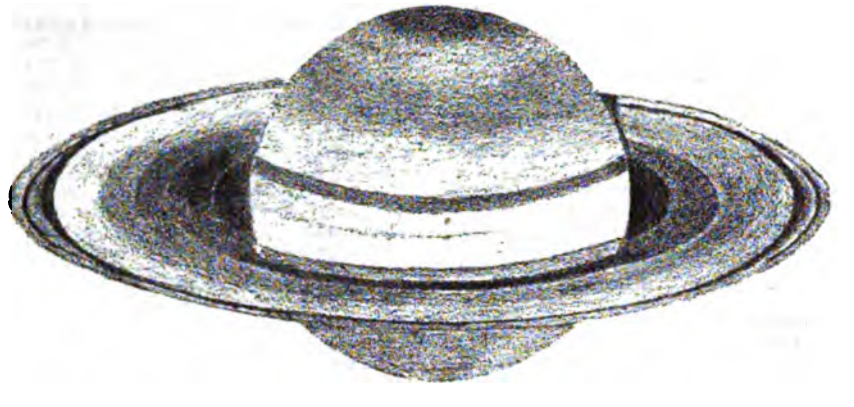
ASTRONOMY—A "SECOND ROTATION OF THE EARTH."

[29786.]—Have any of your amateur or professional astronomers read "Thirty Thousand Years of the Earth's Past History," by Major-General Drayson, 1888. This work professes to set forth a second rotation of the earth, by which the author means the motion of the North Pole round the Pole of the Ecliptic, which has, he says, been hitherto erroneously fixed, and the time of this "second rotation" he fixes at 31,682 years, instead of 25,868, as I have usually accepted, and given by many authorities. The author also states that astronomers are wrong in describing the motion which produces the precession of the equinoxes as a motion of the earth's axis on its South Pole. I don't know where he gets this idea. I have always supposed that the earth's axis *wobbled* on its centre; that the South Pole was as much to the east as the North Pole is to the west of the poles of the Ecliptic. I wish to ask your astronomers whether "a second rotation of the earth" is a correct expression? I think not. He further says that "The pole of the second axis of rotation is always at right angles to the arc which the pole of the heavens is tracing, in consequence of the second rotation" (see page 38). What is meant by a point (the pole) being at right angles to a line? I confess I am puzzled, but the author has written other books, which I have not read, and should speak with authority, having been professor at the Woolwich Academy. I should also like to know as to the 25,000 or 31,000 years period—who is right? Is not this period arrived at by the closest observation of the sun's position in reference to stars, and not by calculation outside observation? I gather from the preface that astronomers did not at first give much weight to Major-General Drayson's doctrines; but is this so now? He claims a new discovery. What is it?

Stroud, March 30. **W. J. S.**

SATURN.

[29787.]—In response to Mr. Hallowes' invitation, I send a sketch of Saturn as seen on March 3



with powers of 325 and 425 on a With mirror of 8¼in. Ring A has a bright band, ill-defined on the inside, but bounded on the outside edge in both ansæ by a clear black line. Ring B has the outer part very bright, then a dusky zone, and on the *p.* side a decidedly darker zone on the inner edge. Ring B is plainer altogether on the *p.* side, whereas ring C is less distinct on that side, and has a dark, undefined patch upon it.

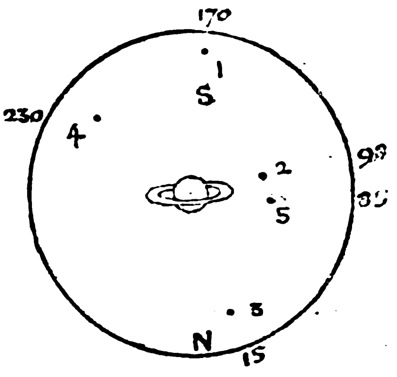
Turning to the ball, the bright equatorial band has a slight dusky marking about the middle, and the narrow dark band south of it, if not double, is better defined at the edges than elsewhere. The last note I have of the shadow of the rings on the ball in the north hemisphere is on Jan. 20.

P. H. Kempthorne.

Wellington College, March 22.

THE FIFTH SATELLITE OF SATURN.

[29788.]—On Friday night, the 24th March, I was rather surprised to see what appeared to be five satellites of Saturn, as per diagram. My instrument is a reflector, 6in. aperture; power used on this occasion, 140, without stop; time, 11.50. The night was favourable up to this time, and definition very good generally. I have numbered the satellites in order of brightness, and given the approximate position-angles, and shall be glad to hear if I have seen Enceladus, about which there have been statements lately as to its non-visibility even in a larger aperture than mine.



No. 1 was the brightest; No. 4 I caught steadily, but could see it best when the planet was out of the field; while No. 5 was very difficult, but I am sure I saw it for 5 seconds at a time; No. 2 was easy.

Ophiucus.

VARIABILITY OF WHITE REGION ON SATURN'S RING.

[29789.]—Several good observations have been secured of the "white region" on Saturn's ring, announced by Dr. Terby. It comes out almost conspicuously in the 10in. equatorial at times.

To me the brilliancy of the "white region" appears variable. Fluctuations of the light at irregular intervals of a few minutes have been detected by careful scrutiny.

William R. Brooks.

Smith Observatory, Geneva, N.Y., U.S.A.
March 19.

SKETCHES OF CELESTIAL OBJECTS—SATURN.

[29790.]—In letter 29782, p. 94, "Reflector" asks how the size of celestial objects, as shown in sketches in the "E. M.," is arrived at, and he gives as an instance the sketch of Saturn on p. 72. I may say, in reply, that the sketch in question was drawn to no particular scale. I merely selected the size Saturn is usually represented in drawings as being the most convenient and sufficiently large to allow of the various details. Of course, it is easy to compare the size which an object appears in the telescope with the moon as seen with the naked eye. It is only necessary to multiply the angular diameter of the object by the magnifying power one is using, and then compare it with the moon's angular diameter. Thus with a power of 330, the diameter of Saturn's globe = 3·3, and the major axis of the ring = 7·9, the moon being 1. "Reflector" may perhaps be referred to p. 16 of Webb's "Celestial Objects."

Observing Saturn last night (30th March), I saw very distinctly what I have suspected on several occasions recently—a bright strip along the inner edge of the *f.* ansa of ring A. If visible at all in the *p.* ansa, it was very indistinct; but Encke's division was seen in this ansa.

Have not the dark belts on the southern hemisphere become much fainter recently? On Jan. 7th there was quite a conspicuous belt about half-way between the dark equatorial band and the pole. Within the past few weeks this belt appears to have been gradually fading, and it has become so faint and diffuse that it now hardly deserves the name of a belt. The dark equatorial belt itself seems less distinct than it has been.

I may observe, by the way, that the "soft dark shading" (Encke's division) has, through some means or other, been omitted in the reproduction of my drawing on p. 72.

Didsbury. **Geo. P. B. Hallowes.**

ASTRONOMICAL.

[29791.]—In reply to Mr. Mee's letter (29739), I happened to be observing the sun on the same afternoon as he mentions. Clouds were constantly interfering. I was, nevertheless, a little more fortunate here, for I saw a group of spots with great difficulty, but could not be certain of detail.

Now, to come to the point: I would state that while making the sketch at the telescope I was then using a 2¾ Tulley. I witnessed the very phenomenon Mr. Mee has already described, and must say I was also puzzled by it. Being only an amateur, it was new to me. The space around the sun appeared quite blank; but across the face of the sun itself innumerable particles were moving in an upward direction, and soon obliterated every detail except the round limb and disc.

Soon afterwards the true explanation came; for a few snowflakes fell, and ultimately I was driven indoors by a snowstorm.

Hereford, March 25. **G. Parry Jenkins.**

LOCKYER'S "ASTRONOMY" AND "F.R.A.S."

[29792.]—Your learned correspondent, whose identity is masked by the pseudomyn [*sic*] of "F.R.A.S.," has evidently no love for Prof. Norman Lockyer in his heart, for if there be the ghost of a chance of bespattering him with abuse he avails himself of it. If no opportunity occurs, he creates one.

Never was this spleen—for it can be nothing else—exhibited in a more despicably unscientific manner than in the reply to "Autolycus" as to the derivation of the frontispiece in Lockyer's shilling primer of "Astronomy." The picture is a good copy of Copernicus, as given by Nasmyth and Carpenter on p. 96 of "The Moon." I have compared the two pictures, and certainly with no detriment to the copy. The same picture is given in Lockyer's "Elementary Lessons in Astronomy," now in its thirty-fifth thousand, and is printed on better paper than that of the primer. In this case almost every detail in the crater is shown. Altogether, no one could say that the plate was not a good representation of Nasmyth's, and, therefore, of the crater Copernicus.

I received my first astronomical knowledge through these two of Lockyer's works, and I feel inclined to suggest to "F.R.A.S.," when he sarcastically remarks he has never seen the primer in question, that he is only blaring forth to the world his own ignorance, and sneering at a work of which he knows nothing.

Again, how very absurd was the statement that Prof. Lockyer very likely did not know himself what his frontispiece meant. It may be possible, but it certainly is not probable, that a man could use good telescopes for about a quarter of a century and then not know the elementary part of his subject.

I have read in the pages of the "E.M." many remarks on the meteoritic theory as brought forward by Prof. Lockyer, but I have failed to find one scientific argument against the spectroscopic evidence adduced. I am an ardent student of astronomy, and a lover of truth. As far as I can see, Prof. Lockyer has made good his case, but I am open to conviction. The meteoritic theory at least is as good as Laplace's nebular hypothesis, and has far more evidence to support it also. I believe Prof. Lockyer has never claimed the authorship of the the theory, although he partially propounded it in 1877. What he has done has been to make a spectroscopic examination of the heavenly bodies, his investigations are open to all, and he invites astronomers to follow up his work and to test it. That is the desire of every scientific man. Why, then, does not "F.R.A.S." disprove the evidence and cut down the theory altogether? He has not as yet done anything of the kind, and I now challenge him to point out to me where Prof. Lockyer has gone wrong; he would then earn a reputation for himself, and the everlasting respect of **Richard Arman.**

115, Rylston-road, Fulham.

REFLECTING TELESCOPE.

[29793.]—The arrangement shown in Mr. Davis's diagram would not be practicable, I fear, except perhaps, on a small scale, on account of the difficulty of working the prism; but it reminds me of an old device of my own, which my partial loss of sight will not now allow me to put to the test. Possibly some one may have sufficient curiosity to make the experiment, so I will describe it.

Take an ordinary refractor, and half-way down the tube insert a plane mirror at an angle of 45° with the axis of the object-glass, such mirror being slightly larger than half the diameter of the o.g. in its shorter axis. Opposite this mirror an opening is made in the side of the tube, and a length of tube attached at right angles to the main tube. This lateral tube carries the usual size eyepieces and focussing arrangement. It also serves as one trunnion for the telescope, and rests in a V or other support. The other trunnion is similar, and may be either solid or tubular, and of any convenient length.

It is evident that, as the eyepiece remains in the same place, no matter what angle of elevation is given to the body, observations may be comfortably made from the horizon to the zenith.

I have not "thought it out," but I think this arrangement would admit also of a special method of illuminating the wires of a transit or other eyepieces.

Of course, if preferred, a prism might be substituted for the mirror.

Will "F.R.A.S." kindly say if this plan is new, and if he considers it practically workable?

A. S. L.

[29794.]—In reply to "Reflector" (letter 29782), I have a metal Cassegrain 5¼ aperture, of my own mounting, with which I can see almost all the detail in the sketches of Saturn which have appeared in "Ours" of late, and can assure him and his friend that they are not overdone and misleading except in the fact that the delicate shadings are difficult to reproduce. Cassini's division is well shown, and the crape ring also, though not so well seen by one or two friends who are not regular observers; the principal belts are quite plain, and three, and sometimes four, of his satellites visible. The markings on Mars were sometimes very fairly seen during the last opposition; also the cloud belts on Jupiter—not faint, but very plainly seen. I think "R.'s" 6¼ must be badly mounted or his eyesight defective. The large mirror of my telescope I had parabolised by Mr. Linscott, and the small one I cast, wrought, and corrected myself, and made all the mountings.

C. May.

[29795.]—I noticed "Reflector's" letter in yours of March 29th respecting a drawing of Saturn which appeared in the previous number. My experience is that a reflector 6¼in. ought to do more than he says it does. It ought at all events to show the belts of Jupiter distinctly. Still, Mr. Hallowes goes, I fear, to the other extremity. He seems to me to draw too much on his own imagination. This has a bad effect, as others who possess even good instruments get dissatisfied. They think that as their telescope will not do what another says his does that there must be something the matter, and in a case where an amateur is making an attempt, he is disappointed, and throws his work aside, concluding that he cannot, after exhausting all his power, produce an instrument worth having. How Mr. Hallowes can see with his 8¼in. anything like the drawing, I cannot conceive. With my 12½in., which is a very fair one, I can see nothing like it. A friend of mine, who lives within a stone's throw of me, has an 8½in. With, strongly mounted. Mr. With pronounced the speculum to be one of the finest he ever made. He has a "perfect flat" by Browning, and a large battery of eyepieces of first-rate quality. I had a look at Saturn on several occasions lately through it, but neither he nor I can see anything what Mr. Hallowes does. Another friend of mine has an 18½in. by Calver, equatorially mounted, with all accessories, and he tells me he cannot see anything like the drawing.

Star Gazer.

NEWTON AND COMETARY FLOODS.

[29796.]—I wish the "F.R.A.S." would quote, or else refer us to, one of the "x times" that the explanation of the last earth-catastrophe, by a comet, has been "exploded," according to him on p. 70. Of course, I am aware of his own amusing dread thereof, and have read each of his tirades about "crazy trash, nonsense," and so forth, for about these twenty years. In fact, thanks to the sensational contents-bill heading every column of his, I can pick them out, and they are the only bits of his writing that I do read. If he let it alone, I should comparatively have neglected it; but I learn, from its effect on him, its real importance and value. I am like the Spanish matador, who learns from the bulls the utility of red cloth. Besides, I begin to reason that, if there were any real flaw in this theory, this "F.R.A.S." would be just the person to have detected and shown it long ere this. His inability to get beyond "crazy trash" and "cometic nonsense" (and that even in twenty years) is a fact speaking volumes, and to which I would draw special attention.

He has now found that some Scotchman wrote to Huyghens (p. 70) that Newton had been inactive and supposed "insane for these eighteen months," in 1694, which happens to be the first of the thirty years during which the other great philosopher (not "insane" Newton, but Halley) left his paper on this subject unprinted, but in the Royal Society's archives. Meanwhile, Newton's "insanity" (or what the unknown Scotchman called so) did not hinder his becoming, in 1696, a Warden of the Mint, and, three years later, Master of the Mint, for twenty-nine years, with more advantage to the nation, all have admitted, than any other master thereof. Moreover, the bulk of his scientific works (even if previously written) first appeared in this period —not before the "insanity," but after. Well, in 1724, the extravagantly ambitious book of Whiston, "New Theory of the Earth," having of course embodied this cometic account of the Deluge (as anyone up to the discoveries of that day must have seen to be necessary), its publication drove Halley to bring out and print his paper of 1694, merely to show there was nothing new in Whiston's book except its errors (which time would safely dispose of), for this obvious connection of the Diluvial catastrophe with a comet had been long broached by Halley himself.

I wonder what scientist of to-day would keep one of his papers 30 years, and then find nothing to alter! Halley printed exactly what he had given the Society 30 years before, without altering a word. He had spoken, at its end, of the theory being "worthy to be cultivated," and it has been a puzzle to me why nobody else, especially why Newton, seems never, in those years to have commented on it. Now, our "F.R.A.S." has just supplied the missing explanation. The reading of Halley's paper, in 1694, was exactly during the few months of Newton's absence. He missed hearing it, and though of course he needed no Halley to bring the subject to his great mind, but must often in those years have dwelt upon it himself, he either wrote nothing on it, or nothing that has reached us (for we must not forget there are 4,000 sheets of his writings still kept from us by priestly bigotry); but only, when 80 years old, being consulted by Whiston about the latter's forthcoming work, approved of the cometic notion "in general." Whiston is too honest to say he had approved of the whole book, or of any details.

"F.R.A.S." says of Newton that it is known "what crazy nonsense he wrote when he touched theology." Now, I challenge him to produce the single line that he calls "crazy nonsense," either in Newton or any one of these three eminent scientists—even a line of the most voluminous and only theological one, Whiston. The man whom Newton, with all England to choose from, persuaded Cambridge University to take as his own successor, I persist in calling (though he was a parson) a scientist, and one of the best of his day. His details about the causation of the Flood by that particular comet, of the 575 year period, were, of course, rash and premature; but that is all—nowise "crazy" or even unscientific. They were inconsistent with facts now known, but with nothing then known. Indeed, it was not his science, but his theology, that was here at fault. In contradiction to Scripture, which makes the "end of all things," as to the human race, always equally imminent, he, by making such end depend on that particular comet, gave us 574 years of safety between every two of danger. Newton would not have done that—having far more reverence.

The only pages of Newton's I have seen that really touch theology are the two or three splendid ones in the introduction to his "Optics," on the being and attributes of God, so far as, he said, the discussion thereof "does certainly belong to natural philosophy."

I should like to know who has ever controverted those, or what church father has ever treated the subject better. I know of none treating it so well. It is not unlikely that a good deal of the suppressed 4,000 sheets of his, if ever seen, may turn out to be theological, and, if so, I venture to predict, he will some day be quite as much read and valued for his theology as for his mathematics; but, of course, this is counting unhatched chickens. Poor Britain will have to see the last lord bishop, and last of lords, probably, spiritual or temporal, before knowing much more of what her greatest scientist left her. We know that in his day "whenever Newton made a discovery, somebody had to discover that he had made it," and so it must still be.

Among his relics, some of the most laboured, and which will be the most valuable, are of a kind not strictly theology, but bearing thereon; as the "Chronology of Ancient Kingdoms," and the posthumous unfinished "Observations on Prophecies of Holy Writ." The research in them is immense, and I am convinced they will some day be of more use than all our clergy have ever written since.

E. L. G.

THE AFTER-GLOW—THE ZODIACAL LIGHT—VENUS.

[29797.]—Has anything been seen recently elsewhere of the "after-glow" phenomena? I ask because several times since the beginning of the present year I have witnessed indubitable faint recurrences of the phenomena of the rose-pink sunset glow. They have, as so often before, been associated with colder weather, and in more than one instance (especially latterly) followed at a greater or less interval by the same kind of *fine* rain of which I have made mention in previous communications as succeeding this phenomenon. One marked repetition took place on Jan. 26th, and another on Tuesday, Feb. 5, and there have been others since. On all occasions the phenomena themselves, the sequence of their details, and the interval separating the maximum from the period of actual sunset, agreed with previous displays, so there was no doubt about the matter. As to the meteorological phenomena, I may note that in the early part of the week following Jan. 26 there was fine rain. The weather continued, as it had been, very mild, and remained so until the 1st Feb., when it changed—and changed in right earnest. On later occasions something similar was noticed. I have so frequently observed association between the "after-glow" phenomena and changes in meteorological conditions, changes similar in many ways, that I am forced to conclude that the meteorological theories of the origin of these phenomena are nearer the truth than the purely cosmic ones. Speaking of theories upon this subject, I would like to get some information as to that one which connects the red glow with the sunspots, and attributes them apparently to a reddening in the sun's light. This theory not only seems in itself very fanciful, but also to be entirely inconsistent with the character of the phenomena themselves. It would seem sufficiently odd that a general reddening of the sun's light should only become evident in so special and peculiar a manner—and not in any general and obvious way. The long-continued and persistently-recurring character of the later fainter phenomena of the rose-pink glows seems fatal to any such hypothesis.

In a recent number "E. E. M." (letter 29585, p. 438) asked me if I had ever seen the "Gegenschein" and "Zodiacal Band." But, like "E. E. M.," I "have never been able to catch either of them"—although, unluckily, I cannot quote the remainder of his sentence (about "exceptionally clear skies"). It is only occasionally that the Zodiacal Light can be seen here with any distinctness, and I have never been able to detect it in the autumn before sunrise. Sometimes, however, it is very plain in the spring evenings. I have had several glimpses this spring, on which occasions it has presented an appearance resembling what it had when I saw it previously. It is no doubt more frequently to be seen than many imagine; but I think one main reason why people often fail to see it is that they expect to see something quite different from what it really is; and another, that it is often mistaken for a faint twilight. For one thing, the conventionally hard and definite pictures which appear in some books, and which purport to represent the Zodiacal Light, are more calculated to mislead than anything else.

I hope the recent and welcome increase in the activity of "our" astronomical contributors will be productive of some good observations of Venus, now so glorious an object in the evening sky. The only fairly good view I have had (and it was not a *very* good one) was on the 16th March. The *south* cusp was seen to project a little, and be blunted at tip. The phosphorescence of the dark side was *very* plain, and seen with both 45 and 145 on the 3¼in. The disc was seen complete, the circle falling slightly within the cusps. I have seen this phenomenon before, but never so bright. The terminator appeared uneven; but the air was too poor for satisfactory observation. I saw Venus on Monday (March 25th), but could not make much out, owing to poor definition. The phosphorescence could be detected, but was faint. I would like to know what "E. E. M." has seen of the phosphorescence.

S. Maitland Baird Gemmill.

Glasgow, March 29.

PLATINUM PLATING.

[29798.]—In answer to Mr. A. Treeby (letter 29773), I cannot quite see where his difficulty lies. If he had given me the exact proportions he used in Sprague's recipe, I might have been able to see. The figures that I possess of Sprague's recipe are, I fancy, incorrect. At the temperature he adopts, A. Treeby ought to have been able to have attained a better result than that he states. I have tried the proportions I gave in my letter, I might state, hundreds of times, and have always found that there was no need for a temperature above 82° F. The wire mesh will be a little more difficult to platinise than the ordinary work, and the copper mesh, as Mr. Treeby states, it is almost impossible to obtain a satisfactory deposit upon. This is exactly what I have found, and not only that, but I have also found that if silver is alloyed with more than 17 per cent. of copper it is very difficult to obtain a platinum deposit upon. I know this for a fact, for I have taken pure silver and repurified it myself, and then alloyed it with various percentages of copper, and have obtained the following results. All deposits upon the alloys were at the temperature of 79° F.

Silver alloyed with

2 per cent. of copper ..	Fine, bright, and reguline deposit.
5 ,, ,, ..	Fine, bright, but not so reguline deposit.
10 ,, ,, ..	Darker and not reguline.
12 ,, ,, ..	Black and not reguline.
17 ,, ,, ..	Black, not reguline, and non-adherent.

These are some of the many figures I have attained in my experiments. Another curious fact is that I have been able to successfully plate with that rare metal, palladium, on copper, with far better success than platinum. Also I see that Mr. Treeby uses the oxalic acid: he does not state whether this is the commercial or the pure kind. It is a strange but true and practical fact that these two kinds will make a marked difference in the solution. This is not mere fiction, but reality, which I have found to my cost in the manipulation of the solutions of the rarer metals which contained it. Has Mr. Treeby polished his platinum deposit when he has attained it? Sometimes I have had to do this to get a bright reguline deposit. For this I always use a piece of wash-leather stuffed with cotton wool, mounted on a stick. Sometimes I have had to take the work out of the bath, and polish two or three times before I could get a bright and reguline deposit; but this polishing must be carefully done, or else the platinum deposit will peel off. After I have polished my work, I swill it in distilled water acidified with acetic acid, and then return to bath again, and it is by this method that I have been able to get bright deposits. But Mr. Treeby must not think that I have always to polish my work, because it is not so. I have had work taken out of my bath bright and reguline as possible; but there is one thing which must be strictly adhered to in platinum plating, and that is cleanliness. I have never come across cases where this is demanded so much as in the manipulation of these rare metal solutions.

Regarding Mr. Treeby's battery, which he asks me to criticise: first of all, then, I think his gas battery will be a success if he only will carry his experiments on a little further. Of course, I know what it is to carry out an idea, spending a good deal of time and money on it, and then reaching a certain point, and then not being able to reach further. I know this because I have been in such circumstances myself in various experiments which I have had to deal with. But, to return; why does not Mr. Treeby use some other frame for his plates instead of ebonite, which he states warps at the temperature he names? and, also, why could not Mr. Treeby use palladium on his + and − plates instead of platinum? I fancy myself that he would obtain a better result than with platinum. If Mr. Treeby would like to know the process for this, I shall be very pleased to give it; but, nevertheless, platinum plating can be done, I think, with very little trouble by my process; personally, I am in favour of palladium, but its high cost debars the use of it. I have myself just completed a gas battery with palladium instead of platinum, but have not experimented with it yet; in fact, really and truthfully speaking, the battery is but an experiment itself. The gases I have experimented with are chlorine and hydrogen, and I can honestly inform Mr. Treeby I have had enough chlorine to suit me for some time to come; of course, this has only been as an experiment. I am now on oxygen and hydrogen, with which I have obtained, I might state, similar results to Mr. Treeby's. I also think that a forced draught would be required for the reasons you name. I am just going to start on another experiment, which has just come into my head through reading about your silver and copper mesh. I am going to start with lead foil pierced and then platinised, and then I am going to try it with palladium, and not only with that, but with the still rarer metals, rhodium, and, if possibly human aid can do it, to try with rubidium, lithium. I expect that palladium will be the most preferable of all—in fact, the high cost of the other rarer metals will debar their use; but I am going to try and see what results I can attain. Of what strength is the dilute H_2SO_4 you are going to use? I have tried with 40 per cent. acid, and can't say I am particularly in favour of it. I am afraid I must not take up any more space now, but wait for a little longer; but if I can be of any assistance to Mr. Treeby, or to any other correspondent or reader of this paper in respect to the deposition of these rare metals, and likewise gas batteries, I shall be very pleased to give any advice or assistance.

F. W. Mason, Consulting Electrician.

HOW TO MAKE A LATHE.

[29799.]—It is generally understood that an efficient lathe cannot be made without being able to cast the requisite parts. This is not the case, for I have constructed a lathe of which nearly the whole is wood, and being satisfied with its efficiency, I decided to send a description of it to the English Mechanic.

You will require about 30ft. of wood 3in. square. Beginning with the flywheel, some of the 3in. square wood must be cut up into twelve pieces, of the shape A B C D, of which E F G H s a sketch put into perspective.

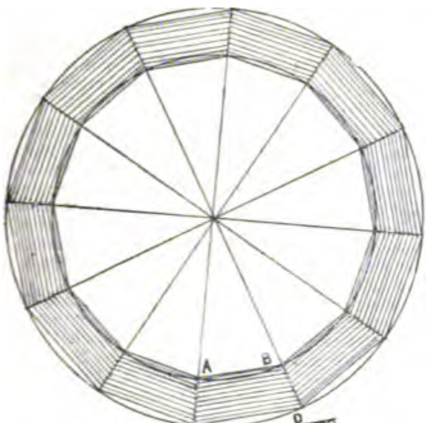


Fig. 1

The side G H must be 6in. long, and the angle E G H is an angle of 75°; twelve such pieces, cut to such an angle will, when put together, form a circle, as in the Fig., of which A B C D is a part.

The wood can be economically cut, as in Fig. 2, and it will be found easiest to cut a piece of paper having an angle equal to the angle C A B in Fig. 1, and then, marking off the wood as in Fig. 2, saw it according to the lines.

The pieces having been put to form a circle, are nailed together by means of two pieces of wood ½in. thick, as in Fig. 3. The wheel is then turned over, and two pieces are put on the other side, but the grain running at right angles to the former.

The nails must be put in as near the inside of the blocks as possible, as they will otherwise be in the way for sawing, as will soon be seen. Both sides being put on, from the centre E (Fig. 3), describe the circle A B C D, put the whole in the vice, and cut out the circle according to the line drawn.

When this is done a hole is made round the centre E, the size of which is 2in. by 1½in., as shown in Fig. 3. This hole must be cut exactly the same on the other side of the the wheel.

Now, to make the crank you will require 3ft. of wood, 2in. by 1½in.; this must be cut up into three pieces, two of which are 11in. long, and the remain-one is 14in. long.

The middle of the one which is 14in. long should be made round as at A in Fig. 4. The pieces should be put on top of each other, as in Fig. 4, and four holes, 1, 2, 3, 4, should be bored, ¾ in diameter; pegs should now be made to fit into the holes as tightly as possible; all is now glued together, and the pegs, previously smeared with glue, should be hammered into their places; when this is dry, one end is placed through the hole in the fly-wheel, and about half the lathe is made.

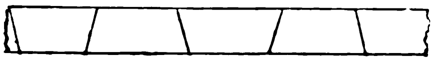


Fig. 2

The next thing to make is the stand. The 3in. by 3in. wood is cut up into four pieces 2ft. long and four pieces 3ft. 6in. long; these when put together make two frames; they must be nailed and glued at each end, using 5in. nails.

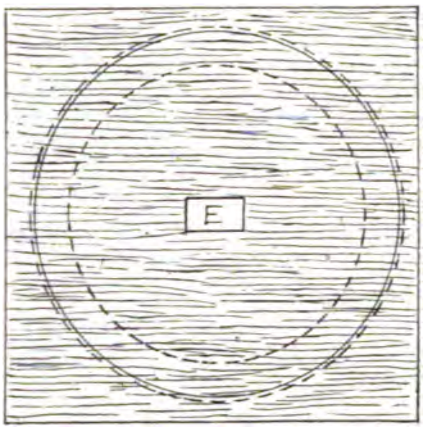


Fig 3

The frames are put together as in Fig. 5, being best held together with pieces of oak, which are glued and nailed to the frames, as seen in the figure. These pieces which hold the frames together should be of ½in. wood, and 1ft. 3in. long. Through the lower outside pieces, holes of ¾ diameter are bored for insertion of a screw-driver, as will be seen. In the inner pieces of wood the holes are only ¼in. diameter; through these screws are put, and screwed into the ends of the axle of the wheel, the smooth part of the screw making a beautiful axle with little friction.

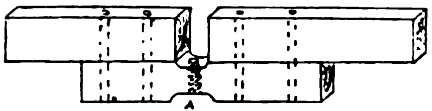


Fig. 4.

Next cut off two pieces of 3in. by 3in. of wood, each 6in. long, also cut one piece of oak ¾in. by 3in. by 1ft. 3in., and one piece of 1in. by 3in. by 1ft. 3in. These must be fitted together as in Fig. 6; but before fitting together a gun-metal casting must be fitted into a hole 5in. from the nearest end of the piece 1in. thick. The shape of this casting can be seen from Fig. 7, and will cost about a shilling to be cast at a founder's. Also, you must chisel out a round cylinder 5in. long and 2½in. diameter, and having flanges at each end as in Fig. 8. Into this, exactly in the centre, is fitted a piece of iron rod ½in. diameter, beaten out flat at one end (A in Fig. 8).

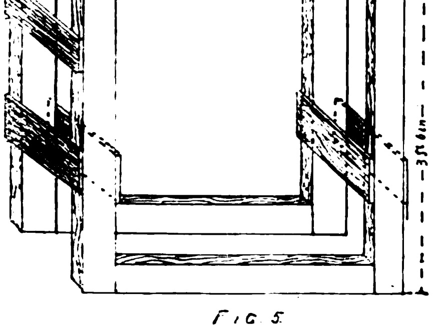


Fig. 5.

The teeth are made afterwards by filing, having obtained an even and straight edge by cutting off a piece with a cold-chisel while the metal is red-hot.

To prevent the iron from turning round inside the cylinder, a hole ⅛in. diameter is drilled at about the middle of the iron rod; a piece of wire, B B, then passes through the wood, through the hole in the iron, and through the wood again; the two ends of the wire are then tightly twisted together.

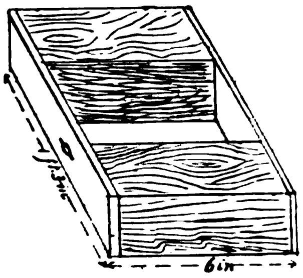


Fig. 6.

Fig. 6 can now be fitted together, but the iron rod in Fig. 8 must be slipped through the bearing before it is secured inside the cylinder.

The whole is now nailed on to the stand on the right-hand side, so that the middle of the roller is straight above the flywheel.

Now take another piece of iron of ½in. diameter, and 3in. or 4in. long; one end must be filed off to a blunt point, the other end must be beaten flat, and fitted into a cube, 3in. side, as in Fig. 9. This cube must be nailed on to a piece of wood 1in. thick, 3in. wide, and 1ft. 3in. long. The cube should not be put on in the centre, but to one side, and exactly facing opposite A in Fig. 8. Another piece of wood, 1in. by 3in. by 1ft. 3in., is cut, and if Fig. 9 be now placed on top of the stand it can be held in place by clamping it to the piece just made, which is placed underneath the top beams of the stand.

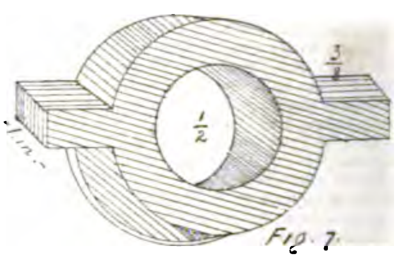


Fig. 7.

A piece of No. 6 gauge iron wire is twisted round A in Fig. 4, and connected to a piece of wood 2in. by 1½in., and 1ft. long, in the following way:—In this piece of wood, near one end, bore a hole ¾in. in diameter, make a loop at the free end of the wire, and this is secured in the hole made in the wood, by driving a nail crosswise through the hole and loop in the iron wire; this makes the treadle.

You must now get someone to turn round the wheel by working the treadle, while you, with a gauge, make a furrow in the wheel as it goes round, for this purpose you will require a very firm rest.

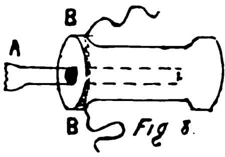


Fig 8.

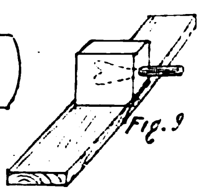


Fig. 9

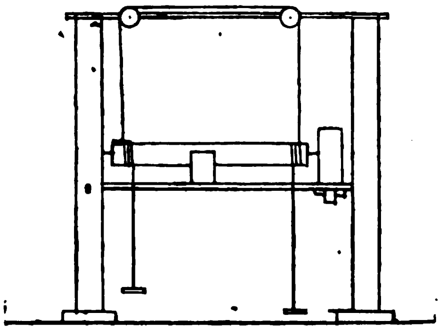
Having made a good deep groove, you will need 1 yard of ⅜in. round elastic to connect the flywheel to the roller (Fig. 8), the two ends being tied together by slip-knots made with good thick string.

All is now finished except the rest, on which to rest the tools while turning. This consists of a piece of wood 2in. by 1½in., and 18in. long, hollowed out underneath to the depth of 1¼in., to allow for the sliding backwards or forwards of Fig. 9: the two ends are then nailed on to the stand. A piece of wood that is required to be turned is rounded off somewhat first, with a chisel, then a slot is made at one end, into which A (Fig. 8) fits. The other end presses against the blunt point of the iron in Fig. 9. A chisel or gouge, held on the rest, cuts the wood as it revolves to the desired shape; it is afterwards sand-papered and, if required, polished, which are best done while still on the lathe.

O. Bolton.

ANOTHER PRIMITIVE LATHE.

[29800.]—I SEND a sketch of another primitive lathe, which may interest your readers. It will be noticed that it has a rotary motion in one direction (slightly intermittent) without any fly-wheel. When one treadle is depressed the work is rotated, the cord attached to the other treadle sliding over the work, without producing any effect. This action is reversed when we press down the second one, it being then the driver, and the other the follower, so to speak.



Referring to Mr. Maycock's letter, No. 29750, should not C^1 be 2ft. high to compare with C?

Lux.

HAYDON BAR.

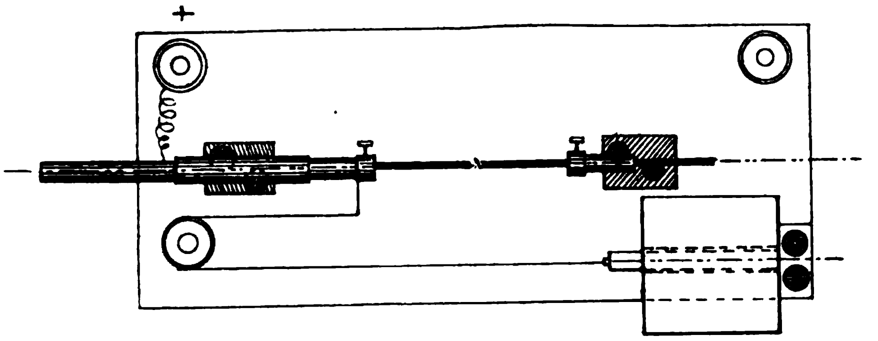
[29801.]—READERS of the "E.M." must be almost equally amused and annoyed to see a writer, with only a few hours' practice, condemn a tool which has stood the test of years.

Whether "F. C." is any authority on mechanical matters I very much question; but he has been for years a most objectionable correspondent, and the manner in which he attacks those who do know is simply disgusting, and deters many from giving their opinions.

I have never heard but one opinion of the Haydon bar. It is a first-class tool for light cuts, and has so many advantages over solid tools, which every-one, except "F. C.," knows. **Mechanic.**

A SIMPLE AUTOMATIC ARC-LAMP.

[29802.]—HAVING recently had occasion to show the electric arc-light, and not having a regular lamp at hand, I rigged up the arrangement shown in the accompanying sketch, which is half-size, and as it served my purpose so well, I thought it might be of service to readers of "E.M." It is constructed thus. Two pieces of sheet brass $\frac{1}{16}$in. or so thick, and ¾in. wide, and about 3¼in. long are taken and bent into a right angle, one side being 1in. and the other 2¼in. long. The short sides are each to have two holes bored through them to pass two screws to fix these cock-pieces against a piece of board, as shown. Through the long arms projecting from the board are passed two short pieces of brass tube, one (the lower) just large enough to allow a 4mm. carbon to pass easily through it, and about 1in. long. This is to be soldered to the cock-piece, and is to be fitted with a clamp-screw at top to fix carbon. The upper of these two tubes is to be rather larger, and is to take a piece of tube (the same size as bottom one) sliding easily through it, and is to be 2in. long about, and soldered to cock-piece, same as at bottom, so that the centre is about 2in. from face of board. The sliding tube is about 5in. or so long, and has a clamp-screw as at bottom. It must slide perfectly freely in any position, but not so as to shake. A stop should be put in this tube about 1in. from lower end, and made water-tight. A small piston, consisting of a short piece of brass wire, should slide easily up and down the tube above the stop, and be secured to a small piston-rod made from a fine knitting-needle or steel wire perfectly straight, which should pass through a hole in a cork or a piece of wood in top end, and the tube should then be filled with glycerine, thus forming a dash-pot, and checking sudden feeds of the carbons. The spiral connecting this + carbon holder with + terminal is made of about a dozen or so strands of No. 36 wire. It should be soldered to the terminal, and also to the carbon rod (higher up than shown in sketch). A piece of strong thread is attached to the lower end of the rod, and passing over a fair-lead pulley, is attached to a soft iron core about $\frac{5}{16}$in. diameter and 2in. long, which works loosely in the solenoid shown at bottom.



The bobbin for the solenoid is of brass, and is made of a piece of brass tube ⅜in. bore for the core and about 2$\frac{3}{16}$in. long, fitted with end cheeks of $\frac{1}{16}$in. brass, 2in. diameter, and the total length about 2in. between end cheeks; it is secured to the board so that centre is 2in. from face of board. This will hold ¼lb. No. 16 c.c. wire, but 6oz. is ample = nine yards about; but before winding on, bore a hole in top cheek to pass the wire through, and insulate with rubber tube. Also wind over the core-tube with two layers of thin insulating tape, and fit thick paper on the inside of cheeks to avoid a possible short circuit. The length of the cord should be such that when the carbons are in contact the core protrudes about ¼in. from top of coil, but as the carbons burn away the core will move further and further out, and the lamp will be out of adjustment owing to the pull on the core being less for an equal current; therefore a small pan is fitted to top of sliding tube in which to put weights for adjustments and to catch any liquid that may ooze out from the dash-pot stuffing-box. With about 5 ampères in circuit and 40 volts, this lamp will give a light of about 400c.p. actual. As the carbons burn away, the bottom carbon must be pushed up to keep the core approximately in the same position. This must be done every ten minutes or so. The lamp fulfils, for parallel working, the condition laid down by Prof. Thompson as necessary in a good arc lamp—viz., that it must keep the watts constant (though I for one don't believe in the "necessity")—i.e., that their currents must be kept constant.

Govan. **Engineer.**

THE HOME MANUFACTURE OF CAMERAS.

[29803.]—THE dark slide will require the greatest care, as if not well made it will admit light, which, of course, is fatal. Take the pieces M and saw them in two, lengthways. This will give four pieces 31in. by 1in. by ¼in., plane them and make them exactly the same thickness. Then groove them as shown in section in Fig. 12. This is best done with a circular saw, or with a grooving plane; but it may be done with a piece of saw-blade screwed on a piece of wood, if nothing better is at hand, or the moulding can be bought ready cut at 4d. per foot.

Fig. 12

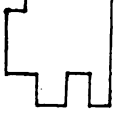
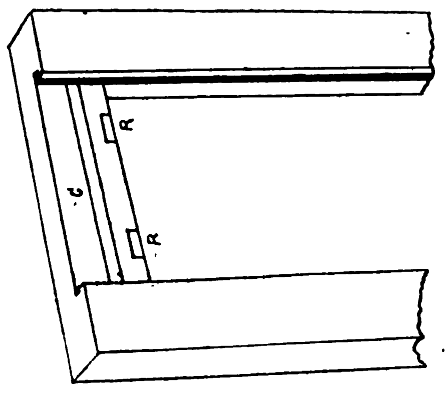


FIG. 13.



With these mouldings make two frames measuring 14¾ by 11¾ inside. This allows ⅛in all round for the plate to rest on. Glue on one end a piece of wood same thickness as moulding, and broad enough to make the outside of that end of the slide flush with the outside of the camera when it is in place. The place where the shutter goes in must now be cut out. Mark with a gauge at the top end $\frac{1}{32}$in. deeper than the shutter groove, and cut down to the mark (Fig. 13).

The shutters will now require to be made. Take the pieces S and place them on one edge. Dress S 3 to 13 by 9 ¾, and join S 1 and S 3 as in Fig. 14. The grain of S 1 must be at right angles to that of S 3. Cut a strip off S 2 13in. by 1in. Now cut out a recess $\frac{1}{16}$in. deep in the piece made of S 1, S 3, and a similar recess in the piece that is left over of S 2, and thin down the whole of the strip 13in. by 1in. to the same thickness as the recessed parts (Fig. 15). Cramp them all firmly together and glue down a piece of stout linen ticking to fill the recess. This makes the double joint. This best way to glue them is to cramp them together as above, brush the glue over and let it set, then lay the linen—cut to the exact size—on it, and rub well down with a piece of hot wood. This will require at least a day to dry. Plane the underside perfectly flat. Now measure the middle of the dark slide to the bottom of the

Fig. 14.

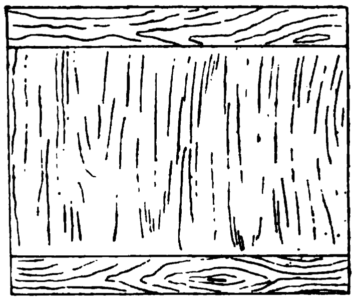


Fig. 15.

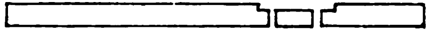
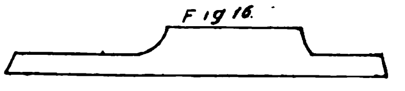


Fig 16.



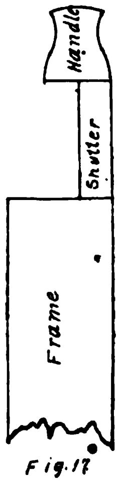


Fig. 17

grooves and cut the shutter just a shade smaller and make a feather at the sides and bottom to fit the grooves in the frame. Take care that it slides easily and without any shake. The inside of the shutter must be planed flush with the frame, and it must be perfectly flat every way. This is a most important part and it must be carefully done. When the shutter is in its place it will be found that there is some surplus wood at the top, which must be planed off. A handle is to be shaped out of it (Fig. [illegible]), and a slot cut in the top of the shutter as in Fig. [illegible], where the shutter is shown partly drawn. When the shutter is closed, the handle rests on the top of the slide, and effectually stops light from getting under the shutter should there happen to be any defective workmanship there.

It will be remembered that the frame was cut down at the top to cover the shutter groove. This is to make room for a strip of black cloth to be glued to the frame C, Fig. [illegible], to form a smooth and light-tight joint with the shutter. Cut out two recesses, R, Fig. [illegible], and glue on thin pieces on the inside of the shutter to fit into them. This is to prevent the shutter being drawn out too far.

We have now two half-slides similar in every respect. The grooves will be to the inside of each, and a thin strip of wood must be glued into this groove in one of the halves so as to project ⅛in. This projection will fit into the corresponding groove in the other half, and form an effectual barrier to the entrance of light. Clamp the two halves of the slide firmly together, and put on the hinges. Then groove the sides to fit into the reversing back. Cut away 1¼in. of the feather about 1in. from the top end. This will allow the slide to be put into position in the reversing back, with only about 1in. movement. The part cut away corresponds to the projecting part in Fig. 3. Now fix on the clips which keep the slide shut, the hooks to keep the shutters from slipping out, the turn-buttons to keep the plates in place, and the number plates, and the slide is finished.

For the focussing screen a frame is made similar to one-half of the slide, only the moulding has no shutter groove. The glass is fixed in, and it is attached to the reversing back by the double-jointed hinges. The feather is cut off the frame at the side where the hinges are, to allow it to swing out when the dark slide is to be placed in the camera.

James Thomson, Camera Maker.

Portgordon.

THE LEYDEN JAR.

[29804.]—In answer to G. B. Lückhoff's letter (29761), I am sorry to state that he has misinterpreted my meaning. By his letter he means to say that I am trying to place my tumbler Leyden jar on a level with the Leyden jar of the present day. I beg to state that that is far from my intention. I simply used my tumblers to illustrate that one of the leading features in the goodness of a Leyden jar lies in its specific inductive capacity, and this in its turn lies in some sense upon the thickness of the glass. If G. B. Lückhoff will turn to Miller, 1st Vol., "Physics," p. 483 and 484, he will see what is meant by specific inductive capacity. The mistake, I think, lies in the words "specific conductive capacity." It should read "specific inductive capacity." I expect it is due to a printer's error, made in consequence of my writing.

F. W. Mason, Consulting Electrician.

LATHE MATTERS — THE RUNNING CENTRE AND SACRED ORIFICE— HAYDON'S CUTTER-BAR.

[29805.]—I think "F. A. M." has stated that the usual taper hole in the mandrel of a lathe which carries the running centre *cannot* be made positively true, or so that the movable centre which is placed within it may be relied upon for accuracy at all times; but that it requires a mark, by means of which it (*the centre*) can always be placed in one position. I fully expected to see a score of pens proclaim that this antiquated system was obsolete, except in tool shops where most ordinary work is produced. My workmen, who read the "E. M." regularly, laughed at the idea of a mark to set the running centre by; and they cannot understand how it is that a very clever amateur like "F. A. M." can entertain such an unmechanical idea; the difficulty seems to them, how to bore the hole so that the centre runs incorrectly, except it is that the mandrel itself or the bushes are incorrect, or that the mandrel is of bad material, and is hard in places; but even this latter defect could be overcome by grinding. If "F. A. M." has not tried this method, perhaps he will, and report as to its success.

I do not wish to enter into further discussion on cutter-bars simply to introduce an amount of uninteresting matter of no value to the majority of the readers of the "E. M.," but would point out to Fred Carre that the fact of *his* Haydon bar not working satisfactorily in a planing machine is in no way against its value as a lathe tool; the general construction of a lathe and of a planing machine, and the conditions under which the cutting edges work are not alike, and the construction of any cutting tool, either a hand-forged tool or a cutter-bar carrying a tool, is necessarily (if the best results are desired from its use) in accordance with certain conditions appertaining to its position; and to take any such tool, no matter how accurately they may be made, unless they have been practically designed to suit the circumstances under which they are to be used (the gib-packing piece now used with Fred Carre's cutter-bar appears as an example), will only end in vexation and annoyance.

Edward Hines.

ORGAN MATTERS.

[29806.]—I am glad to see the subject of the organ is again taken up in these pages, and with with Mr. [illegible]. I heartily wish that not only the subject of tone-voicing, but other matters should be thoroughly ventilated. Last year we had a great deal of dispute about the swell-box, and I think the conclusion arrived at was that the swell-box, if properly constructed and of suitable materials, was not detrimental to organ tone generally.

After Mr. Audsley's papers which appeared from time to time on the different forms of the organ, I set to work to scheme an instrument which I intended to be a chamber organ, based as far as possible on his lines, but rather more ambitious in size, and I want people to express their opinions upon it as regards expression and tonal structure, &c.

I thoroughly agree with Mr. Audsley that a revolution is necessary in matters of expression, tonal structure, and last, but not least, in stop nomenclature.

I will proceed, then, to give a sketch of the organ I schemed, and submit to the merciful criticism of both parties. The specification is as follows:—

Three-Manual and Pedal Organ.

First [Great] Organ. First Manual [Great], compass C C—c^4 = 61 notes. W.P. 2¾in.

1. (1) Principal No. 1 [open diapason], metal, 8ft., 61 pipes.
2. (2) First flute [döppel flöte], wood, 8ft. tone, 61 pipes.
3. (3) Second flute [clarabella] (open from ten. C. wood, 8ft., 61 pipes.
4. (4) First gamba, metal, 8ft., 61 pipes.
5. (5) Salcional, metal, 8ft., 61 pipes.
6. (6) Octave [principal], metal, 4ft., 61 pipes.
7. (7) First octave flute [wald flöte], metal, 4ft., 61 pipes.
8. (8) Soft super-octave [gemshorn], metal, 2ft., 61 pipes.
9. (9) Harmonics C C 19, 22, 24, 26, 29 [mixture V. ranks], metal, 305 pipes.
10. (10) Cornopean, metal, 8ft., 61 pipes.

Nos. 2-10 are inclosed in No. 1 Swell chamber (front) controlled by a centrally-placed balanced expression lever.

Three combination levers controlling Nos. 1-10 and Pedal stops.

Second [Choir] Organ. Second Manual (middle), compass C C—c^4 = 61 notes. W.P. 2⅜.

11. (1) Soft flute [lieblich gedact], wood, 8ft. tone, 61 pipes.
12. (2) Principal No. 2 [dulciana], metal, 8ft., 61 pipes.
13. (3) Second gamba [echo gamba], metal, 8ft., 61 pipes.
14. (4) Sharpened gamba [voix célestes] (to G G only), metal, 8ft., 54 pipes.
15. (5) Soft sub-octave, treble [double dulciana] (to middle C), metal, 16ft., 37 pipes.
16. (6) Soft sub-octave, bass, [lieblich bourdon], wood, 16ft. tone, 24 pipes.
17. (7) Second octave flute [lieblich flöte], wood, 4ft. tone, 61 pipes.
18. (8) Super-octave flute [lieblich gedact], metal, 2ft. tone, 61 pipes.
19. (9) Soft harmonics C C 15, 19, 22 [dulciana mixture III. ranks], metal, 183 pipes.
20. (10) Oboe, metal, 8ft., 61 pipes.
21. (11) Vox humana, metal, 8ft., 61 pipes.

Nos. 12-21 are inclosed in No. 2 Swell chamber (middle) controlled by a centrally-placed balanced expression lever.

Three combination levers controlling Nos. 11-21 and Pedal stops.

Third [Solo] Organ. Third Manual (highest), compass C C—c^4 = 61 notes. W.P. 3in.

22. (1) Loud flute [flûte harmonique], metal, 8ft. tone, 61 pipes.
23. (2) Violoncello, 8ft., 61 pipes.
24. (3) Vox angelica (on special W.P. of 1¾in.), metal, 8ft., 61 pipes.
25. (4) Orchestral flute, wood, 4ft., 61 pipes.
26. (5) Violin, 4ft., 61 pipes.
27. (6) Piccolo, wood, 2ft., 61 pipes.
28. (7) Orchestral oboe, metal, 8ft., 61 pipes.
29. (8) Orchestral clarinet, metal, 8ft., 61 pipes.
30. (9) Orchestral trumpet, metal, 8ft., 61 pipes.

All the stops of the Third Organ (Nos. 22-30) are inclosed in No. 3 Swell (back) chamber, controlled by a centrally-placed balanced expression lever.

Pedal Organ, compass C C C—F = 30 notes.

31. (1) First principal [open diapason], wood, 16ft., 30 pipes.
32. (2) First octave [principal], wood, 8ft., 12 pipes.
33. (3) Bourdon, wood, 16ft. tone, 30 pipes.
34. (4) Flute, wood, 8ft. tone, 12 pipes.
35. (5) Second principal [dulciana], metal, 16ft. tone, 30 pipes.
36. (6) Second octave [dulciana principal], metal, 8ft., 12 pipes.
37. (7) Fifth [quint], metal, 10⅔ft., 0 pipes.
38. (8) Contra saxophone (free reed), metal, 16ft., 30 pipes.
39. (9) Saxophone (free reed), metal, 8ft., 12 pipes.
40. (10) Double bass viol, metal, 16ft., 30 pipes.
41. (11) Violoncello, metal, 8ft., 12 pipes.
42. (12) Trombone, metal, 16ft., 30 pipes.
43. (13) Trumpet, metal, 8ft., 12 pipes.

Nos. 31-34 are uninclosed; Nos. 35-39 are inclosed in No. 1 Swell chamber.

Nos. 40-43 are inclosed in No. 3 swell chamber.

Nos. 31-39 are on a W.P. of 2⅜in.; Nos. 40-43 on a 3in. W.P.

The combination levers of first and second organ stops act also on the pedal stops.

No. 31 has also 28 pipes. The CCC and DDD pipes having pneumatic valves at the top, are made to serve for the CCC sharp and DDD sharp pipes as well.

Nos. 32, 34, 36, 39, 41, and 43, have only twelve pipes, their basses being borrowed from Nos. 31, 33, 35, 38, 40, and 43 respectively. No. 37 has no pipes of its own, being borrowed from Nos. 35 and 36. All borrowed stops act independently.

Couplers.

44. (1) Second manual to first, unison.
45. (2) Second manual to first, octave.
46. (3) Second manual to first, sub-octave.
47. (4) Third manual to first, unison.
48. (5) Third manual to second, unison.
49. (6) First manual to pedal.
50. (7) Second manual to pedal.
51. (8) Third manual to pedal.

Couplers have draw-knobs arranged in a single row above.

THIRD MANUAL.

Mechanical Accessories, &c.

Tremulants.

52. (1) First organ tremulant (with draw knob) affecting Nos. 1-10.
53. (2) Second organ tremulant (with adjustable foot lever) affecting Nos. 11-21.
54. (3) Third organ tremulant (with adjustable foot-lever) affecting Nos. 22, 23, 25-30.

Each tremulant perfectly noiseless and inclosed in its own department swell-box, combination levers.

55-57. Three combination levers affecting first organ and pedal stops.
58-60. Three combination levers affecting second organ and pedal stops.
61-63. Three combination levers affecting entire organ, speaking stops, and couplers.

Expression Levers.

64. No. 1 (left) affecting Nos. 1-10 and 39.
65. No. 2 (middle) affecting Nos. 12-21.
66. No. 3 (right) affecting Nos. 22-30 and 40-43.

Pneumatic Ventils.

67. (1) Controlling wind to first organ stops (Nos. 1-10).
68. (2) Controlling wind to third organ stops, Nos. 22, 23, 25-30.

These ventils are controlled by Pneumatic buttons placed under the claviers.

I may also add that if a concert-room organ of, say, half the number of stops of the St. George's Hall organ had been built according to Mr. Audsley's design, I am sure that it would be superior to it as regards tone-colour, contrast, and expression: though, of course, not in volume of sound. I also think that "Chopin" must have made a mistake about free reeds, or else how is it that Mr. Audsley has introduced a stop of this class into such a delicate and refined instrument as his own chamber organ, in preference to the ordinary striking reed, and, nevertheless, speaks in such high terms of its softness, smoothness, and roundness of tone?

G. Dixon.

Bradfield College, Berks, March 26.

VASELINE.

[29807.]—I beg to thank Mr. Chas. E. Sohn for his lucid reply relative to the above-named substance. (See letter 29755, p. 74, No. 1,252). The "doubts" I expressed had reference to the supposed records of its pathogenetic effects alleged to have been recorded at the Homœopathic Hospital. In my younger days I was fairly up in inorganic chemistry for an amateur; but for many, many years past I have not been able to follow the developments of this interesting science, especially in connection with the hydrocarbons.

I was one of the earliest to adopt the use of the camphene lamp at its introduction by Young, and continued to use it until it was put *hors de combat* by the American civil war, which caused the price of oil of turpentine to be prohibitive. Paraffin oil was then introduced, and later on petroleum. Of course, any one could see that they were near of kin, but with certain marked differences. Then solid paraffin came into use in substitution of wax for candles. I know that in petroleum there were found several volatile oils, differing slightly in composition; but I had no idea that there existed more than one kind of solid paraffin, or that the latter was extracted from anything but the old paraffin-oil generally obtained—if I am not mistaken—from peat.

I expect I shall be only one amongst many of your readers who will be thankful for the information afforded. **Gamma Sigma.**

REPLIES TO QUERIES.

⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

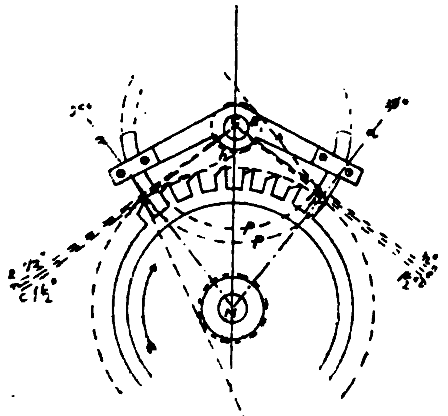
[67472.]—**Dead-beat Escapement.**—As only two answers have appeared in two months, I venture to give "Bell"—if he has not lost his patience—a clear, complete, and scientific description, from which he will be enabled, by following these instructions, to make a perfect Graham anchor-escapement. The description is given by a well known and great German authority—the late Grossmann—and is reproduced with practical hints, and also with designs in Mr. Hermann Sievert's book for young watch-makers.—"The proportions of a perfect Graham anchor-escapement are calculated mathematically, and as this gives the means of knowing the dimensions of anchor arc, pallets, and the distance of centres, a design is not wanted. The proportions of an escape-wheel with 30 teeth, when the anchor embraces 6½ teeth, are:—

Diameter of escape-wheel	= 1
„ „ inner anchor circle	= 0·7706
„ „ outer anchor circle	= 0·8490
Width of pallets	= 0·0392
Diameter of arc-circle (cercle de l'arc de levée) for arc of 1°	= 0·1443
„ for arc of 1½°	= 0·2109
„ „ „ 2°	= 0·2741
Distance of centres	= 0·6430

To find the real dimensions, multiply the diameter of escape-wheel with the numbers quoted. This gives, for a Graham anchor, say, of 36·6 millimètres, with movable pallets and 1½° arc, the following measures:—

Inner anchor-circle	= 28·80
Width of pallets	= 1·43
Arc circle......................	= 7·70
Distance of centres	= 23·55

Suppose the escapement required is that for a regulator beating seconds. The escape has 30 teeth, the anchor embraces 6½ teeth; each tooth measures 12°—equal to 78° in all. From the centre, M, draw two lines, *a a*, forming the angle of 78°, thus giving



M, centre of escape-wheel; C, centre of anchor; S, circle of arc (cercle de l'arc de levée); *p p*, anchor circle (inner and outer).

39° at each side of the vertical line. On these lines *a a* draw, at right angles, the tangents *r r*, which gives the centre of motion of anchor C. The motion of one tooth at each lifting of the anchor is 6° (360′); but ¼ (90′) must be deducted from it for the dropping of the tooth and for the thickness of its point; thus 4½° (270′) remains for the width of the pallets. These 4½° are indicated on the circumference of wheel—that is, 2¼° are on each side of the lines *a*, *a*; then the arc anchor circles can be traced. The arc ought to be not less than 1° and not more than 2°; let us give it 1½°. The tooth must have ½° for resting on the dead face, thus the motion of the anchor is altogether 2°, when the tooth drops from the pallet.

From *r* to *n* is ½° for rest of teeth
„ *n* to *e* is 1½° for arc
„ *r* to *e* is 1½° for arc
„ *e* to *n* is ½° for rest of teeth.

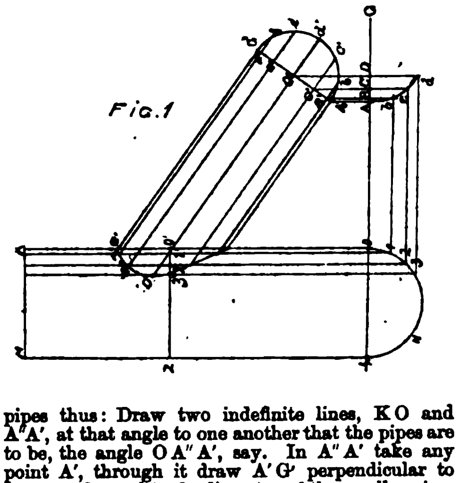
To find impulse face of pallet trace the lines *h*, *h* through the points of junction of line *n* with the outer anchor circle with *e* of the inner anchor circle (for left-hand impulse face), and of *e* with the inner and with *r* of the outer anchor circle (for right-hand impulse face). If the design is correctly drawn according to these instructions, then the lines *h h* ought to be tangents to one and the same circle, which is called the circle of arc S. The inclination of the teeth is from 10° to 12°. If "Bell" wishes, I will send for insertion in a future No. the description how to make the anchor absolutely correct.

San Remo. W. van Eys.

[67559.]—**Bisulphate of Potash in a Leclanche Cell.**—To "F.R.Met.Soc." I write as promised. It is, in my estimation, an advantage to use the above in a Leclanché; but it should only be used sparingly, as if it is used in a too great proportion it will cause the cell to work furiously for the first, and then it will break down in a month or two. The bisulphate should be used at the rate of 2oz. for a No. 1, 1½oz. for No. 2, and ¾oz. for a No. 3. If it is used in these proportions it will be a great success. I have had a No. 2 cell with it in running for 15 months. Bisulphate of potash seems to me to be to the cell what medicine is to the sick man: it gives strength and vigour to the cell. Any further particulars "F.R.Met.Soc.," or any other reader may require I shall be pleased to give.

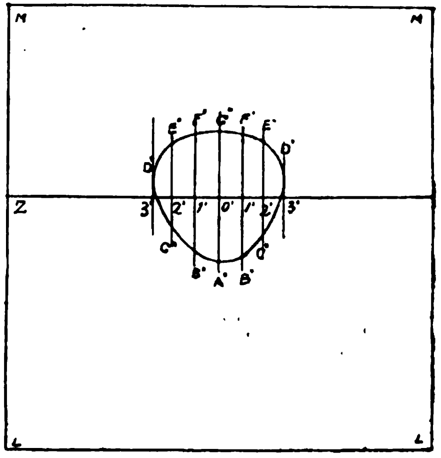
F. W. Mason.

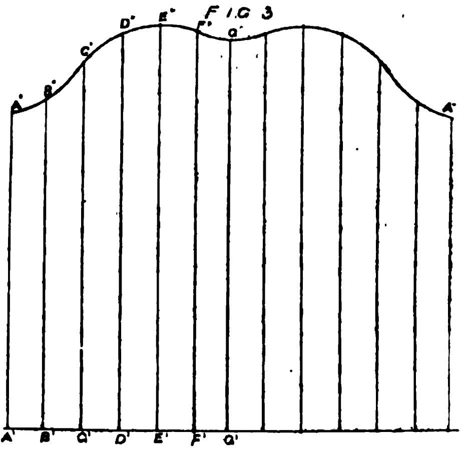
[67717.]—**Smoke-Pipe.**—Your correspondent, "J. S., East Cowes," in replying to this query by copying from Millis's "Metal-Plate Work: its Patterns and their Geometry," should have copied the whole of the problem that there appears, instead of only part. Whilst, on the one hand, not copying enough to make himself intelligible, he has, on the other, omitted what obviously anyone who requires patterns for such work could not dispense with—namely, the important matter of the shape of the junction-hole of the two pipes in the pattern for the larger pipe. As the construction differs in principle from any other with which I am acquainted, I give it fully from Millis's work. The characteristic fashion of Millis's lettering "J. S." followed. The problem (No. III. Book III. pp. 246—51) is, for unequal pipes meeting at any angle not a right angle. Fully set forth, the problem and working are as follows:—To draw the pattern for the "slanting T" formed by two equal or unequal circular pipes (cylinders of equal or unequal diameter) which meet otherwise than at right angles. Suppose the pipes unequal. First draw (Fig. 1) a side elevation and a part plan of the



pipes thus: Draw two indefinite lines, K O and A″A′, at that angle to one another that the pipes are to be, the angle O A″ A′, say. In A″ A′ take any point A′, through it draw A′ G′ perpendicular to A″ A′, and equal to the diameter of the smaller pipe, and through G′ draw a line parallel to A″ A′ and meeting K O in G″; then A″ A′ G′ G″ will represent in elevation a piece of the smaller pipe. Next, in K O take any point O, and through it draw an indefinite line L G perpendicular to K O. Make O L equal to the diameter of the larger pipe; through L draw an indefinite line L M parallel to K O; in L M take any point M, and through M draw M K perpendicular to M L. Then M K O L will represent in elevation a piece of the larger pipe, and M K G″ G′ A′ A″ O L a side elevation (except the curve of junction) of the slanting T. On A′ G′ describe a semicircle, A′ *d′* G′, and divide it into any number of equal parts, here six, in the points *b′*, *c′*, *d′*, *e′*, and *f′*, and through these division points draw indefinite lines *b′* B″, *c′* C″, *d′* D″, *e′* E″, and *f′* F″ parallel to G′ G″, and cutting A′ G′ in the points B′, C′, D′, E′, and F′. Now, from A′ let fall a perpendicular to L G meeting L G in A, and through B′, C′, and D′ draw indefinite lines B′ *b*, C′ *c*, and D′ *d* perpendicular to and cutting L G in B, C, and D. Make B *b* equal to B′ *b′*, C *c* equal to C′ *c′*, and D *d* equal to D′ *d′*, and from A through *b* and *c* to *d* draw an unbroken curved line. On L O describe the semicircle L 3 O, and through the points *b*, *c*, and *d* just found draw lines *b* 1, *c* 2, and *d* 3 parallel to L G, and cutting the semicircle L 3 O in points 1, 2, and 3; then L N 3 *d* D is a part plan of the slanting T. Through point 1 draw a line, 1 F″, parallel to O K, and meeting B′ B″ and F′ F″ in B″ and F″ respectively. Through 2 draw to 2 E″ parallel to O K, and meeting C′ C″ and E′ E″ in C″ and E″ respectively, and through 3 draw 3 D″ parallel to O K, and meeting D D″ in D″. From A″, through the points B″, C″, D″, E″, and F″ to G″, draw an unbroken curved line, then this curve is the elevation of the curve of junction of the two pipes. In the straight line A″ G″ take any point O′, about midway between A″ and G″, and through it draw O′ Z perpendicular to K O, and cutting lines 1 F″, 2 E″, and 3 D″ in points 1′, 2′, and 3′. Now, to draw the pattern for the larger pipe, the longitudinal seam to correspond with the line M L. First to set out, apart from the pipe itself, the shape of the hole in it. Draw (Fig. 2)

Fig 2





two indefinite lines, Z O and G″ A″, intersecting at right angles in O′, and from O′ or Z O, right and left of G″ A″, set off distances, O′ 1′, 1′ 2′, and 2′ 3′, equal respectively to O 1, 1 2, and 2 3 (Fig. 1), that is, to the actual distances on the curve of the pipe at Z O that the lines B″ F″, C″ E″, and 3 D″ are apart. Through points 1′, 2′, and 3′, right and left of G″ A″, draw F″ B″, E″ C″, and D″ 3 perpendicular to Z O. Make O′ G″ equal to O G″ (Fig. 1), O′ A″ equal to O′ A″ (Fig. 1). Also make 1′ F″, 2′ E″, 3′ D″ right and left of G″ A″ and above Z O, equal respectively to 1′ F″, 2′ E″, 3′ D″ above Z O′ (Fig. 1), and 1′ B″, 2′ C″ right and left of G″ A and below Z O, equal respectively to 1′ B″, 2′ C″ below Z O′ (Fig. 1). Through all the points as above found, namely, D″, E″, F″, G″, F″, E″, D″, C″, B″, &c., draw an unbroken curved line, then D″, G″, D″, A″ will be the shape of the hole required. To complete the pattern for the M K O L (Fig. 1) piece of the larger pipe, make O′ Z and O′ O each equal to half its circumference, and through Z and O draw indefinite lines M L perpendicular to Z O. Make Z M of left-hand line M L, and O M of right-hand line M L, each equal to Z M (Fig. 1); similarly, make Z L and

O L each equal to Z L (Fig. 1), then M L L M will complete the pattern required. To draw the pattern for the smaller piece of pipe, the longitudinal seam to correspond with the line A″ A′ (Fig. 6). Draw (Fig. 3) an indefinite line A′ A′. In it take any point A′, and from A′ set off distances A′ B′, B′ C′, C′ D′, D′ E′, E′ F′, and F′ G′ equal respectively to *A′ b′, b′ c′, c′ d′, d′ e′, e′ f′*, and *f′ G′* (Fig. 1), that is, equal to one another. Through A′, B′, C′, D′, E′, F′, and G′ draw indefinite lines A′ A″, B′ B″, C′ C″, D′ D″, E′ E″, F′ F″, and G′ G″ perpendicular to A′ A′, and make A′ A″ equal to A′ A″ (Fig. 1), B′ B″ equal to B′ B″ (Fig. 1), C′ C″ equal to C′ C″ (Fig. 1), and D′ D″, E′ E″, F′ F″, and G′ G″ equal respectively to D′ D″, E′ E″, F′ F″, and G′ G″ (Fig. 1). From A″ through B″, C″, D″, F″, and G″, draw an unbroken curved line. This completes one half of the pattern required. The half to the right of G′ G″ can be drawn in a similar manner, setting off along G′ A′ the same above distances, but in reverse order, and starting from G′. This completes the problem, which will now be of use to many readers of "Ours." In concluding, I protest very strongly against the violation of fairness in not giving the source whence information has been obtained. ALIQUANDO.

[67862.]—**Distribution of Weight.**—I have not noticed an answer to this, so offer the following: Mark the supports, commencing with the bottom, A B C D (at top) C′ B′. The weight will be carried by each support inversely as its distance from W. These distances will be from W to A = 1, to B and B′ each $\sqrt{3}$, C and C′ each $\sqrt{7}$, and to D = 3. We have then (if x be the proportion carried at A) as follows:

$$x + \frac{2}{\sqrt{3}} x + \frac{2}{\sqrt{7}} x + \frac{1}{3} x = W;$$

$$\text{or } 3{\cdot}244\, x = W.$$

$$x = \frac{W}{3{\cdot}24} = \text{weight at A.}$$

$$\frac{1}{3} \text{ of this at D.}$$

$$\frac{1}{\sqrt{3}} \text{ of this at B and B}'.$$

$$\frac{1}{\sqrt{7}} \text{ of this at C and C}'.$$

Bristol. T. C.

[67865.]—**Electro-Dyeing.**—Where does this querist find any mention of electro-dyeing? Bleaching by the electric method is now quite common, but not dyeing. S. M.

[67870.]—**Hot-Air Engine.**—This query is so mixed up that it is difficult to answer; but it must suffice to say that a 2H.P. hot-air engine is rather a heavy affair. Rider's is, I think, the best, and the makers could give the exact weight; or try Bailey and Co., Salford. M. T.

[67872.]—**Organ Reeds.**—"A. B. C." can use organ reeds on the pressure system if he likes, but there is no advantage in so doing. They are adapted for the suction system, just as harmonium reeds are adapted for the pressure system, and won't do well on suction wind. How is it people want to use things in the very positions for which they are not adapted? The position of the reeds will not make any difference in so nondescript an instrument. ORGANON.

[67875.]—**Electro-Metronome.**—What would be the advantage of having a metronome actuated by an electro-magnet? If the querist has an idea of such a thing, why does he not invent it? T. J.

[67879.]—**Prevention of Rust.**—Nothing new in the use of carbonate of potash to prevent rust. Iron does not rust in the presence of pure oxygen, and the oxygen of the air cannot attack it, unless other things are present, such as carbonic acid and moisture. A solution of any of the carbonates would preserve it. FER. BRAS.

[67882.]—**Electrical Fire-alarm.**—Either the platinum or the mercury requires cleaning. E. M. F.

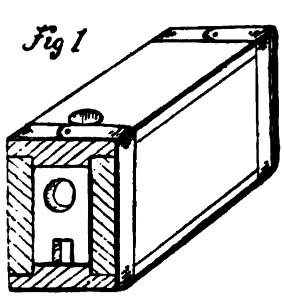
[67883.]—**Governor for Model Engine.**—Several governors will be found in back volumes—even in recent numbers (see p. 23), and the principal data for their construction are given in all the text-books. F. T.

[67890.]—**Expansion of Metals.**—The expansion ratio of metals is given in nearly all the text-books, and it would be scarcely worth while to occupy space here with it. G. M.

[67894.]—**Compound Engine on the G.E.R.**—May I call the attention of "East Anglian" to this query on p. 528. What does the sketch on p. 441 last volume mean? Without explanation, it looks like a waste of space. STRATFORD.

[67895.]—**Cement for Steam Joints.**—The ordinary red-lead cement will do for the purpose; but perhaps asbestos cement would be preferred. If the joints are not to be broken frequently, perhaps the cement given in a recent number might be useful. T. M.

Fig 1



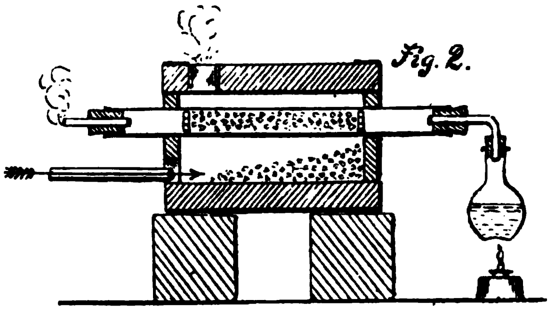
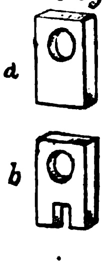


Fig. 2.

Fig. 3.



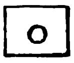
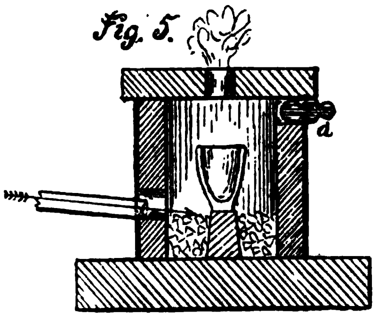


Fig. 4.

Fig. 5.



[67903.]—**Wheel-Cutting.**—Should not this querist state what kinds of wheels he means? At any rate, the information he seems to require will be found in back volumes. T. M.

[67904.]—**Round-faced Hammer.**—What did "Z." expect from a round-faced hammer? Why did he purchase such a tool to drive nails? The seller must have laughed a trifle when he was supplying "Z." with the latest and best "round-faced hammer." OHMI.

[67906.]—**Dynamo and Storage Cell for Bicycle.**—Sorry to find that the questions I put on p. 35 have not as yet been answered. I showed the reply referred to to an electrician, who is also a rider of cycles, and his remark was anything but complimentary. May I again ask Mr. Bottone, who replied on p. 17, how the dynamo is to be fixed to the bicycle, and where the two storage cells would be carried? I am also constrained to ask what they would weigh, for my friend above mentioned laughed at me when I gravely asked him about it. He seems to think it not exactly impossible, but ridiculous, to adopt the dynamo and storage cells as advised by Mr. Bottone. A CYCLING MECHANIC.

[67908.]—**Electro-Motors.**—Full directions for making chromic-acid cells have been given; and it has been frequently pointed out that Leclanché cells are useless for constant work. T. M.

[67916.]—**Organ-Blowing.**—Perhaps "A New Reader" will say what size his organ is. He may then get an answer to his query; but as to the space occupied by pedals, he may take the width of the keyboard as the smallest, and allow for a projection of 30in., say. B. C.

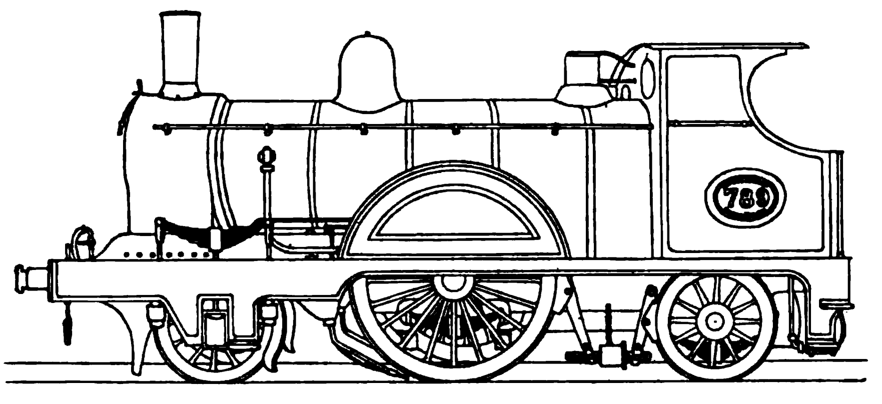
[67925.]—**Blowpipe Furnaces.**—The accompanying sketches illustrate some apparatus of this nature which I made some time since with good results. If not exactly what the querist wants—the query being indefinite—they may perhaps point the way, and be useful to others. Figs. 1 and 2 represent a perspective and a sectional view of a furnace suitable for heating tubes and such like objects. In its construction four similar fireclay bricks are bound together with a pair of iron hoops, so as to form a rectangular chamber. The two bricks forming the top and the bottom have rabbets cut in their inside edges, thus allowing them to be held together more firmly. Near one end (the end intended for the front) of the top brick a hole is cut for the escape of burnt gases. Fig. 3 shows the ends, which are made of fireclay and baked. The second hole in the front end *b* is made to admit the point of the blowpipe; it is well to have it a little larger than the blowpipe tube. The method of working the furnace is as follows:—Having placed it in a proper position and fixed in the ends, the tube is now put into its place, and any space left between the tube and the sides of the holes filled with a piece of asbestos so as to leave no open gaps. Two or three handfuls of coke broken to about the size of beans are then thrown into the furnace through the top hole, and pushed back into the inclined position shown in Fig. 2. Latterly, the blowpipe is fixed and set working, but not too fiercely at first, or the tube will be smashed if it is glass or porcelain. Immediately some of the coke will be seen to glow, on seeing this, a piece of thin sheet iron (Fig. 4), having a hole in its centre the exact size of the blowpipe tube, is slipped over the point of the blowpipe and pressed close to the furnace; by this means no air, unless that which passes through the blowpipe, enters the furnace. The gas and air may now be increased until the desired temperature is obtained. If the gas be in excess it will be seen to burn at the escape hole; this may be made right by turning on more air. When working properly the gas burns without any visible flame, and emits a peculiar deep roaring noise: no further attention is required. With a furnace eight times the size of Fig. 2, and the air pressure of an ordinary foot bellows, with $\frac{3}{16}$in. gas supply, I have often heated a porcelain tube 1in. in diameter, the whole length of the furnace, to a bright orange heat. Fig. 5 is sectional view of a similar furnace suitable for heating crucibles. It consists of an exterior circular shell of thin sheet iron, the inside of which is thickly lined with firmly rammed fireclay; this is placed on a slab which constitutes the bottom. Another thinner slab of fireclay, with a hole in its centre, is placed on the top, and serves for a cover. Previous to lining the shell a hole is made near the bottom for the blowpipe, and it is wise to have another near the top also (*a*, Fig. 5), so that tubes may be connected with the crucible if necessary. The method of working this furnace is the same as that before described. I have melted iron in one eight times the size of Fig. 5. Of course, these furnaces may be made any size and shape to suit the particular purpose to which they are to be applied. R. MCLAREN.

[68045.]—**Portable Vapour Bath.**—Seeing but one short reply to this query, I give "Solvardo" my experience in making and using the vapour and hot-air bath at home. The first I made was the cloak or petticoat form (canvas), which soon proved a failure, for various reasons not worth space here. I have also tried metal, then wood—there is nothing to beat wood for a portable Turkish bath. For nearly thirty years myself and family nave used one, and I often give a suffering neighbour the benefit of it too. It is light and neat, and "Solvardo" may know how I made it, cost of materials (which is trifling), and any others particulars, free, at 22, Coventry-road, HINCKLEY.

[68077.]—**Water-Wheel.**—Thanks for reply to water-wheel question; but I cannot give quantity of water passing. Perhaps you can get at it—The gate is lowered 22in., and takes the water off the top and goes on the wheel at about half-past three on the face of the clock. The wheel clears the tail water well except on floods. The present wheel runs 5½ revolutions per minute. COUNTRY MILLWRIGHT.

[68116.]—**Dynamic.**—My question seems to have lacked data. Will you kindly insert the following, which I trust "T. C., Bristol," or some other kind reader, will solve for me at his earliest convenience?—viz., What power will it take to slide a body of one pound weight along a horizontal plane 6ft. long, the plane to be elevated 4ft. from the ground? After the body leaves the plane, the velocity must be sufficient to keep it (the body) travelling horizontally through space until it is gradually brought to the ground by the force of gravity, a distance of about 25ft. from starting point, or about 19ft. from where it leaves the plane (to travel through space). The power to travel behind the body, forcing it (the body) onward the first 3ft. from starting point. DYNAMIC.

[67977.]—**G.E.R. Locos.**—I hope the inclosed outline will give what "Baltimore" requires. The new single engine is No. 789, and is very similar to Mr. Holden's coupled express engines, having 7ft.



driving-wheels, the leading and trailing being 4ft. diam. This engine only came out last month, and is the result of some trials made by Mr. Holden last summer, by taking the side rods off one of his coupled engines, No. 721. 789 was sent to Cambridge on 1st March to work on the joint line to Doncaster. East Anglian.

[68116.] — **Dynamic.** — "D.'s" query may involve important results, but it is very vague. Insufficiency of data and superfluity of words is what it suffers from. He should know that the model commonwealth which he addresses does not ask for motives, but lends a helping hand to all whom the Editor admits to its counsels. He omits to give the height of the plane above the ground, which makes all the difference in the result. It must be substituted for h in the following:—By the well known formula, t, the time which the body will take to reach the ground will $= \sqrt{\frac{2h}{g}}$, therefore the velocity with which it must be projected from the plane to cover 19ft. in its descent must $= \frac{19}{t} = 19 \div \sqrt{\frac{2h}{g}} = \frac{19 \times \sqrt{32 \cdot 2}}{\sqrt{2h}} = \frac{76 \cdot 19}{h}$. The force to give this velocity varies as the duration of its action; thus "D." will see that it is impossible to give him even an approximate answer without having further particulars. The force actually expended is the *momentum*, or the mass multiplied by the velocity. In the above, no account is taken of the friction or air resistance, and as by these conditions the body must be assumed to be maintained for 6ft. in a horizontal direction without any expenditure of force, which is absurd in connection with the second part of the problem, I have only considered this latter part, and the velocity given is that with which the body must leave the plane. To include the 6ft., one must know the coefficient of friction. The air-resistance will not make much difference unless h is small. I. Q.

[68126.]—**Paris Exhibition.**—Having received upwards of 300 letters of inquiry in response to my brief note in your issue of March 22nd, I feel convinced that the subject is of sufficient interest to a large section of your readers for me to ask for a small space to give a few brief words respecting the probable cost of a visit to Paris during the Exhibition season. To the whole of the above letters I have replied, and given as full particulars as time would permit. The following fares, charges, and fees are to be taken as a rough guide or estimate of an ordinary week's visit. The lowest rate from London to Paris will be £1 3s. 3d.; but as part of this journey will have to be made on railways not equal in comfort to some of our great railway companies' carriages, I advise all "ours" to travel 2nd class; this will cost £1 10s. 3d., viâ Newhaven and Dieppe, and occupy about 11 hours. Bed and breakfast can be had at boarding-houses for 4s. 6d., with meat tea, 6s. 6d.; to this must be added about 9d. per day for attendance; a substantial lunch can be had for 2s. 6d. to 4s. Admission to Exhibition, 1fr. and 2fr., between 8 and 10 a.m. and after 6 p.m. In addition to these expenses each visitor should visit Versailles and other towns in the environs, which can be reached by train or carriage, the latter mode costing about 8s. Visitors should also have the use of carriage at least one day within the city, to visit principal places of interest; this will cost, with interpreter, about 8s. Those requiring more luxurious quarters must be prepared to pay accordingly, up to 20s. per day; but good comfortable lodgings, with breakfast and evening dinner, can be had for 10s. per day; but in all cases lodgings are booked a long time in advance, for which a small fee is required, from 1 to 2fr. beyond these charges. Many opportunities occur where extras come in, and these soon run up the bill. I have been over the route and made extensive arrangements for several parties, the inclusive fare of £4 6s. 6d. from London for a week being I believe, the lowest possible figure it can be done for, consistent with comfort. Of course this does not include alcoholic drinks, but every other necessary outlay except light refreshment in middle of day. Hope this will meet the requirement of your readers who are ignorant of Paris and its ways.

Leicester. W. C. Phipps.

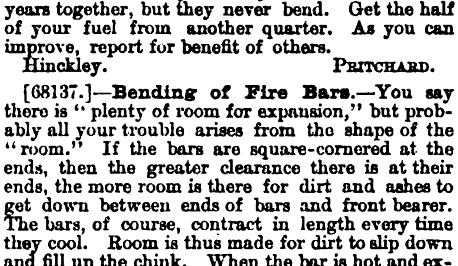
[68137.]—**Bending of Fire Bars.**—I was in a similar difficulty, and found a remedy in having the bars cast four in a gang. Until this was done we wanted a new set about once a month; but now, after nine months' wear, with some very bad coal, they look like a regiment of soldiers.

Dursley, Glo. A Printer's Devil.

[68137.]—**Bending of Fire Bars.**—During very many years' hard stoking, with many sorts of fuel, I never found fire bars to bend if allowed free expansion endways and sideways. Do the heels or shoulders of your bars jam against dead plate? You say the boiler is fired hard: here is one cause. You must keep those clinkers broken up at nearly every fire, and let the air pass through them, and not allow surface of bars to remain caked over too long between times. Perhaps your slack is fine, and you put one fire on before the last is burnt off—this is another cause of over-heating. I have had a set of bars destroyed every twelve months for years together, but they never bend. Get the half of your fuel from another quarter. As you can improve, report for benefit of others.

Hinckley. Pritchard.

[68137.]—**Bending of Fire Bars.**—You say there is "plenty of room for expansion," but probably all your trouble arises from the shape of the "room." If the bars are square-cornered at the ends, then the greater clearance there is at their ends, the more room is there for dirt and ashes to get down between ends of bars and front bearer. The bars, of course, contract in length every time they cool. Room is thus made for dirt to slip down and fill up the chink. When the bar is hot and expands, it cannot crush out the dirt; so as it gets hot and soft it must bend to get room for its extra length. In cooling again it does not straighten, although its length contracts, so it forms a still wider chink at its end, which again gets filled up as the fire is raked out or lighted, and so the evil grows. The bars ought to have a bevel at one end (see sketch), so that that end may slide up and down the suitably-shaped bearer when expanding or contracting. Perhaps your bars are too close together for the kind of fuel you are using; it would tend to keep them cooler if they were as wide apart as would not let the fuel fall through wastefully. Then each bar should have a strip cast vertically on the centre of its side, as shown at D. This keeps them apart, and would help to prevent the bars falling over sideways. Sulphur in the fuel is also a cause of over-heating and softening of bars, and possibly too heavy firing may help to cause so much clinker. I mean too deep a mass of fuel on the bars at one time. Fire "thin and often." With some boilers it is necessary to fire mostly at the door end, and as the coal gets the gas drawn out of it, it is pushed further in with the rake. T. F. S. T.



[68141.]—**Nickel Plating.**—I am afraid that unless "New Subscriber" has well read up "Nickel Plating," he will make a mull of the job, as nickel-plating is, even to experienced hands, very troublesome, the articles having to be taken out of the bath every few minutes and polished, and then put back in the bath again. I should certainly advise "New Subscriber" to send his work to a professional plater. The battery strength best employed is three Bunsens, each holding one pint of solution.

F. W. Mason.

[68143.] — **Silver-Chasers' Pitch.** — Chasers always mix their pitch "by rule of thumb," the basis being Stockholm pitch and plaster of Paris in equal parts. The pitch is first melted at as low a temperature as possible, and the plaster added by degrees, the mixture being constantly stirred all the while; when the whole is properly incorporated a piece of Russian tallow or a little linseed-oil is added. Rosin, which toughens the cement very much, and beeswax are also used. If "F. W. S." will experiment a little, he will soon arrive at the right proportions. When cold it should be just soft enough to be indented by the thumbnail.

Fal.

[68144.]—**Cuckoo Clock.**—The reason it does not "warn," is because you have put the pin too close to the lever, so that it does not "run" just before the hour. You must take the warning wheel, six pinions (the wheel that drives the fly) out of the wheel that drives it, and put it back so as to give it a run of full half a turn before the pin is stopped by the lever. Charles A. Jones.

[68147.]—**Photo. Enlarging Apparatus.**—Will "B.Sc." kindly describe the 40 or 50 candle-power Argand paraffin-burners referred to, and say if they can be obtained in England? If patented, can he give reference to the specification, or say by what name they are known, and greatly oblige?

Finem Respice.

[68150.]—**Chemical.**—You do not say if there are any more acids in the mixture, but if they are the only acids the following analysis will do:—Add Na_2CO_3 to exactly neutralise any free acid, then to the neutral solution add $CaCl_2$ (solut.), allow to stand for twenty minutes, and filter. I.—The precipitate will contain CaO + CaT. Add a cold strong solution of KHO, shake up, and filter. 1. The precipitate is CaO; heat on Pt. foil in Bunsen flame, and add HC2; the salt effervesces, because CaO has been turned into $CaCO_3$. This tests and separates the oxalic acid. 2. The filtrate = CaKT, add $AgNO_3$, a white ppt. Dissolve in least quantity of NH_4HO, heat; the Ag will be deposited as a metallic mirror. This tests and separates the tartaric acid. II.—The filtrate contains $MCHO_2$, $MC_2H_3O_2$, and $M_2(C_7H_4O_3)$. Add $AgNO_3$; boil; filter. 1. The precipitate is $AgCHO_2$, or metallic Ag, which, on dissolve in HNO_3, add Fe_2Cl_6 = red colouration. This tests and separates the formic acid. 2. The filtrate is AgA + $M_2(C_7H_4O_3)$, add $AgNO_3$; filter. (*a*) The filtrate is $M_2(C_7H_4O_3)$. Add Fe_2Cl_6 to a portion = violet colouration. Add bromine water to another portion = yellowish white ppt. This tests and separates the salicylic acid. (*b*) The precipitate is AgA. Dissolve in NH_4HO or boiling water. Add Fe_2Cl_6 to a portion = red colouration. Add $AgNO_3$ to another portion = white ppt. of $AgC_2H_3O_2$ sol. in NH_4HO. This tests and separates the acetic acid.

Derby. F. E. Hollingshead.

[68154.]—**Testing Strength of Soda Crystals.**—**Correction.**—For 10 grains in first line of answer read 10 grams. Printer's error.

F. Knott, Analytical Chemist,
Woolwich Arsenal.

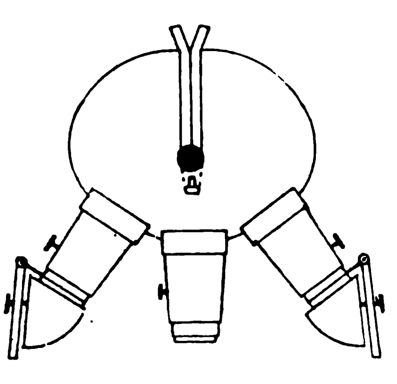
[68157.] — **Cup-and-Ball Microphone.** — I made a microphone of this class six months since, and had just the same difficulty; but on increasing the size of ball and the aperture between the two cups no crackling was heard, and the instruments are now in daily use. I made diaphragm of straight-grained deal ⅛in. thick, and have three Leclanché cells at each end, but have not tried less.

Huddersfield. W. G.

[68162.]—**Stereotype.**—There is but one way of obtaining a perfect plate from a plaster mould, and that is by "dipping." Dry and warm the plaster mould; then fasten it, face upwards, in a shallow cast-iron pan; plunge pan and all into a pot of molten metal, and keep it immersed until bubbles of air and steam are no longer given off. Draw it out, permit it to cool, and separate plaster from mould (of course, spoiling the mould), and you will find a perfect copy of the original. If this process is too elaborate, try Spence's metal, if you can get it. If not, advertise your address, and I can let you have a somewhat similar compound.

Stereographic.

[68165.] — **Prismatic Dioptric Dissolving Apparatus.**—The following, which I have taken from "Chadwick's Lantern Manual," may interest "Photus":—The Rev. Canon Beechey some thirty years ago (1840) had a lantern constructed in which only one light was used to illuminate three distinct optical systems, and for the purpose of producing dissolving views and other dioramic effects. This lantern was first exhibited at the Exhibition of 1851, and is here illustrated. It consists of three separate optical systems emanating from one body, with prisms placed at the extremities of the side systems, which were placed at such angles that the discs from all three were concentric on the screen. The first illuminating power used was the oxy-hydrogen limelight, the cylinder form of lime being used, and which was supported upon a pin, this pin being fixed central with all three condensers. An unequal light was the result, the side systems receiving less than the centre one. As it was the inventor's intention not only to produce dissolving views, but also to have all three systems in operation at the same time when required for effects, &c., he therefore discarded the cylinder form of lime, and substituted the spherical, which was suspended by a platinum wire over the flame of a fountain oil lamp, through the centre of which passed a gentle stream of oxygen. The whole of the lower portion of the lime was thus rendered luminously incandescent, and the rays of light collected by each system thus equalised. The oxygen nozzle being of large size, little pressure was needed, and therefore the lime was not liable to split, as if a small nozzle and heavy pressures had been used. Although this oxy-calcium light was much inferior to oxy-hydrogen, it proved very successful for small-sized discs. A very perfect mechanical dissolver was attached, and the whole arrangement was so simple and unique that we cannot but express surprise that the principle has so long remained *in statu quo*. This same idea of dissolving with one light has been adopted in M. Duboscq's apparatus; both sets of lenses were placed as close together as possible with convenience, and parallel to each other, a concave reflector being arranged to throw the light to each condenser alternately, while a very simple sliding dissolver opened and closed the objectives. X. Y. Z.



[68175.]—**To Fasten Rubber to Stereo Metal.**—Take pulverised shellac dissolved in ten times its weight of pure ammonia. In three days the mixture will be of the required consistency. Ammonia penetrates the rubber and enables the shellac to take firm hold; but as it all evaporates in time the rubber is immovably fastened to the metal. The following is said to be a good cement for leather:—4oz. guttapercha, 1oz. indiarubber, ¼oz. pitch, ¼oz. shellac; ¼oz. oil. Melt together and use hot.

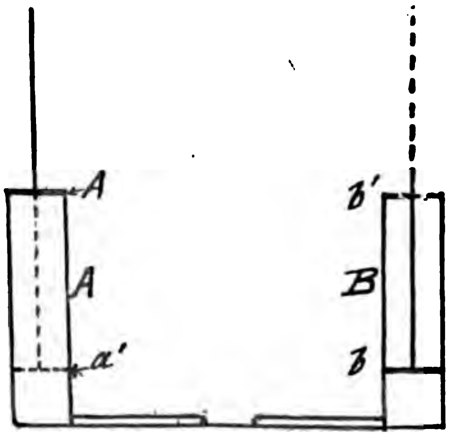
Stereographic.

[68177.]—**Electric Clock.**—You must state more definitely what you mean by "electric clock." Do you mean merely self-winding? The current does *not* work the clock hands: it either winds the spring, (self-winding), or moves the pendulum. The length of pendulum is determined by the space you have at your disposal for it. Seconds pendulum 39·14in., and pendulums to beat half the time will be one-fourth the length. The length of pendulum determines the train. Example: A centre wheel of 64 gearing with next pinion of 8, having a wheel of 60 on its arbour gearing with pinion of 8 carrying the 'scape wheel, is a seconds train for $\frac{64 \times 60}{8 \times 8} = 60 \times (2 \times 30) = 3{,}600$ seconds per hour. Electric clocks keep no time. Self-wound clocks would if made well. Some of our electrical friends will tell you of a battery. Charles A. Jones.

[68179.]—**Coating for Carbon Cells.**—First remove all the old covering and thoroughly dry the cells, then give them two or three coats of Brunswick black. I have used hundreds of these cells and have found this keep them sound. I believe the makers of the carbon cells are enamelling the outside now. I should think they would do those of "J. W. S." if he communicated with them.

W. J. Woodward.

[68183.]—**Compressed Air.**—I will try to answer this query in popular language, without using such terms as latent heat, specific heat, &c., as I think it is one which many mechanics would like to understand. Let us first try to grasp the fact that there is a certain quantity of heat in every cubic foot of air taken from the atmosphere; then imagine a vertical cylinder, A, containing 4c.ft. of this air. Force a piston down from *a* to a^1 until the air occupies only 1c.ft., and we shall have a pressure of (we will say for present argument) about four atmospheres, and the heat of four concentrated in one. This compressed air, containing four times the quantity of heat as an equal volume of the surrounding atmosphere, becomes perceptibly hotter (as the thermometer shows), and, assuming this to be "cooled with water down" to the heat of the surrounding air, we shall have lost about ¾ths the original quantity of heat. This cooled air is now conveyed to the engine in a volume of 1c.ft., and after doing its work escapes at the exhaust pipe as 4c.ft. For simplicity we will suppose a cylinder, B (similar to A), for re-expanding this air, and here the 1c.ft. is expanded, as the piston moves from *b* to *b'*, and occupies its original space of 4c.ft.; but these 4ft. now only contain the heat of 1ft. of the surrounding atmosphere. Again, for simplicity, we may assume the heat of the 1ft. of compressed air to be 60°, and this being expanded over 4ft. to be 15° only, or 17° below freezing. Hence "the freezing atmosphere" produced by the exhaust air from your engine is evident. I cannot understand, nor do I believe, that "the pipes leading from the engine are quite hot" (if you mean the engine using the compressed air) unless the compressed air conveyed to it is perceptibly hotter than the surrounding air. The figures assumed above are only approximate; but I hope they have served the purpose of showing the general principles asked in the query, and at the same time how freezing-rooms are supplied with refrigerating air for freezing, conveying, and preserving fresh meat. Acier.



[68191.]—**Wounds.**—In reply to the query of "L. H.," I beg to inform him about the piercing the breasts as we boys performed the operation at the Lycée I mentioned. The operation is so simple that it is not required to make any sketch. The only requisites are some fine, strong, sewing silk, a long, thin needle with a long eye (a small-size darning-needle is just the thing), and a pair of gold ear-wires of the largest size. The needle should perforate the centre of the breast from side to side in a horizontal direction, and should pass close to the skin of the body, so that the ring, when inserted, may lie flat on the body below the breast. The mode in which we used to proceed is this:—Standing in front of a mirror, make a little dot with ink on each side of the breast, centrally and at its base, to show the places where the needle should pass in and out. Take a piece of the silk about 8in. or 10in. long, and, doubling it in the middle, tie the two free ends together, and pass the loop end for about an inch through the eye of the needle; then lay hold, with the first finger and thumb of the left hand, of the skin which is underneath the breast, so as to hold it steady, and protruding in front, and having a thimble on the second finger of the right hand, take the needle, and entering its point at the dot on one side, pass it through the breast and out at the other dot. If the needle does not come out in the proper place, it may be partially withdrawn and its direction corrected. As the skin is very tough, it requires a little force to push it through. When the needle is correctly placed, then draw it through the breast, carrying with it the loop-end of the thread, which will now be on one side, and the tied, loose ends on the other. Not more than an inch of the loop should be drawn through, as it has presently to be retracted. Perforate the other breast in the same manner. The needle is no more required after this. Now take two pieces of the silk, each as long as the first one, and passing them through the loop of the first thread, double them in the middle and tie each pair of loose ends in a knot. Now, holding the breast steady with one hand, draw the first thread back carrying with it the two other threads for about an inch; the first thread is now removed, being not any more wanted. There are now four threads passing through each breast, two loops being on one side of it and two pairs of loose ends on the other side. The silk thread should be as strong as possible, although rather fine, as it requires some force to pull it through the skin. The operation may be further proceeded with at present or be left till next day as preferred. To proceed: Place in each loop two threads, in the same manner as before, and draw each pair successively through the breasts so as to have eight threads passing through each of them. Leave it now till next day; by proceeding in this gradual manner to enlarge the holes very little pain is caused. The next day, or the day after is better, the gold rings may be inserted. To do this, have the rings ready opened, then cut off the threads close to one side of the breast and pull the whole of them out of the hole, into which at once put the point of the ring and pass it through before the hole can begin to close. When the rings are once inserted all trouble is over. In a very short time one could scarcely know that the rings were being worn, except anything should touch them rudely. Do not attempt to move them until healed; only anoint them three or four times a day slightly with olive oil, which will prevent them sticking. They should not be removed from the breasts for, at least, several months; as, until the holes are thoroughly cicatrised, there is a tendency to grow up again. Although this description may seem long and complicated, it is really very simple in practice, and gives not much pain; it only requires a little care and some resolution. If "L. R." wishes to try the experiment of piercing his breasts, I am sure he will be quite satisfied with this method. I hope he will send word to the English Mechanic to say how he succeeded. Of course the operation could be done with an ear-piercer; but it would be then much more painful, as the hole would have to be made full size at once, and it would require the aid of a jeweller to perform it. Although I have known many boys who had their breasts pierced, yet until lately I never met with a lady who had submitted to this operation. But when I was in London last Christmas holidays, I was introduced to a young Polish lady, an artist. One occasion, as she was sitting down and myself standing by her side, I noticed something shining inside her bosom, her dress being low in front. On getting another look I saw it was a ring in her breast. On a future occasion I told her what I saw, and she allowed me to see the rings in situ. They were of gold, nearly as large as a crown piece, and quite thick. She told me that it was quite usual for the peasant girls in the part of Russian Poland from whence she came to wear them, but usually made of silver. She, however, and some of her girl friends who had been persuaded to submit to the operation, wore gold ones. These large rings are commonly worn in the ears also, but they are mostly smooth, and not facetted like the rings generally worn in this country. The operation was performed for this young lady by a jeweller with a large ear-piercer. She said the pain produced by the piercing was very great: she nearly fainted, and hardly had courage to have the second breast pierced. But as there was a ring in one breast it was useless to hesitate, so after a short rest she submitted to have the other one pierced; after a few hours the pain had entirely ceased. When I saw her she had worn the rings for some years without any inconvenience. During the five or six years that I wore rings in my breasts I never found them any trouble; indeed, I was very seldom conscious that I was wearing them. As I no longer reside in Birmingham, I beg to subscribe myself

Jules Orme.

[68195.]—**Largest Locomotive.**—A mammoth loco., which may be regarded as the largest engine in the world, was constructed lately in the Central Pacific Ry. shops at Sacramento, for use on the Sierra Nevada mountains; the loco. is called the "El Gobernador." Total length of loco. and tender, 65ft. 5in.; driving wheel base, 19ft. 7in.; five pairs of drivers 4ft. 9in. diam., with a four-wheel truck in front; water capacity of tender, 3,600 gallons; cylinders, 21in. diam., 36in. stroke; total weight of engine and tender, 98tons 650lb. There are two six-wheel trucks under the tender, making a total of twenty-six wheels in all. I am unable to add more, or give a sketch of the loco.

J. A.

[68196.]—**Leclanche Cells.**—I have always worked this battery with solution over the blocks, and believe it is all right; at least I have never had any trouble with cells through it.

F. W. Mason.

[68200.]—**Coating Electric Accumulators.**—For the positives mix a stiff paste of red lead and one part of commercial sulphuric acid to two of water; acid and water must be added till all trace of red lead is gone; the paste then consists chiefly of sulphate of lead. The paste is best laid on with a piece of wood and the surplus scraped off with a piece of hoop-iron. The plates should be left for about a day to dry, and after that should be quite hard if the consistency of the paste was right. The negatives should be treated in the same way, only using litharge instead of red lead. They ought then to be charged till they boil.

Electromaniac.

[68201.]—**Bevel-Wheels.**—The querist cannot use a larger or smaller wheel with B, unless he alters the direction of the shafts. The lines constituting the sectional edges of the teeth of bevel gear must, when produced inwards, all meet in one part. He must regard these wheels as portions of cones rolling together, which they cannot do unless their apices coincide. To map out a wheel to gear with B, take a cone whose length, upon its side, is equal to that of which B is a part, and the diameter of whose base is proportioned to obtain the desired speed. On this mark out the teeth, taking care that the flanks all radiate to the apex. The angle between the shafts will be half the sum of the vertical angles of the two cones. I. Q.

[68204.]—**H.P. of Portable Engine.**—The I.H.P. ought to be about 13·6H.P.
Electromaniac.

[68204.]—**H.P. of Portable Engine.**—I expect that R. J. Merry will find the calculating of the mean pressure the most difficult part of his task. It is generally done by means of hyperbolic logarithms; but were I to recommend him that way, I am afraid he would be inclined to say, with Shakespeare, "Out, hyperbolical fiend!" and take the mean pressure on trust, which I do not think he wishes to do. The method herewith is rather long; but it has the advantage of showing the pressures at different parts of the stroke—in fact, it clearly tells one what he is about. First, assume the stroke to be divided into a certain number of equal parts—in his case, 28 of ¼in. is the most convenient. It is more than is really necessary, but the greater the number the more accurate the result. Then 21 of these parts are traversed by the piston before the steam is cut off, and adding one for the clearance and passages (perhaps this is excessive, seeing the small piston speed, but it is rather less than is generally allowed), will make 22. These 22 parts of steam, at 50lb., have to expand to fill 29; seven parts after the cut-off. In these calculations we must use the absolute pressure—i.e., 50 + the atmospheric, say, 65lb. Then there will be, in the cylinder—

at the 21st division 22 parts at 65lb. = 1430
,, 22nd ,, 1 ,, $\frac{22}{23} \times \frac{65}{1}$ = 62·17
,, 23rd ,, 1 ,, $\frac{22}{24} \times 65$ = 59·58
,, 24th ,, 1 ,, $\frac{22}{25} \times 65$ = 57·20

and so on to the 28th division, when the sum of the values to the right will be 1817·30; which, divided by 29, gives the mean absolute pressure = 62·3. Subtract the atmospheric to get the mean effective pressure = 47·30. Then the piston area is 3½; the radius squared $= \frac{22}{7} \times \frac{21}{4} \times \frac{21}{4} = 86{\cdot}62 \times 47{\cdot}3 = 4097{\cdot}36$lb. This acting over $\frac{28}{12} \times 90 = 210$ft. per minute is $\frac{4097{\cdot}36 \times 210}{33{,}000} = 26{\cdot}09$ horse-power. It is an old-fashioned way, but being all straightforward arithmetic, it will perhaps suit Mr. Merry better than the hyperbolic method which I have no doubt others will give. I. Q.

[68205.]—**Lantern.**—The illumination of the disc depends on the distance at which the light is placed behind the condensing lenses; if it is too near to them the middle of the disc will be badly lighted, and if it is too far back the edges will be dark. The right distance is a little greater than the focal length of the condensers, but it must always be adjusted by trial. It is worth noticing that when working with a long-focus objective the light must be brought up nearer to the condensers than would be right with an objective of short focus. This, of course, admits a wider pencil of rays through the condensers and gives a brighter disc; hence it is wise to work with an objective of as long focus as possible. The size of the disc depends on the distance of the screen, as well as on the focal length of the objective; it may therefore be enlarged to any extent within the power of the light to illuminate it sufficiently by placing the lantern farther from it. If "J. P." requires a simple method of calculating the distance for obtaining a given disc with different objectives, the following may suit him: Reduce the diameter of required disc to inches, and divide it by the diameter of the slide in inches; add one to the quotient, and multiply it by the focal length of the objective in inches. The product will be the required distance in inches.
F. E. C.

[68207.]—**Battery.**—I do not quite understand what "Nimrod" means by the zinc at the bottom of the cell. Does he mean the zinc sulphate, $ZnSO_4$, or does he mean that he has a Zn at the bottom of the cell, lying flat, as it were? A good solution to use is sulphuric acid 5oz., chromic acid 1½oz., and water 2 pints. Cannot state whether it is bad materials or wrong proportions, as you do not give particulars to either. I should certainly advise "Nimrod" not to try and make his porous cells—leave that to the makers; I know from experience what it is to try and make porous cells. You must not mix the plaster of Paris too thin, and also avoid air-bubbles. Any further information "Nimrod" may require shall be pleased to give.
F. W. Mason.

[68207.]—**Battery (Bunsen's).**—The modern form of the Bunsen is a cylinder of zinc surrounding the porous cell, and no bottom piece at all. As the size or shape of the zinc has very little to do with the efficiency of the battery, you may use any form of zinc you may find most convenient, with equal results. As you do not say how many cells nor what voltage lamp you are using, it is impossible for me to say where the defect may be. Two cells should light a 4-volt lamp for several hours. The best proportions for the inner cell are:—Chromic acid, 2 parts by weight; water, 3 parts by weight; sulphuric acid, 1 part by weight. The sulphuric acid may be the ordinary oil of vitriol, and should have a specific gravity of 1·845. The addition of one-third part of nitrate of soda to the above, confers great lasting powers on the above, so that a 4-volt lamp can be run for 30 hours; but nitrous fumes are given off towards the end, and these are injurious. Unless you are a skilled potter, you cannot make porous cells. Plaster of Paris is of no use, since acidulated water soon dissolves it. In the outer vessel, along with the zinc, use the ordinary 1 to 10 sulphuric acid and water mixture. See that your carbon contacts are good; your failure is most likely there. S. Bottone.

[68208.]—**Dynamo.**—There is a printer's error in my query. Instead of "and 14 pieces of ¼in. by ⅜in. wrought iron are riveted on to *four* cogs," which is nonsense, it should have been printed "to *form* cogs." My writing was, I know, very bad, and the word "form" has been mistaken for four.
J. M.

[68208.]—**Dynamo.**—To Mr. Bottone.—There appears to have been some words left out or misplaced in this query, so that the sense is by no means clear. However, presuming that you have an armature with 14 sections, 3in. in diameter, 4in. long, wound with 14 coils of No. 13 wire, about 1lb., with field magnets 5in. by 3in. by ¼in., you ought to get, notwithstanding the joints, quite 4 ampères at 25 volts pressure. I speak from actual experience, as I have made Edison-Pacinotti dynamos of this type and size, the only difference being that my field-magnet cores were circular in section, 1¼in. diameter, so that the mass of iron was about the same. If connected up as a shunt machine, you ought to be able to light five or six 6-volt lamps, and charge a small pocket accumulator easily. Speed about 2,500 revs. per minute. S. Bottone.

[68209.]—**Shunt Dynamo.**—Premising that you have got very little wire on your armature (I get nearly 6lb. on such an armature), you may expect to get about 40 volts from your armature, if driven at about 1,500 revs. per minute, in a suitable field. Allowing at this rate of driving 1 volt per yard of active wire, as you have 72 yards of wire, of which of course the inner layers are idle, you may reckon upon 40 volts, or more if you drive faster. As to the proper amount of wire on the field magnets to balance this, and reckoning by Sir W. Thomson's rule, that the resistance of the field-magnet coils should be at least 364 times that of the armature, we get for the resistance (running) of armature ·15 of an ohm, being the quarter of the resistance of 3lb. No. 16. Multiplying this by 364, gives 64·6 ohms, which, taking into account the wire space you have on your field magnets (do I understand them to be 4in. in diameter?), you would best get by using about 13lb. No. 22, having a resistance of about 5 ohms per lb., since 13 × 5 = 65. Driven at about 1,800 revs per minute, you should be able to light from 6 to 8 of your 45-volt lamps.
S. Bottone.

[68212.]—**Lines of Force.**—"Lines of force" have no real existence; the term is only a means of expressing magnetic theory. If you place a magnet under a card or piece of glass, and tap the glass gently, you will find the iron filings (which you must place on the top) arrange themselves in certain curves, which are supposed to indicate the direction of the magnetic forces. To explain the matter fully would take more time than I have to spare. See textbooks.
Govan. Engineer.

[68217.]—**Screw-Cutting.**—Rig up a pulley as large as possible on top slide screw, and by means of a cord and suitable size pulley on mandrel (led through guide pulleys) drive the screw at the required speed, and take light cuts.
Bristol. T. C.

[68218.]—**Bicycle.**—The number of revs. per minute would be 49·7, or, say 50. R. James.

[68218.]—**Bicycle Speed.**—If "Wat" will do a simple multiplication and division sum as follows, he will get at a result near enough for practical purposes. Multiply 1,760 yards (one mile) by 8, and the product by 4½ (the circumference in yards of his driving-wheel), and divide the result by 60 minutes, and he will find that the revolutions in that space of time is a fraction over 52. Fuzz.

[68219.]—**Dynamo—Speed Required.** — To Mr. Bottone.—It is impossible, without knowing the size and make of dynamo, to say what speed is required to make it light a 5c.p. lamp. To begin with, I ought to know the voltage of the 5c.p. lamp. Some are made as low as 6 volts, others require 10, or even 15 volts. Those of low voltage generally take more ampères of current. The average is 3½ watts per candle-power; hence, a 6-volt 5c.p. will take about 3 ampères, while a 15-volt lamp will probably take about 1 ampère. Then again, most dynamos are constructed to run with an angular velocity of armature of about 1,250ft. per minute, and are so wound as to give a given voltage and given current at that speed, so that if your dynamo were constructed to give only four volts, you would have to drive very much faster to make up the required E.M.F. Again, a dynamo constructed to give 50 volts, if driven very slowly, would give six or seven volts. One of my little 15s. dynamos, driven at 3,000 revs. per minute, lights easily a 6, or even an 8-volt lamp. The armature is only 1in. in diameter, so that the angular velocity is only 833ft. per minute. To get this result I am obliged to use a comparatively large quantity of wire an the armature—nearly 16 yards—which, if driven at 1,250ft., should, and does, actually give me 16 volts. S. Bottone.

[68220.]—**Balloon.**—"J. M. B." does not give capacity of balloon; but you could erect such an apparatus for about £20. F. W. Mason.

[68221.]—**Rusty Water.**—If this is caused by the surface rust of the iron pipes and boiler, use and lime will be the remedy; but if caused by the presence of iron in the water, I am afraid H. Spink is in a hole, and will have to put up with the inconvenience. Fuzz.

[68224.]—**Hydraulics.**—Rankine, in "Applied Mechanics," and "Box's Hydraulics," and read all the works you can lay your hands on bearing on the subject.
Bristol. T. C.

[68226.]—**Electro-Plating.**—I expect the substance is copper. F. W. Mason.

[68228.]—**Leaky Portable Engine.**—If tubes are swelled into plate, they may be tightened by expanding them with a tube expander; if fitted with ferrules, drive in further; if screwed into plate and fitted with nuts, red lead and a spanner will tighten them. McGill.

[68228.]—**Leaky Boiler.**—If tubes are sound re-expand them by means of a proper "tube expander," and if ferruled, tap the ferrules firmly in. If the latter are too slack, stretch them, or have new ones.
Bristol. T. C.

[68228.]—**Leaky Boiler Tubes.**—I presume it is the boiler, not the engine, where the leak is going on. I presume you have ferrules in tubes? If so, drive them out with 1¾in. or 2in. round iron bar, 2ft. longer than tubes, with head upset at one end just to fit the tube nicely; with tube expander roll the tubes, stretch old ferrules, or put in new ones. M. W. S.

[68228.]—**Leaky Boiler Tubes.**—Rd. J. Merry had better drive out the rings by means of a rod or mandrel just fitting the tubes, this rod to be inserted in the smoke-box end, and driven through into the fire-box, and, of course, carrying before it the tube-ring. Next, with a mandrel slightly tapered, or, if procurable, with a tube-expander, he should carefully stretch the tube at fire-box end, and having stretched the ring to a proportionate size (this may be done by heating and hammering on the beck of an anvil), carefully drive home the ring to its former position, and caulk up the joint with a small hammer. To draw and refix the tubes is a much more difficult job, and Mr. Merry had better not attempt it unless he is a handy mechanic.
Fuzz.

[68229.]—**Electric Indicator.**—Try the addition of another cell. Providing the wires are properly insulated, there will be no harm in having them whitewashed and covered.
F. W. Mason.

[68229.]—**Electric Indicator.**—The reason your bells will not work when you insert your galvanometer in the circuit, is because the coils of the galvanometer offer so much resistance that the battery cannot work through it. The wire on the coils may appear the same size as that on the bells, but there is much more of it. Your wires are very poorly insulated, and it will not do to whitewash them, though papering over them will do no harm.
F. C. Allsop.

[68231.]—**Injection of Petroleum in Steam Pipe.**—Not much danger of explosion with the exhaust steam mixed, if only a small proportion of petroleum. Have the supply of latter overhead some distance away, and lead a pipe to funnel and let a small jet of live steam spray the petroleum by blowing across the open end of supply pipe.
Bristol. T. C.

[68232.]—**Lens.**—The (negative) focus of a Barlow lens (which for astronomical purposes at least must be an achromatic combination) is usually from 4in. to 8in., and may be placed at any distance from field-lens of eyepiece, but the limits are from 2in. to 6in. One of 4in. negative focus, placed from 2in. to 3in. from field-lens, would suit you very well. The second query is fully explained on page 389 of Vol. XLVI. If "F.S.A." has any desire to make an achromatic o.g., he should read up the articles on Object-Glass Making in Vols. XXXVII. and XXXVIII. J. C. Linscott.

[68233.]—**Bell.**—Sketches are all right, though left-hand one is rather difficult to make out. Test your magnets—I fancy there is something wrong with them; look likewise to your connections.
F. W. Mason.

[68233.]—**Bell.**—Your bell should work all right if joined up as shown in either of the sketches. The size of wire on the bobbins is rather small, however, and better results would be got by using No. 26 B.W.G. double silk-covered. Perhaps the bell is not properly adjusted; the proper method of adjusting a bell was given in article II. of "Electric-Bell Construction."
F. C. Allsop.

[68234.] — **Charging Accumulators from Small Dynamo.**—I presume "A Cyclist" means a tricycle, and not a bicycle, as I cannot see how he gets the dynamo on. Case for accumulators should be 14 by 6 by 4, four cells, and charge till gas is given off.
F. W. Mason.

[68234.] — **Charging Accumulators from Small Dynamo.**—Firstly, you will require four cells of accumulators to light your 8-volt lamp, since each cell gives two volts. These must be coupled up in series. Their size for 15 minutes' run need not exceed 4in. by 4in. by 1in. The reason why you have not been able to charge your accumulator from your dynamo, though you can easily do so from your battery, is because your dynamo, being shunt wound, will not work at all with so low a resistance as the cells present. If, however, you insert in circuit a piece of No. 30 German silver wire, say about 3ft., you will find that your accumulators will charge. For convenience of packing into a small space this wire should be silk-covered and paraffined. It may then be rolled into a tight little coil and inserted between one terminal of the dynamo and one electrode of the accumulator; the other terminal of the dynamo being connected as usual to the other electrode by means of a short length of copper wire. Two wires are now to be brought from the accumulator to the lamp. You will find that the accumulator will act as a kind of flywheel on the dynamo, taking up the excess of current during rapid travelling, and giving it up when slackening. It should be disconnected when stopping.
S. Bottone.

[68235.]—**Engine Query.**—The diagrams have been reduced, and it is a query as to how much; but I have assumed them as half-size. Divide them into 10 equal divisions, and measure the heights within the diagrams between each ordinate. I make the total for h.p. 8⅙in., which, with 48lb. to 1in., gives 392lb. This divided by 10 = 39·2 average. In the same way I make 12·1lb. average for l.p. Let us take 39lb. and 12lb. Area 13in. diam. = 132·7sq.in., and 132·7 × 39 = 5,175lb. Area 22in. diam. = 380·1sq.in., and 380·1 × 12 = 4,561 (which seems tolerably even).

$$\frac{(5175 + 4561 = 9736) \times 6 \times 60}{33{,}000} = 106\text{H.P.}$$

The extra pressure would make but little difference in this case, but would be in favour of the higher pressure.
Bristol. T. C.

[68239.]—**Lifting Water.**—This is ten gallons per minute, which, under the circumstances, will require ¾ to 1H.P., and an ordinary force-pump 3in. diam. of plunger and 7in. stroke, or equivalent, should do it. Have an air-vessel next the pump, or as near as convenient, and 1½in. pipe—that known as steam-pipe with screwed sockets. Pressure on pump = 80lb. per square inch.
Bristol. T. C.

[68240.]—**Electro-Motors: How Made.**—To S. Bottone.—The dimensions given are correct. Thickness of F.M.'s 5/16in.; thickness of yoke, ½in. The distance between the armature and sides of tunnel should be about 1/16in. all round, and this practically decides the distance of pole pieces.
S. Bottone.

[68241.]—**Valve.**—What do you call extreme pressure, and how large is the port. However, I should think that a balanced drop-valve might suit you.
Bristol. T. C.

[68241.]—**Valve.**—The above query hardly gives enough information; but I have just taken out a patent for an instantaneous valve that may be worked by a handle or a float, and have supplied one to the London Hydraulic Power Co., of which they speak very highly. I shall be pleased to give any information respecting this if "One Anxious to Know" could give me fuller particulars of his requirements.
C. E. Gittins.

[68242.]—**Wimshurst Machines.**—"Glatton" will find the above machines useful for every experiment for which the old amalgam machine answers. When using an influence machine with the glass stool, it is better to dispense with the Leyden jars, for when the Leyden jars are in the circuit it is always likely that, by some unintended movement, circuit with the outside coating of the jar is made, and a painful spark obtained. One great advantage of the Wimshurst machine over the older forms is that it is always ready for full and perfect action with about the first turn of the handle. The glass stool and similar experiments are best performed by connecting one terminal to the stool, and the other terminal to the earth.
J. W.

[68245.]—**Telephones.**—Not having specified what kind of "mechanical telephones" you are using, I am at a loss to advise. I should imagine that the contacts are defective, and that the steel wire is vibrating very much; but this is simply a guess. I must have more particulars as to the telephones themselves, in order to be able to advise intelligently.
S. Bottone.

[68246.]—**Tainted Well Water.**—Hard to state unless an analysis is made; but at any rate the well should not be messed about. Try filtering the water; but if then the water has still an unpleasant smell, have it analysed.
F. W. Mason.

[68250.]—**Dynamos.**—If the motor were wound carefully so as to get the full amount of wire on the armature and fields, you could easily light a 6-volt 5c.p. lamp if you drove it at 2,000 revs. per minute. Provided you had two wires to your block of wood, one for each platinum loop of your lamp, and a twin flexible conductor from dynamo to block, you could carry the lamp about.
S. Bottone.

[68253.]—**Standard Element.**—The standard element, as it gives a constant potential, is used for verifying and calibrating voltmeters and galvanometers, also for testing resistances, and comparing the E.M.F. of other batteries, &c.
S. Bottone.

[68253.]—**Standard Element.**—A standard element is a cell whose E.M.F. is taken as the standard, and to which all other cells are expressed in terms to the standard E.M.F. The usual standards are the Daniell and Latimer-Clark. I am writing an article now for "E. M." on this standard battery, which I think may help T. Heath. Any further information I shall be pleased to give.
F. W. Mason.

[68254.]—**Bichromate Solution.**—You ought to be able to dissolve 3oz. of bichromate of potash to the pint, with the addition of 1½oz. (fluid) strong sulphuric acid. Bichromate of potash dissolves in a far larger quantity in hot water than it does in cold, so that when the solution cools the bichromate crystals are thrown out.
F. W. Mason.

[68254.]—**Bichromate Solution.**—It is quite true that some of the bichromate crystallises out when the solution cools; but the addition of sulphuric acid decomposes the bichromate, with the production of potassic sulphate and chromic acid. Nearly all, if not all, the bichromate is therefore dissolved. But why use bichromate, when you can get chromic acid so cheaply? It dissolves so freely in water, and no chrome alum is formed, so that no crystals form.
S. Bottone.

[68256.]—**Dynamo.**—Connect this up in series; it will then light four or five 5-candle power lamps of eight volts each, if run in parallel. As a series-machine it will not do for accumulator charging, as it will reverse. You could charge your accumulators with it if you coupled it up as a shunt machine. You would need a switch arrangement on the dynamo terminal board, so that you could connect it up as a shunt or a series, by altering the position of the switch.
S. Bottone.

[68257.]—**License to Grind.**—"Travelling Dick" does not require a license to go about grinding. A license is only required when a person goes about selling goods he does not make. If he makes the articles he sells, he requires no license.
Ecnal.

[68257.] — **License to Grind.** —"Travelling Dick" should inquire at the police-office in his neighbourhood whether a "pedlar's certificate" is required, as in the case of persons who hawk on foot. An Excise license is not now required for "foot hawkers"; but a certificate from the superintendent or inspector of police of the district over which the foot pedlar travels is required. An Excise license was never required to be taken out by a person who did not sell goods as well as "grind."
Supervisor.

[68258.]—**Grinding-in Plug Taps.**—"Dicky Sam" should use a good free oil as lubricant, mixing the flour emery to the consistency of cream, or thereabouts.
Fuzz.

[68258.]—**Grinding Plug Taps.**—It is your method more than your material; but use sand. You appear to keep the plug in one place too long—it should be continually withdrawn a short distance and then pushed in tight, and only let the tap turn two or three, or a very few, times, between each withdrawal. This will prevent rings and seizing; a little oil for the finish.
Bristol. T. C.

[68258.]—**Grinding Plugs in Taps.**—There is a soft earth called locally "Mullic" by the brass workers, and used by them. Animal oil or thin tallow works "sweeter" than water. Work the latter spindle only a revolution or two, backwards and forwards. In the absence of "mullic" try the finest grindstone trough deposit you can get. Dry it and mix a little French chalk or rottenstone with it, and use oil, &c., as suggested above.
Birmingham. Hall.

[68259.] — **Cylinder.** — Of course, when the cylinder is cooled by standing, the steam condenses on entering. Keep the jet cocks open until cylinder is hot, and the knocking ceases.
Bristol. T. C.

[68260.]—**Dynamo.**—Presuming this to be a Siemens Alteneck dynamo, with drum armature wound with 1lb. No. 18 wire, you should get, if the machine is perfect, 40 volts; but 8lb. of c.c. wire (what gauge?) on the fields may be very wasteful if the wire is coarse and the machine is shunt-wound, while it may be quite right if very coarse and series-wound. If the latter, the machine would probably light four or five 10c.p. lamps of 15 to 20 volts each.
S. Bottone.

[68261.]—**Lighting Shop-Window by Electricity.**—To Mr. Bottone.—The best battery for your purpose will be a modification of the Fuller. Make up a solution of: chromic acid, 3 parts; water, 20 parts; sulphuric acid, 6 parts. Use this in the porous cell along with the carbon. In the outer cell, with the zinc (which must be amalgamated), use a mixture of sulphuric acid, 1 part; water, 11 parts. The number of cells will depend on the voltage of the lamps used. Say you were going to use two 10c.p. lamps of about 15 volts, you would need eight or ten such cells.
S. Bottone.

[68262.]—**Power of Engine.**—You will get 16H.P. with ¾ cut-off.
Bristol. T. C.

[68262.] — **Power of Engine.**—Your engine would be 17·7H.P., or 9·34 effective H.P.
R. James.

[68262.]—**Power of Engine.**—Running at 73 revs., you would get about 30lb. mean pressure, which would make your engine indicate 13·5H.P.
McGill.

[68262.]—**Power of Engine.**—$8^2 \times \frac{\pi}{4} \times 73 \times 40 \times 4 = 587{,}036{\cdot}8$ft.lb., which is equivalent to this number of pounds lifted 1ft. high every minute, or 18 horse-power.
J. A.

[68263.]—**Pipes for Engine.**—Have ½in. steam-pipe and ¾ exhaust, if this is to indicate 1H.P. only. Give the size of the ports for other particulars. But you may do thus: Give it a 1/64 lead and let lap = ⅜ width of port, and make travel twice the width of port added to twice the lap. No lap to exhaust, or lead either.
Bristol. T. C.

[68265.]—**Modified Battery.**—To Mr. Bottone.—E.M.F. about 1·079. Duration entirely according to work put upon it. I have run one of these batteries for more than 18 months right off for transmitting hourly clock signals.
S. Bottone.

Another Dynamite Gun.—A Mr. Hicks (of America) has invented a centrifugal dynamite gun, and has brought it to this country with the view of submitting it to the Admiralty authorities. The machine is made up of a rotating carriage, consisting of two steel disc wheels placed concentrically side by side upon a shaft having a pulley-wheel on which the discs revolve. The discs are thick in the centre, tapering towards the peripheries. Between the discs and close to the peripheries, and at equal distances apart, are four carriers, which hold the projectile when the gun is charged. Two doors, which lock and unlock automatically, are fitted into these carriers to hold the shells firmly until the firing operation. When the operator wishes to discharge the projectile a lanyard is pulled, and this action, unlocking the automatic apparatus, allows the projectile to be thrown forward with great force, the velocity depending on the rate at which the carriage is revolving at the time. The projectile is filled with Nobel's explosive gelatine, guncotton, a small quantity of fulminate of mercury, and potassium. It is fitted with a centre rod, which is slightly beyond the point of the shell, and this, on hitting an object, is driven to the rear of the shell, and strikes the fulminate. The gun which Mr. Hicks has brought to this country has a 20in. wheel, and the projectile is 1in. in diameter.

Marion's Systematic Development.—Messrs. Marion and Co., of Soho-square, have just issued a new list of their photo. plates, which will be of considerable value to amateurs and others, as detailed instructions for developing are given, together with the developers, in percentage solutions, for all well-known makes of plates. This system simplifies and renders comparatively easy what was a source of much trouble and vexation.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

67589. Limelight Jets, p. 448.
67590. Centrifugal, 448.
67596. L. and N.W.R. Locos., 448.
67600. S.S. *Brodick Castle*, 448.
67607. Ink to Dry Quickly on Paper, 448.
67609. Water Wheel, 448.
67613. Banjo, 448.
67619. Gas Engine, 449.
67639. Soap, 449.
67640. L.B. and S.C. Locos., 449.
67641. Fish Glue, 449.
67642. Stubb's Gauge, 449.
67643. Screw-plate Sizes, 449.

67856. Roulette Turning, p. 527.
67857. Commutators, 527.
67862. Distribution of Weight, 527.
67868. Gas Tube, 527.
67900. Clasp Nut, 528.
67909. Electrical, 528.
67915. Lineman's Duties, 528.
67918. Electric Motor, 528.

QUERIES.

[68268.]—**Centre of Pressure.**—Will any reader give the working by algebra (not the calculus) for C. of P. on a plane area, say, a rectangle, with one edge in the fluid? Can the problem be solved by algebra when the plane is lowered?—A. A. E.

[68269.]—**Pattern.**—I want to make a pattern for a 5ft. gap lathe bed. Will any reader give me a sketch in the proper parts for it to leave the sand?—Carpenter.

[68270.]—**Fret-Sawing Machine.**—Would some reader give me information how to make a simple fret-sawing machine?—An Old Reader.

[68271.]—**Manganese and Carbon Battery Plates.**—Will some fellow-reader kindly inform me how to make powdered manganese peroxide and carbon into solid plates for medical batteries, so as to dispense with porous cell? Is shellac of any service? If so, how?—Student.

[68272.]—**Engine Speed.**—I have an engine, 3in. cylinder, 4in. stroke. Please inform me what speed I may expect with this engine in 25ft. boat? Steam at 80lb.—G. S., Scotland.

[68273.]—**Dynamo.**—To Mr. S. Bottone.—I have got the carcase of a dynamo which I want to use for charging accumulators. F. M. 6 by 4 by ⅝. Where armature rotates 1in., which is cast iron. F.M. wrought iron. Armature H form, 4 by 1¾, laminated. What wire to use for same to get about 8 ampéres, 12 volts?—Reader.

[68274.]—**Railway Accidents.**—There have recently been two collisions on the L.C. and D.R., on Dec. 31st last at Loughboro', and on March 18th at Snow Hill. After hearing from time to time so much about the perfection of the signalling apparatus on this line, one naturally asks, How did they occur?—S. R.

[68275.]—**Loco. Boiler.**—Will "T..C., Bristol," or other correspondent please give size of boiler (loco.) required for a two-cylinder engine, 2in. by 4in. stroke? A few instructions stating size of firebox, number and size of tubes, &c., will greatly oblige.—C. B.

[68276.]—**Medical Battery.**—Many thanks to Mr. Bottone for his replies to my queries, but shall be glad of further information. Will he kindly tell me whether 26 quart cells will be as effective as 40 pint ditto, because I have three of these by me complete? Also why are so many required and why Leclanché cells? Mr. B. will pardon my ignorance.—C. Field.

[68277.]—**Reflector.**—On the end of a reflector is engraved, James Short, London, $\frac{64}{566} = 7$. As this fraction does not equal seven, the querist will be obliged for an explanation of the meaning of these figures?—Triangle.

[68278.]—**Faulty Watch.**—I have a Geneve that will go any length of time in pocket or hanging up, but when a sharp jerk is given so as to cause the balance to swing further than ordinary distance, a tooth of escape wheel gets set fast in cylinder. This only occurs at one part of escape wheel. The banking pins are right, and balance free of everything. Will any reader kindly inform me of cause and remedy?—F. W.

[68279.]—**Luminous Life Buoys.**—What composition or chemical is used in the life buoy, now in use in the Royal Navy, to illuminate the same at night? How does it work exactly? Can any of your correspondents tell me of some composition that would burn brightly on the surface of salt water, without being extinguished by the waves, wind, &c., and if such a thing is known, as I believe it is, does exposure to the air deteriorate its efficiency? Calcium phosphide, when immersed in water (fresh), emits a gas, and causes a small flame to ignite on reaching the air, but it does not burn continuously, and, I believe, deteriorates with exposure, but I fancy there may be some method of making it answer my purpose. The composition must be of such nature that it can be kept in store, or at least be easily made and harmless.—Will o' the Wisp.

[68280.]—**Induction Coil.**—I have made an induction coil, but cannot get it to work properly. It will induce but a very slight current. The core is ½in. diam. The primary consists of two coils of No. 18 c.c. wire. The secondary is about ¼lb. of No. 30 s.c. wire, and is wound on the same way as the primary with paraffined paper between each coil. The contact breaker is on a different stand. Does it matter which way the secondary wire is wound? I expect I have wound it the wrong way. Will some one please help me out of my difficulty?—Nil Desperandum.

[68281.]—**Collotype Printing.**—Will some interested reader in photo-mechanical printing kindly give the following information? I have been preparing collotype plates for some time past and have got very satisfactory results, using Henderson's gelatine for the emulsion; but on applying to my chemist for more of Henderson's he informed me that it was not now procurable, so have been trying other gelatines with very bad results. In using Nelson's No. 1 and 2 with a little chrome alum the films have a great tendency to peel off, and are not strong enough to stand much printing. What gelatine would you recommend, and how much chrome alum does it require?—No Sig.

[68282.]—**Wall Sundial.**—I wish to construct a wall sundial, but the wall upon which I wish to place it does not face due S., but more nearly S.E. How would I have to graduate the dial? Could I do it by marking the positions of the shadow at times indicated by a clock and allowing for the difference between the sun and clock? Also what is the exact difference between Carlisle and Greenwich time?—Phaethon.

[68283.]—**Railway Shunting.**—Three or four carriages leave Chester station to be attached outside the station to the express going south from Birkenhead. They are (and have been for some years) drawn by an engine, which has then to be uncoupled and got out of the way before the express can back on to these additional carriages, and time is lost in doing it. The more obvious course would be for these extra carriages to be pushed by their engine up to the express, but, no doubt, there is some good reason why this simpler and shorter plan is not adopted. What is it?—Antares.

[68284.]—**Battery Cell.**—I should like Mr. Bottone or some other competent contributor of "Ours" to answer the following. If you had a cell exposing, say, 6sq.in. of surface of carbon in it, and 1c.in. of solution last for two hours, would 2c.in. last for four hours with the same elements, and if you doubled the elements in 1c.in. of solution, would the cell only last for one hour? If this is not so, kindly say how it would vary, and also if the cell marked 8 ampères, how would the increase of solution effect it, and also how would the doubling of the elements, would it double the ampères of the cell or no?—Beginner.

[68285.]—**Obeeyahism.**—On the 3rd of Jan. and 15th Feby. there appeared in the *Pall Mall Gazette* two remarkable articles by Roslyn D'Onston, in which he gives particulars of the wonderful power possessed by "Subè," an "obeeyah" woman. "Subè," according to the writer (who says he was an eye-witness), was able to do the most wonderful feats—viz., create "mealies"—similar to the Indian mango trick—change a toad into a tic-polongas (a deadly serpent), petrify a living woman in the space of a few minutes, and transform a living man into an actual living woman. The writer also states that he was himself proof against "Subè's" spells, because he had a talisman given him by "Bulwer Lytton," who also taught him how to use it. As the facts related by D'Onston are almost too incredible for human belief, I should like to ask "Eos," "E. L. G.," "Sigma," or any other reader of "Ours" if the facts above recorded are within the range of common matter-of-fact occurrences, or if the power of "Subè" consisted simply of her skill to use mesmeric or other influence upon those persons who witnessed the effects of her marvellous and terrible power? I should also like the names of a few books in which similar facts are mentioned. —J. N. O.

[68286.]—**Photographic.**—I had some residues of an old toning bath which had been treated with sulphuric acid, the chloride of gold being precipitated in minute particles of gold glittering very brightly among the chloride of silver. After they were dried I added some regia water, then placed in a warm oven till it would dissolve no more gold. Largely diluting it with distilled water, neutralising with chalk and filtering, the liquid being the colour of a deep sherry (when diluting with six times its bulk of water it has the colour of a fifteen-grain tube of gold, broken and dissolved in two fluid ounces of water), testing with a silver meter, it registers 11 grains of gold and silver to the ounce. It will not tone prints. Is it on account of the dissolved chloride of silver? I scarcely know how to proceed with it.—W. O.

[68287.]—**Polishing.**—How are the finely polished surfaces seen on the lathes and machines sent out by such firms as the Britannia Co. obtained, especially those of the cog wheels, where it is impossible for an emery disc to be used, seeing that the part between the edge of the face and the boss is recessed? Then again, there are the mouldings and small hand-wheels with circular rims?—Machinist.

[68288.]—**Legal.**—A sells a freehold property to B with the sole restriction of building a slaughter-house on it. Suppose at some future period A or his descendants repurchase the property from B or his descendants, has he —i.e., A or his descendant—the right to build a slaughter-house on the property?—A. L. B. T.

[68289.]—**Mincing Machine.**—I have a meat-mincing machine. If the white enamel wore off the inside, would any of "ours" kindly advise me what to get to recover the iron? Also a black covering for the outside of the machine.—Meat.

[68290.]—**B Pumping Ram.**—I have a 4in. machine with diaphragm arrangement. Fall 4ft. 6in. for driving power, lift 170ft. Could any of "ours" recommend a harder material than leather for the seatings of ascension or retaining valve? I find the metal cutting into leather, which prevents a free escape of water through the valve. I have used a red hard-fibre material, but this gets soft at the edges in a few weeks.—B Ram.

[68291.]—**Burnisher.**—Can anyone tell me how to make a simple burnisher for photos., or of any mode of putting a bright finish on prints after mounting, or can anyone refer me to recent numbers of "E. M." containing notes on burnishing, or making a burnisher?—Lurgan Amateur.

[68292.]—**Surfacing Machine.**—I wish to construct a small machine for scraping zinc and pewter plates. I have heard of a planing machine which will reduce rough surfaces to a perfect degree of flatness. If this is correct, will some reader kindly send sketch, as I should like to make one on a smaller scale?—Scraper.

[68293.]—**Arithmometer Calculating Machine.**—I shall be greatly obliged to any correspondent who will give a description of the arithmometer or calculating machine of Mr. Thomas, of Colmar. I am informed that it is used in banks, insurance offices, and the Polytechnic schools of France. Is the machine complex and likely to get out of order? Is it portable and of small weight?—W. H.

[68294.]—**Small Electro-Motor.**—My inquiry *re* above has been misunderstood. What I required was information regarding some light motor that would work with one Leclanché cell, as it is for intermittent work, and very light work, being only required once every hour to run for about 30 or 40 seconds, and must also be self-starting. I have tried the H pattern armature, but cannot get it to work satisfactorily. Information regarding the Manchester motor will, I think, suit me.—M. F.

[68295.]—**Silver Solution.**—I intend making a silver-plating solution (150gal.) by dynamo power. Will any reader say the required amount of cyanide per gallon?—E. P.

[68296.]—**A Sensitive Galvanometer.**—I am a country surgeon who wishes to try the treatment of certain cases by means of the electric current. I find, however, that the expense is far too great if I go and buy the apparatus. The chief piece that I want is a galvanometer that will show from 5 to 50 milli-ampères. Would some of your readers give me directions how this should be made and calibrated? The other parts of the apparatus I have already fixed and find work well enough, but the galvanometer I have tells nothing more than that a current passes, and even then must be a pretty strong one.—Geo. Kelman.

[68297.]—**Telephone.**—To Mr. Bottone.—I am desirous of making a telephone as described in "Electrical Instrument Making for Amateurs," but cannot procure the ferrotype plates, as no photographers or dealers in their goods keep them in Gloucester. Would a very thin brass plate, with a small disc of soft iron over the magnet pole in the centre of plate, answer the same purpose? If I knew where to send for plates, I suppose a firm would not take the trouble to send a few plates. In making the bobbins, it says they should be 1in. diam. by 1in. wide in the channels, but in sketch it shows them barely ¾in. wide in channels. Surely they would not require to be 1in. wide to hold 1dr. of No. 36 wire. Neither would the boxes 1½in. deep, take them 1in. wide, allowing room for ferrotype plate, and a little play for adjusting magnet.—G. T.

[68298.]—**Horse-Power.**—Will any reader kindly state what is the H.P. of double-acting compound condensing pumping engine? H.p. cylinder 22in. diam., l.p. cylinder 36in. diam., 6ft. stroke, vacuum 27lb., pressure on steam gauge 40lb. per square inch, working 7 strokes per min. Please state power of each cylinder, and how it is calculated. Also H.P. of non-condensing engine, 30in. diam., 5½ft. stroke, 40lb. steam pressure, working 20 strokes per min. —Vacuum.

[68299.]—**Painting on Silk.**—I should feel obliged if any reader could give me a hint or two as regards painting on silk. I have tried water colours, but find the colour sinks through, and when dry becomes obliterated. Is it possible for water colours to be used on silk, and if so, is the silk prepared in any way?—J. A.

[68300.]—**Mercurial Pressure Gauge.**—Will any of your readers say if a double mercurial column in a U tube, with one arm double the area of the other arm, would faithfully record the height of water in a distant tank, 6ft. deep, situate on a hill 112ft. above datum? If so, kindly say best material for the U tube, so as to prevent an amalgam, the length of U tube, and length of glass for observing the variations. Presuming this gauge will work satisfactorily, would it be necessary to lay inch pipe from tank to gauge so as to give true results, as it is found ordinary pressure gauges attached to rising main are useless, owing to friction in pipes and throbbing of pumps when engines are at work?—Remitro.

[68301.]—**Hydraulic Pressure Gauges.**—Can your readers tell me the best method of indicating at a pumping station the depth of water in a distant tank, situate on a hill 112ft. above the works? The tank, whilst holding a large quantity of water, is not sufficient for one day's consumption, and being only 6ft. deep, ordinary pressure gauges are useless, the variations are so very slight. Again the ordinary gauge will vary considerably when the pumps are at work, showing an excess of head over the actual. This is due to friction in pipes and throbbing of the pumps. It is important that some gauge should be erected, as every drop of water which overflows the tank must be again pumped as sewage.—Remitro.

[68302.]—**Boring a Wheel without a Lathe.**—Is it possible to bore a wheel without a lathe, and if so, how is it done? Wheel 4ft. Hole to be 2in.—Fuzz.

[68303.]—**Siemens Dynamo Construction.**—Mr. Bottone, in his book, "Electrical Instrument Making," p. 108 to 114, gives practical details for making a Gramme dynamo. Do the same calculations and measurements apply to a Siemens pattern machine if the field-magnets are same size as there given, or does a different size wire have to be used on the I girder armature? Any information will oblige. I have also his book "The Dynamo," but the measurements there given are for one small size only.—M.M.I.Sc.S.

[68304.]—**Lapping Gold Alberts, &c.**—Will any of "ours" describe the process of lapping or polishing the parts of alberts, guards, &c., and suitable jewelry? What is the material the lap is made of, and what do you charge it with, and how?—E. P.

[68305.]—**Dynamo.**—Will Mr. Bottone or other electrical reader give dimensions for a 200c.p. Manchester dynamo, speed to run at, number of sections on armature, size of shaft, number of volts and ampères, &c.?—E. M. F.

[68306.]—**An Unbutton Hook.**—With all the small comforts and conveniences now to be obtained, one's dressing case is decidedly incomplete for want of a contrivance for unbuttoning one's boots. To have to perform this operation by manual labour, especially in wet and dirty weather, covering one's fingers with a compound of mud and blacking, is decidedly primitive, to say nothing of the frequency of pulling off the buttons. Can any reader suggest a convenient mechanical arrangement that would push the buttons back through the holes?—A. LLOYD.

[68307.]—**Watch Repairs.**—Will H. Wake or some other reader answer the following? I have a Geneve watch that wants a new dial, and I have got several dials that will fit, but the feet will not come in, and I have filed one off and drilled a hole, but cannot fasten a foot in. What sort of fluid solder must I use? How do they gild and frost watch movements as new?—COUNTRY WATCH JOBBER.

[68308.]—**Cement for Pushes.**—I have broken several of my pushes, which are made of some composition (I think it is plaster of Paris) and they were expensive ones, costing from 4s. to 5s. each. Could some one recommend any kind of cement or glue that would keep them together? There are no pieces broken off; they are only cracked. Some of them are in two and some three pieces, which, I think, has been caused by putting the pushes and the block in wall when the wall was damp, and the damp getting in the block caused it to swell, cracking the push. Is this theory right?—WREXHAM.

[68309.]—**Boiler Coating.**—Can any of "ours" tell me of an efficient non-conducting coating for a boiler, other than asbestos or silicated cotton, which are very expensive?—ERRIGLE. [Nonsense! Nothing is really cheaper than either Leroy's or Bell's asbestos covering. We have recently used the latter here with the best possible results. It is cheap on first application, and the most effective economiser of heat we have ever tried.—ED. "E. M."]

[68310.]—**American Organ Query.**—Would some reader kindly furnish me with a diagram of the soundboard and action of a two-manual American organ? The reeds to be taken out from the front absolutely on the Smith or Karn principle. Any other information will be greatly esteemed, such as couplers (manual), &c.—MECHANIC.

[68311.]—**Induction Coil.**—1. I have made an induction coil. Core 4½in. long. Four layers of No. 18 s.c. primary, and about ⅜lb. of No. 36 s.c. secondary. 2. Can I put an indicator on to it, and which way to join it up? 3. How many cells will it bear (bottle bichromate)? 4. How is it that one person can stand a lot of it and another can hardly touch it? Does that go to show that the one who can hold it the longest has the strongest nerves? 3. I have a glass cell 6in. deep by 3in., with a plate of copper in it. It has been used for a coil. How is it charged?—A. M. J. R.

[68312.]—**Saw Setting.**—Will some good hand at saws put me right? I can manage to sharp a hand-saw pretty well, but in setting the teeth, if one saw is a little harder than another, they will snap. I have a good set. Should the teeth be bent straight over, or twisted a little? How do other men avoid this?—AN INVALID.

[68313.]—**Transit Tables.**—Are Clark's Transit Tables (2s. 6d.) discontinued? If so, will "F.R.A.S." kindly say where similar can be seen?—OBSERVER.

[68314.]—**Wire on Coils.**—Will any of our electrical friends kindly inform me how to calculate the number of yards of wire on a coil or bobbin? I once saw it in a King and Mendham's price list amongst other formula, but cannot find it now, either in their new list or in several books I have on electricity.—FORMULA.

[68315.]—**Plates for Wimshurst.**—Will Mr. Bottone kindly tell me if discs of plate glass would be better than window glass for the machine described by him in his "Electrical Instrument Making for Amateurs"? Also how are the jars connected with the frame conductors and combs?—NOVICE.

[68316.]—**Measuring Wind Velocity.**—Could any reader kindly give me any particulars as to how the velocity of the wind is measured? I am aware that there are instruments that give the pressure of the wind per unit of surface, and that from this is deduced its velocity, and also that there are instruments with revolving parts and an index for recording the number of revolutions per unit of time, but I cannot understand how these results are translated into those for velocity except by the use of formulæ. My object in asking these questions is to elicit how the figures representing wind's velocity have been arrived at, and why it is that the empirical formulæ are at variance with known mechanical laws. In other words, why the pressure per unit of surface is not equal to the fluid's momentum, which, in this case, would be equal to the weight of one unit multiplied by the square of its velocity.—FRANCISCUS OUDDENS.

[68317.]—**Lubricating Oils.**—Which are the best kinds of each of the three descriptions—animal, vegetable, and mineral, and which should be used for different rates of motion? For instance, a heavy shaft, making 12 revs. per min., a portable engine at 130 strokes, and a dynamo at 900 revs. ANTARES.

AN example of the cost of the medicinal root ginseng is afforded by a recent *Pekin Gazette*, which contains a report from the military governor of Kirin, in Manchuria, stating that he has forwarded for the use of the Emperor by special messenger eight large and 16 small ginseng, weighing altogether 9·4oz. The total cost is given at 1,560 taels, or about £400, being at the rate of about £45 an ounce.

A MONSTER crane capable of lifting a weight of no less than 250 tons, has been completed at Chatham Dockyard. The crane measures 134ft. from the end of the jib to the ground, and is the largest in the world.

ALL fast trains in Bavaria are, it is said, now equipped with the Westinghouse brake. The Heberlein brake will be used on mail trains.

IT is stated that the Prussian State railway authorities intend to open 648 miles of new railway in 1889.

ANSWERS TO CORRESPONDENTS.

⁂ All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008.
Varnishes: Nos. 478, 619, 675.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 3, and unacknowledged elsewhere:—

L. L. AND T. Co.—Cuttriss and Co.—M.A.A.—W. Wray.—Leroy and Co.—Aquarius.—W. R. Waugh.—R. Dunning.—T. Minto.—Young Jeweller.—Cambridgeshire Boy.—Bolton.—T. T.—Thomas Clark.—Jael.—R. R. N.—F. W. Mason.—J. A.—T. C., Bristol.—T. M., Tyneside.—A. Southgate.—Eos.—L. Andrews.

WALTER C. STUNT. (We cannot; but the Address Column is open to you. See Hints No. 5 above.)—J. A. WILSON. (Apparently you mean Sturge's Motive-Power for Tricycles. We illustrated and described it in No. 1,002, June 6, 1884. We know of nothing of the kind in 1887 or 1888. See Hints, above.)—P. BENNETT. (A little hot-air engine is probably the cheapest motor for a sewing-machine; but it depends on how long it is wanted to run. See indices. 2. The degree of B.E. is granted by Dublin and Queen's University, Ireland. Full information in the Calendars.)—GRADGRIND. (The weight of 15-gauge steel per square foot being given in the tables, the question is merely a simple sum.)—SEMPER FIDELIS. (You must not heat it to a red; but it may be warmed and well-dressed with paraffin oil. Then clean thoroughly with finest emery and oil.)—NORTHERN LIGHTS. (The reply referred to is, no doubt, that on p. 176, Vol. XLVII., in which iron is obtained in fine particles by passing hydrogen through a moderately heated tube containing oxide of iron. Are you sure you do not mean rouge?)—SIM. ARITH. (Bourne's "Catechism of the Steam-Engine," Longmans and Co.)—KEYBOARD. (Clean the keys with a little spirit, and expose them to the sunlight near a window. If the piano is nearly new, the ivory ought to have kept its whiteness a little longer. All available information will be found in back numbers.)—NEGOTYPE. (The query is not clear; but we have no doubt that the information required can be found in back volumes, or in some handbooks of photography. A ferrotype is not like a negative.)—PAINT BRUSH. (See p. 309, No. 1,183, or procure the colours ready ground.)—O. O. C. B. (A tricycle can be propelled by an engine; but where is the petroleum-engine to do it? Several devices have been given in back numbers; but at present the mechanical propulsion of cycles is prohibited because they come under the same rules as the traction engines, and no cyclist would care to be limited to the rate of speed allowed to them. Those who have not the use of their legs can have a cycle to be used with the arms, and arrangements of the kind have been illustrated in back volumes.)—D. POTTER. (Directions for making magnets have been given many times; but a "strong magnet" to lift 12 stone is a very large order! How far is it to lift such a weight?)—XERO. (All the information needed has been given many times; but it is not easy to make a dynamo which shall run as an electro-motor and vice versâ. See the articles on the subject, and the numerous replies in back numbers. We cannot engrave every sketch merely to show the dimensions of some motor or dynamo which readers may have designed.)—JOHN TAYLOR. (See Hints No. 5 above: 1·39, with the recurring decimal, is right.)—W. D., Newcastle-on-Tyne. The Cyanotype Process was fully described in No. 1,245, Feb. 1, last. Special paper is required—though any good paper might be made to do: that is a matter for experiment, and much will depend on the experimenter.)—J. HOSBOURN. (The only way to cure bacon is to salt it and smoke it; and as to pork pies, any cookery-book gives a recipe, as well as for curing bacon.)—THOS. WORKMAN. (See the indices of the back volumes for various processes of photo-lithography and zincography. There is a little book published by W. T. Wilkinson, Otley, Yorkshire, on Photo-engraving and Photo-lithography, which may be useful; and Richmond's "Grammar of Lithography," Wyman and Sons, is a standard textbook. Photo-lithography is not an art to be practised at once; it needs much experience and a good deal of technical knowledge. The details will be found in back numbers.)—SMITHY BOB. (The charcoal used in filters must be renewed, not merely occasionally, but frequently, and as to the sponge, well, that should be inadmissible.)—ARMOURER, W. J. T. (Don't use a signature already adopted by a contributor. You can procure a handbook of brewing which may suit you; but why do you want to dispense with malt?)—FRED WINDFIELD. (We have no further particulars about the circular bellows.)—SHORT-SIGHT. (Any optician can supply you with a suitable field-glass. There is no special combination of lenses for short-sighted people.)—W. J. (We do not know of any work specially devoted to such a matter, and as to emigration, procure the circulars issued by the Emigrants' Information Office, 31, Broadway, Westminster.)—MECHANIC. See indices under the head Medical Coil.)—OLD SUBSCRIBER. (Draw through pins placed in a zigzag line on a board. Answered many times.)—LOWER MOLAR. (Scarcely of much interest to our readers, and altogether too long. Perhaps there was some galvanic action. 2. What do you mean by a "sculling boat"? As you speak of "outriggs," do you mean a match boat or "outrigger," as it is called?)—J. CLIPSHAM. (It is useless sending stamped envelopes for reply. See Hints, No. 5 above. Full directions for doing repoussé work will be found in Nos. 1,101 and 1,102, and many useful hints in back volumes.)—G. A. M., Barnes. (Directions for fitting up telephones have been given frequently. You cannot find the prices in the lists, because the telephone is protected by patent, and if you erect a line and use it, the owners of the patent can sue for damages. See indices.)—ARGENTO. (It depends on the strength of the dulcimer frame, and on the tension of the wires. Send a sketch fully dimensioned to one of the music-wire dealers, and ask for a set of strings. The bridge rests on the soundboard. 2. Perhaps the prints are mounted with insoluble glue.)—AMATEUR INVENTOR. (Cut it with a good saw.)—T. S. (Strode and Co., 48, Osnaburgh-street, N.W., keep the most reliable electric gas-lighter we know of. 2. If the horsehair is properly dressed beforehand, insects will not appear. No chemicals will prevent the breeding of insects if the eggs are in the stuffing, nor cedar wood, nor camphor, nor anything else.)—J. R. CAMPBELL. (No apology necessary. We wish no one gave less trouble than yourself. Any obligation is on our side, we are sure.)—G. T. DAVIS. (We really do not care for the effusions of correspondents who send one letter on Tuesday, and while that is being put into type follow it up with a second countermanding it, and then another of inquiry, and lastly a letter of remonstrance, and so forth. We don't want "two strings to our bow," but a little consideration. We really fear to put your last letter in hand, the odds being that by the time the sketch is engraved we should get another requesting us not to insert it.)—HEAN. (Sketch illegible, and figures on it especially so. You must repeat it and your query, if you expect a reply worth anything.)—L. Q., E. L. G., S. E. PEAL, JOHN MAXWELL. (In type.)

Thousands of People have tried the effect of wearing HARNESS' ELECTROPATHIC BATTERY BELT for the prevention or cure of disease, and in every case the result has been most satisfactory. All in search of health should wear this, the only *bona-fide* reliable galvanic belt recommended by thousands (see testimonials) for the immediate relief and speedy cure of all rheumatic and nervous affections, impaired vitality, liver and kidney diseases, ladies' ailments, &c. Pamphlet and advice free on application to Mr. C. B. HARNESS, Consulting Medical Electrician, the Medical Battery Company (Limited), 52, Oxford-street, London, W. (corner of Rathbone-place. Note only address.

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⁂ It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

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Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

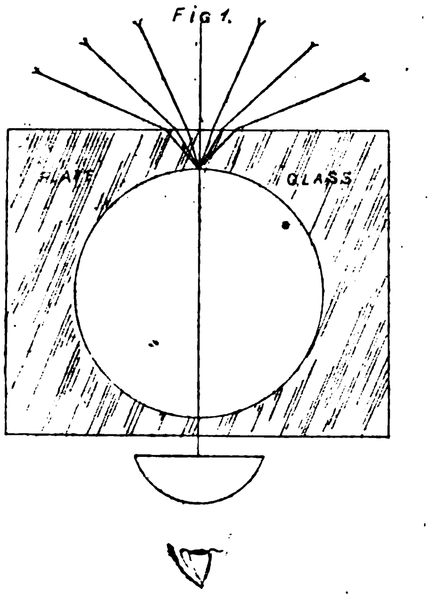
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 12, 1889.

MICROSCOPICAL ADVANCES.—XLV.

By Dr. Royston-Pigott, M.A. Cantab., F.R.S. F.R.A.S., Memb. Roy. Coll. Physicians; Fell, Cambridge Phil. Society; former Fellow of St. Peter's College, Cambridge.

Apochromatic Results.

Of refracting back margins, a new instance is seen in the plume oil of Lepidopterous scales of considerable interest. An unexpected demonstration of its refractive power was just observed as now recorded. In scales from *Papilio Memnon* were seen to have exuded by pressure a surrounding lakelet of oil defined by an intensely black margin, one scale being superimposed on the other. Its breadth was measured, and comparing it with other refracting margins of oil, there remained no doubt as to its oily nature.



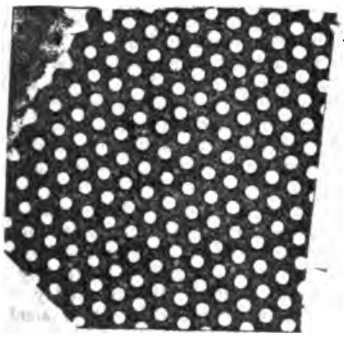
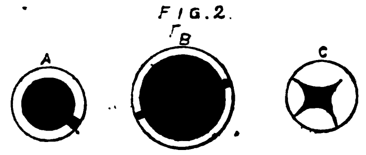
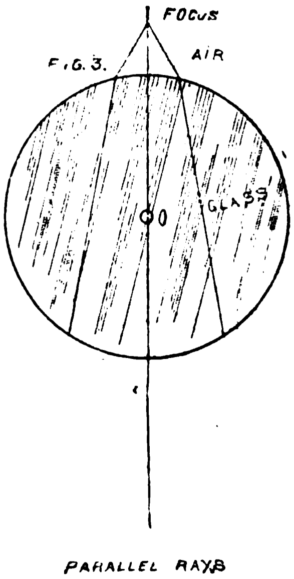


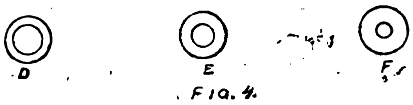
Fig. 1a.

Such examples give a unique proof of the value of marginal refractions. The phenomena are constant. Inside a scale this oil imparts to the dry scale brillance of definition, exuded, it seems, almost to disguise structure, having nearly the same refractive index. A very little pressure squeezes the oil out into little lakes, whilst a film of air spots it with brightly-defined beading. Four very fine "quarters" have been sent to me, all judged equally good. One only, however, was particularly free from residuary aberration, and bore a power of 1,200. It is instructive to reflect that the maker was in total ignorance of its splendid resolving power. The black beading of Papilio Memnon is with it startlingly clear.

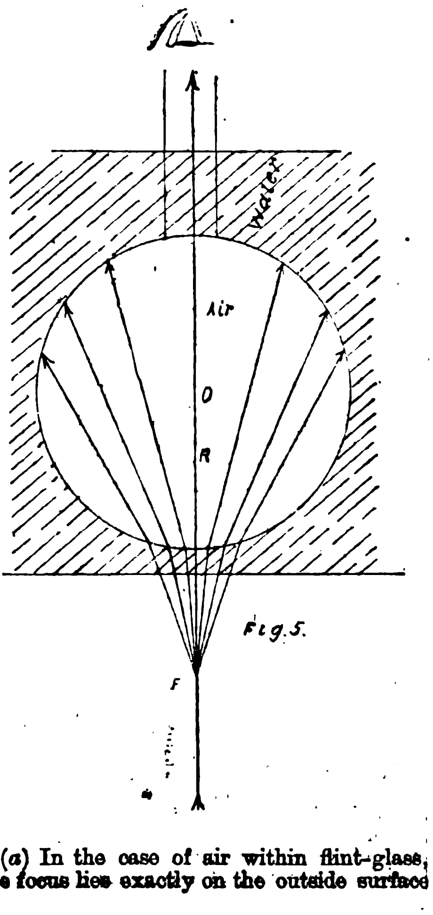
The problem of refractive margins, both in lakelets and bubbles, is quite a novelty, and it demands the higher optics for its solution.







When the bubble is inclosed in a substance of higher refractive power, its focus is either upon or within the bubble, and placed towards the light.



(*a*) In the case of air within flint-glass, the focus lies exactly on the outside surface towards the light, and refracts the rays as a double-concave lens.

(*b*) From water into air the focus lies 1-3rd of the radius outside the air-bubble towards the light, and the air-bubble is doubly concave.

(*d*) An air-bubble in Canada balsam forms a focus towards the light inside the surface ninety-four hundredths of the radius towards the centre.

(*e*) Essential oil of bitter almonds converges to a focus *within* an air-bubble rather nearer the centre—i.e., eighty-three hundredths within.

So that *a b d e* all give negative images of distant objects when inclosed between parallel plates possessing extraordinary angular aperture. On the contrary, when the light is refracted from air into an olive-oil bubble, the focus is outside the surface, away from the light, just 7-100ths of the radius. A few diagrams will more clearly illustrate these points.

An air-bubble found in oil of cassia ($\mu = 1{\cdot}635$) presents an extremely broad, black margin, inclosing a remarkable miniature. On the other hand, where the refractions are more nearly alike, as between air-bubbles and glycerine, these test margins are marvels of attenuation. These margins vary with the refractive index and the thickness of the film, and also with the aperture of the condenser, parallel rays giving the broadest. The most striking margins are those shown within air-bubbles. The thinnest appear when the bubble or globule (as oil in water) has an index more nearly equal to the fluid. There are some interesting facts in this matter.*

A most beautiful brilliantly-white diffraction line may be detected in the midst of the margin of the hollow sphere of unmeasurable tenuity—a trying object for the best glasses.

When an air or gas-bubble is inclosed in glass plate or in Canada balsam, with an index $\frac{3}{2}$ the principal focus of the hollow spherical lies exactly on the surface next the origin of light. If the bubble in plate-glass of a garden window be carefully examined with a powerful pocket lens, the whole garden up to an aperture of 180° will be most beautifully displayed, encircled by a broad jet-black annulus of a fixed breath. And this resembles vision under water of a fish, who sees the angler on the bank obliquely.

We approach, now, one of the burning microscopical questions of the day—Are the markings on the *Angulatum* caused by convex lenses, or are they produced by concavities?

The previous investigations of the primary foci of a sphericle, whether disposed in a higher or lower refractive medium than itself, exhibit significant results. From air into silica the index is nearly one and a half $\left(\frac{3}{2}\right)$ from which one may calculate the primary focus of spherical beads, as of those widely-separated beads on *Creswelli superba*—viz., f = 1-6,000 of an inch.

The focal point lies demonstrably outside the bead towards the eye of the observer. As the hole admitting the illumination varies in size, so does the image of it in the bead, as it is a true, perfectly exact miniature. The same thing may always be observed (especially with fine *apochromatics*) in a great variety of well separated diatomic beads. I have received a photograph of *P. angulatum* from Kühl and Co., of Frankfurt, made with "4,900 diameter, by means of an apochromatic 2.0 Mm., 1-30 aperture, and a *projections ocular* 4."

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* Note.—If the index of refraction μ be inverted, i.e., made into $1 \div \mu$, it will represent' the refraction from a dense into a rarer medium; so that here writing $\frac{1}{\mu}$ for μ, the principal focus $f = \dfrac{-\frac{1}{\mu}.r}{2\left(\frac{1}{\mu}-1\right)} = \dfrac{-r}{2-2\mu} = \dfrac{r}{2\mu-2}$ $= \left(\mu = \frac{3}{2}\right) = \dfrac{r}{2\times\frac{3}{2}-2} = +r$. Which is positive, and shows the place of the focus is measured from the centre of the sphericle towards the light, i.e., is situated on the anterior surface of the hollow sphere.

This magnificent result entirely throws all previous attempts into the shade. The woodcuts in Carpenter's work are, compared with this, quite laughable caricatures of truth.

These beads are distributed over the frustule in lines inclined about 60° to each other. A singular relation subsists between the foci of diatomic beads and insect eyes. The focus of a coleopterous eye was found to be 1-600th to a diameter of 1-1000th. In a diatom the bead showed a focus of 1-6000th to a diameter of about 10000th inch—a fine collateral proof of similarity in the refractive index of each. I very carefully measured the diameter of the white discs in Angulatum-photo at 1-70000th.

The images formed by these diatomic bosses are singularly true and beautiful under a first-rate *Apochromatic objective.* For all these vary slightly in quality, whilst curvature and centring are still as difficult as ever. These images must be sought for as in Fig. 3, outside or above the bead where a real focus exists of the positive order. But if the sphericle is a double concave lens the images must be sought for beyond—i.e., towards the light.

A large, black Maltese cross, gummed on a brightly-lighted window pane, gives in these silica lenses very lovely miniatures of exceeding attenuation. (Fig. 2 C.)

I propose to insert in a note a short list of diatoms exhibiting very widely separated sphericles, selected for me by Mr. Hinton, Vorley-road, Holloway, which are invaluable for demonstrating the positive refractive power of the beading.*

In all the cases where refraction of parallel rays is from a dense medium through a rarer bubble, the primary focus lies beyond its centre towards the light, and in extreme cases, as from water into an air-bubble, the focus lies two-thirds of the radius outside the sphere towards the light: diagram attached shows a divergent pencil emerging from the focus F, beneath the bubble one-half the radius beneath it with a negative effect.

Images must, therefore, be sought below the aërial sphericle floating within the water.†

The research is more difficult with negative foci. The immense aperture embraced, the close crowding of the images into a small circular space or field of view, the subtlety of the focal changes (by 1-100000th of an inch deeper), and the interference of lower strata of molecules, all combine to render Apochromatic experiments of this order eminently *recherché*.

When two apertures ¼in. apart are illuminated 3in. below the *negative* sphericle, two very bright discs can be seen finely pictured below. If it be *positive*, the images appear above and much closer together; the aperture of the first being at least ten times that of the second.

Taking large beadings such as those of the well-separated bosses of *Cestodiscus superbus*: a delicate miniature of Gillet's stop was seen, and even the supporting arms were glinted *above* the boss; very thin indeed.

The miniatures of the open holes varied progressively in size as in D, E, F, Fig. 3. Gillet's condenser has about 17 holes and stops, but always brought to a clear focus above the convex bead.

Fig. 3 shows the course of a pencil of parallel rays entering a silica bead and converging to a focus above it—i.e., outside the surfaces. If it were hemispherical, the focus would be twice more distant from the centre.

A MODEL LOCOMOTIVE.—V.

Springs—Axles.

THE received formulæ relating to the strength, elasticity, and proportions of springs are due to Mr. D. K. Clarke. Let:—

E = elasticity or deflection in sixteenths of an inch per ton of load.
S = the working strength or load in tons.
l = the span when loaded, in inches.
b = the breadth of plates in inches, supposed uniform.
t = the thickness of plates in sixteenths of an inch.
t' = the thickness of plates in inches.
n = the number of plates.

Then, for elasticity:—

$$E = \frac{1{\cdot}66 \times l^3}{b \times t^3 \times n}$$

$$l = \sqrt[3]{\left(\frac{E \times b \times t^3 \times n}{1{\cdot}66}\right)}$$

$$n = \frac{l^3 \times 1{\cdot}66}{E \times b \times t'^3}$$

And, for working strength:—

$$S = \frac{b \times t^2 \times n}{11{\cdot}3 \times l}$$

$$t = \frac{b \times t^2 \times n}{S \times 11{\cdot}3}$$

$$n = \frac{S \times l \times 11{\cdot}3}{b \times t^2}$$

To find the required curvature or compass, C, of the spring before loading,

C = E × S + desired working curvature + ⅛in. to ⅜in. for permanent set.

Thus the strength of the spring is proportional to the number of plates, to their width, to the square of their thickness, and inversely as the length, or span, and depends also on the nature and temper of the material—a very variable factor. And it is seen that there is a distinction between the strength and the deflection of a spring. The strength increases as the square of the thickness; but the elasticity or deflection diminishes inversely as the cube of the thickness. For this reason it is not desirable to make the long top plates materially thicker than the others with a view to obtaining increased strength, because the diminution of elasticity is in proportion to the cube of the thickness, while the strength is only increased as the square. Hence a thick spring plate would break before it would bend to the same extent as the thinner ones.

Possibly all my readers may not be aware of the fact that the first efforts made in order to lessen the shocks incidental to travelling on rough roads were not made with the, to us, obvious device of using steel springs, but with the steam-pressure of the boiler acting on steam-tight pistons. This was a device of the elder Stephenson, and is described and illustrated in Nicholas Wood's old treatise on "Railroads." Over each axle-bearing there was placed a cylinder, bolted by means of a curved skew flange to the outside of the boiler, and entering within it to a distance of several inches. This contained a closely-fitting piston, whose rod, projecting vertically downwards, pressed upon the top of the axle bearing or step, like an ordinary spring-thrust rod. The diameters of these pistons were so proportioned as to sustain a steam pressure equal, on the average, to the total weight of the locomotive. The reaction of this pressure, therefore, supported the engine as upon elastic cushions. The illustration in Nicholas Wood's book shows a six-wheeled engine supported on six of these steam springs.

Passing now to the *crank-axle*, we note that it is the weakest portion of the locomotive, as is evidenced by the large number of failures which occur every year, to say nothing of the large numbers of axles which are condemned in the shops. It is in the condition of a beam whose continuity is broken by the bending of the cranks. Regarding it as supported at both ends in its bearings, it is subject to the steam pressures acting alternately in opposite directions tending to bend it. If the resistance measured at the radius of the wheel tires is considered, the steam pressures tend to twist it off. Regarded as a column set on end, it is subjected to end-long stresses by reason of the shocks operating through the rails on the wheel-flanges. For this last reason the flanges of the driving wheels are often turned thinner than the others. Mr. Stroudley, in a paper read in 1885 before the Inst. of Civil Engineers, gave the average life of his crank-axles as 360,000 miles. He found that while a crank deflected $\frac{1}{32}$in. only under its working load, the deflection under steam was $\frac{3}{32}$in., or three times as great, and he therefore judged the steam pressure to be primarily the cause of crank failures.

From the Board of Trade return on driving axles, which was issued in consequence of the Penistone accident, it appears that in the year 1883 there were 14,848 driving axles in use in this country, of which 12,943 were cranked for inside-cylinder engines, and 1,905 straight, for outside cylinders. Of this number 80 broke in running with passenger trains, and 127 with goods trains. As many as 704 defective axles were discovered and taken out in the shops. These figures sufficiently show the inherent weakness of locomotive axles, and it is worthy of note that these returns show also nearly the same percentage of fractures in straight axles as in those which are cranked. The total percentage of fractures of the latter was 5·7, that of the former 5·5. It is, however, a significant fact that, while of ordinary cranked axles without hooped webs the failures while running were, in iron 3·1 per cent., and in steel 0·9 per cent., the corresponding failures in those with hooped webs were 0·85 in iron and 0·9 in steel. The former relations speak volumes on the advantage of hooping the fagoted wrought-iron, whose weld joints are often incipient causes of fracture. Mr. Stretton, having found that there were more unhooped than hooped cranks, instituted experiments, the result of which went to prove "that when a crank-web breaks nearly or quite straight across, the hoops are of the greatest use in holding the crank together; but, on the other hand, when the fracture occurs in a slanting direction, the hoop is not only rendered of no value, but it even tends, by its tightness, to force the broken part out of the required position." ("Safe Railway Working," p. 103.)

Crank-axles almost invariably fracture across one of the inside webs, or through the point of junction of the pin with the inside web, by a kind of ball-and-socket fracture. The wheel-boss and the outside of the crank arm keep the wheel in position until the engine gets home. The wider the webs of crank axles the better. It is, however, impossible in inside-cylinder engines to make them very wide, hence the reason why many are hooped or bonded. Since such hooping encroaches on the available space beneath the boiler, Mr. Stretton has patented a method of strengthening the webs by passing a steel bolt through a hole drilled longitudinally down each web.

The statistics just now given do not show that straight axles are very superior to the cranked forms. The straight axles are subject to great torsional stresses, operating alternately through the opposite pistons. Mr. Stroudley says that he has known straight axles of steel 7in. in diameter to break in engines having 17in. outside cylinders, the appearance of the fracture indicating that the breakages were due to torsion.

In reference to the relative merits of iron and steel axles, Mr. Stretton has compiled a table from the Board of Trade returns, showing the total number of failures during a period of five years. Taking one year only as illustrative of the average mileage of axles that failed, in 1885 the average mileage of 125 iron axles was 226,037, that of 63 steel axles 219,644 miles. This is in keeping with the remaining statistics, showing that the iron axles run longest, but that the steel show fewer fractures. ("Safe Railway Working," p. 101). The advantage of steel for axles is, that it has no fibre, so that none of the evils due to lamination or imperfect welds, can come into operation.

Turning radii in all angles is a matter of very great importance, as tending to reduce the risk of fracture. There must be no sharp corners anywhere. In some cases this practice is carried to so great an extent that there is scarcely any portion of the crank-pin, or crank-axle journals left straight.

J. H.

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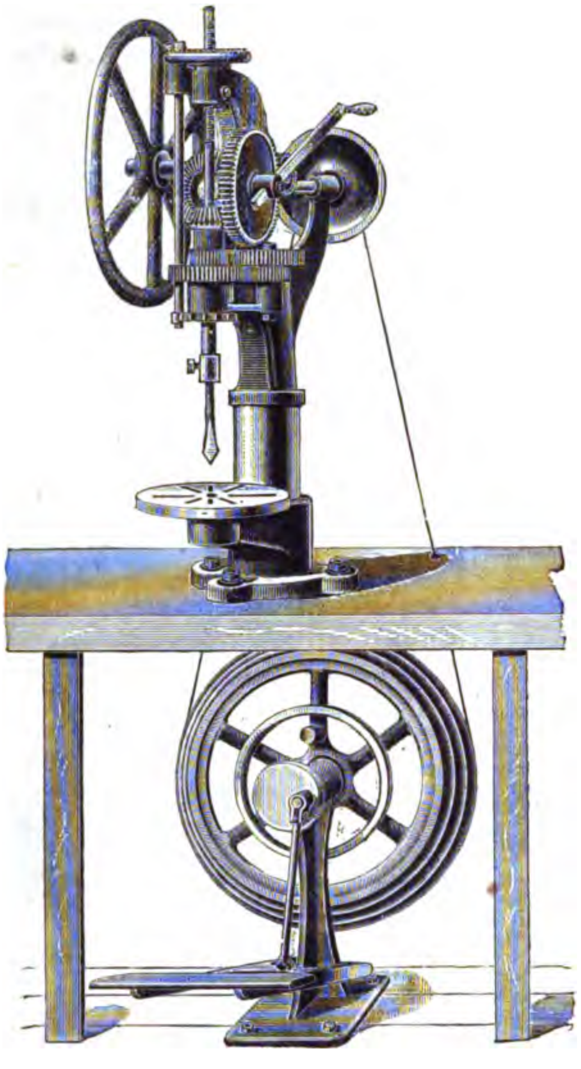
* Note.—*Auladiscus pulcher, Auladiscus Comberi, Fossil diatoms* (Virginia), *Stictodiscus Buryanus, Coscinodiscus concavus.* In this I got black dot images of Powell's soled stop without any condensing glasses.

† Note.—The following calculations of the foci have been several times verified for their distance from the centre. Air into ice sphere twice the radius; air into glass 3·2 radius; water into air 1⅓ radius; water into olive oil 1·07 by radius; Canada balsam into air 94 100 of radius; essential oil of almonds into air 83 100 radius; glass into air bubbles, the radius. The last shows that the focus lies exactly on the anterior surface of the bubble towards the light, and is a virtual focus.



BRITANNIA CO.'S IMPROVED BENCH DRILLING MACHINE.

An improved bench drilling-machine, illustrated in the annexed engraving, can be seen at the Britannia Co.'s show-rooms, 100, Houndsditch. It is a handy drill for light work, and, as will be seen, can be made to drive by hand or by treadle, or by both, and can also be driven by power if desired. It is constructed with a web-section body, turned to fit on to and swivel around a stiff turned pillar, secured by a nut at any angle, and by loosening which the drill can be brought to any position in its radius, thus making it very handy for drilling holes in large objects. The pillar is cast in one with a strong foot, to bolt on to the bench, and it carries a bracket which swivels entirely round it, with a circular work-plate which also swivels on its own centre, giving every facility for adjusting the work bolted to it under the drill. It has two driving shafts, that for the treadle or power running to the back, and that for hand motion to the right side, and these drive the spindle by bevel and spur gearing. It is constructed with a specially ingenious contrivance of spur gearing in combination with a flywheel, which gives immense impetus to the motion, and greatly facilitates the work. It has also single and double gearing for small and large holes, and has both self-acting and hand feed. The treadle driving gear is made independent of the machine, to fix under the bench, the wheel having four speeds to drive the speed cone fitted to the driving shaft, thus giving with the double gearing eight changes of speed. The diameter of the spindle is ⅞in.; drilling up to ¾in. diameter, by 5in. deep; pillar, 4in. diameter by 11in. high; distance from drill point to pillar, 9in.; diameter of driving shaft, ⅞in.; diameter of flywheel, 18in.; diameter of driving wheel of treadle motion, 20in.; diameter of circular worktable, 10in.; table will rise and fall on pillar 6½in.; approximate weight, 2½cwt.

There are about 150 American medical students in Vienna.

BICHROMATE BATTERIES FOR DOMESTIC ELECTRIC LIGHTING.

Within a few years, the arrangements of bichromate batteries designed for domestic electric lighting have been notably improved, not only for the purpose of rendering their use as economical as possible, but especially with a view to facilitating the manipulation of acid liquids (an operation that is usually disagreeable), and to doing away with the mounting and dismounting of the elements—an operation that on each occasion takes a relatively long time.

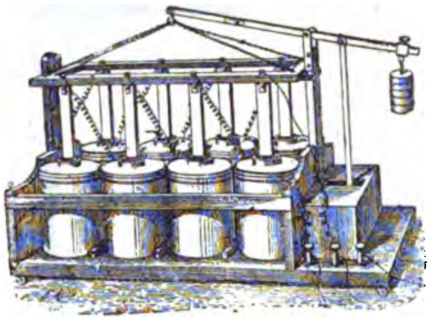


Fig. 1.—Mareschal's apparatus for removing the zincs from batteries.

1. *Single-Liquid Batteries.*—Single-liquid bichromate batteries possess the grave defect of discharging in open circuit—that is to say, the zinc is attacked if it is dipping in the liquid, even when the lamp that the battery is to supply is not lighted. In order to remedy this trouble, the zinc must be preserved against the action of the acid by removing it entirely from the liquid; hence the numerous models of batteries with a winch, the most widely distributed of which are those of M. Trouvé. This arrangement necessitates the execution of a contrary manœuvre before lighting—that is to say, the re-immersion of the zincs in the liquid. As it is but very rarely that the batteries can be placed near the lamps, it is necessary, before and after lighting, to proceed to the room wherein they are located, and this, under certain circumstances, may be impossible, or at least inconvenient, without any other source of light, or without a complicated mechanical transmission which is not very ornamental in an apartment.

M. Mareschal has overcome this inconvenience by devising an apparatus capable of effecting such operations at a distance. This apparatus (Fig. 1) consists essentially of a device whose rotary motion communicates to a rod a rectilinear alternating motion downward for a half-revolution and upward for the following half-revolution.

If to this connecting-rod there be attached a piece connected with a frame carrying the zincs, the first half-revolution of the motor will, for example, remove the zincs from the liquid; and if, at this moment, the motion of the revolving device be arrested, the zincs will remain out of the liquid until the moment at which the mechanism, being able to continue its motion, gives the connecting-rod a contrary direction, that causes the zincs to descend again into the liquid. These intermittent motions are obtained by means of gearing that permit of effecting but a half-revolution of the crank, O L (Fig. 2).

The zincs are suspended from the extremity of the lever J K, which is movable around the axis N. A counterpoise, P, placed at any point of J N, balances the weight of the zincs Z, so that but a slight force suffices to make them rise or descend. The extremity J of the lever is attached to a connecting-rod M*h*, set in motion by the crank O L. The motive mechanism carries along a flywheel, V, with a vertical axis, against which a screw, T, constantly presses an iron block F, which performs the functions of a brake and prevents its rotation. In order to allow the flywheel V, and consequently the rotary device, to revolve, it suffices to remove the brake block, F during the entire time that it takes the crank O L to effect a half-revolution.

In the system adopted by M. Mareschal, the block F is pulled back by means of an electro-magnet, A, actuated by an auxiliary pile, R. The batteries designed for apartment call bells may be utilised. Upon pressing upon the button B, placed near the lamp X, that is to be lighted, the block is attracted, and the crank O L, which was in the position O L′, is set in motion. When the crank is vertical, the small pin D S, fixed upon the axis O, is horizontal at D′ S′, and keeps the spring E H in the position E G. As soon as a rotary motion of O L′ occurs, the end D of the pin escapes, and the angular projection of E G bears against the copper bar K H. There is thus established a permanent contact which keeps up the current of the pile R, through the electro A, and permits of the continuous rotation of the clockwork. In the case represented in Fig. 2, this half-revolution immerses the zincs in the bichromate. The rotation of O L will continue up to the moment at which the extremity S, of the pin D, having become horizontal, meets the projection of the spring E H, which will leave K H and cut the circuit of the pile R. As the brake block F is no longer attracted by the electro A, it will bear anew against the fly-wheel V, and stop the motion of the revolving device, and the zincs will remain submerged in the bichromate, and the lamp X will be lighted. In order to extinguish the latter, it suffices to press anew upon the button B. As the brake block F is not in contact with the wheel, it will allow the crank O L to make a half-revolution from L to L′ in the direction shown by the arrow *f*. The extremity J of the lever J K, being drawn downward, will lift the zincs out of the acid solution.

In order to change the depth of immersion of the zincs, it is merely necessary to increase or diminish the travel of J K, and to do this it suffices to vary the radius of the crank O L by fixing the button L of the connecting-rod in the apertures R_1 R_2 R_3, &c., of O L.

The Mareschal apparatus evidently offers a complete solution of the problem, but it requires the use of an auxiliary battery and constitutes a cumbersome apparatus. Besides, it in nowise does away with the inconveniences of the single-liquid battery—such as the changing of the liquids, the amalgamation of the zincs, &c. Moreover, if it be desired to light a variable number of lamps, it is necessary to proceed to the apparatus in order to change the immersion of the zincs, so that the lamps in circuit shall not be burned when the lighting is diminished, and so that the zincs shall not be used up at a pure loss in consequence of local action.

Upon the whole, the ordinary single-liquid bichromate battery does not permit of the application of the electric light to daily requirements, and does not satisfy all the exigencies of domestic lighting; but without speaking of the application to medicine it is very well adapted for decorative effects, one battery being capable of supplying several lamps, provided that they are lighted at the same time.

2. *Batteries with Two Liquids.*—Batteries with two liquids, that is to say, with bichromate and carbon, with acidulated water in the external vessel and zinc in the porous one, have the great advantage of much diminishing local action, and consequently the wear of the zinc. The internal resistance

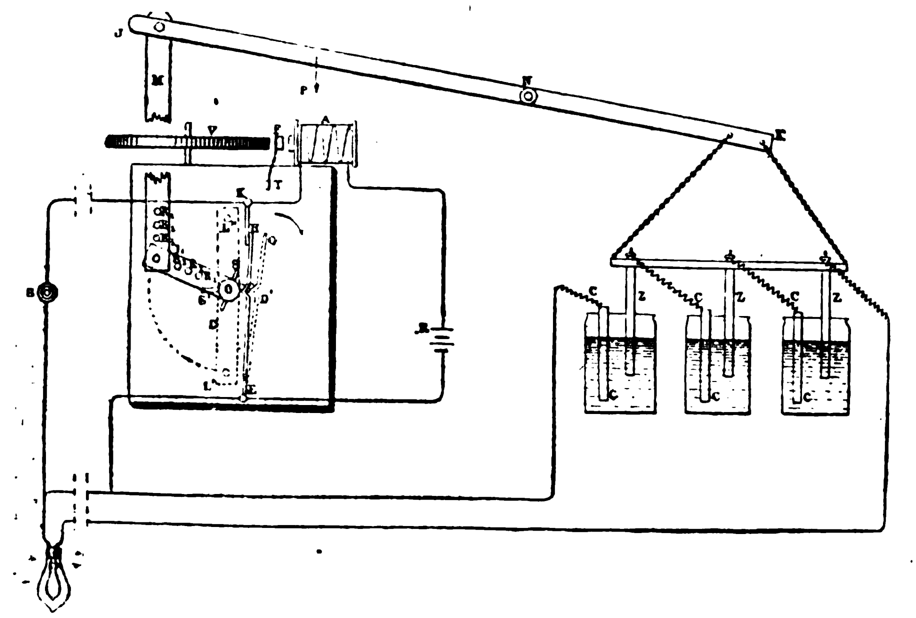


Fig. 2.—Diagram of the Mareschal apparatus.

of the pile is increased by reason of the presence of the porous vessel, and so these kind of batteries discharge less than the preceding, and permit of lighting but one lamp at once per battery.

One of the best-known models is the eight-element battery of M. Radiguet (Fig. 3). In this battery it is necessary to change the acidulated water of the porous vessel several times before the bichromate solution is exhausted; but if particular precaution be taken in the amalgamation of the zinc, it will be possible to leave the latter continually immersed in the acidulated water without any appreciable wear taking place in open circuit. Consequently, the battery is constantly ready to furnish light through the simple closing of a commutator. But, as we just remarked, it is necessary to assure of as complete an amalgamation of the zincs as possible in order to prevent wear in open circuit.

In order to fulfil this condition, M. Radiguet in the first place devised the arrangement shown in Fig. 3. The lower part of the zinc dips into a cup containing mercury, which gradually rises on the surface of the zinc and prevents local action. Owing to this simple precaution, the zincs are capable of remaining permanently in the acidulated water, thus permitting practically of having light at any moment whatever.

The keeping of this system in order is therefore reduced to the renewal of the acidulated water every week or fortnight, according to the service required of the battery, and to the renewal of the depolariser every four or five weeks.

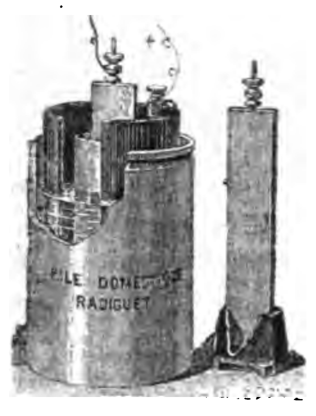
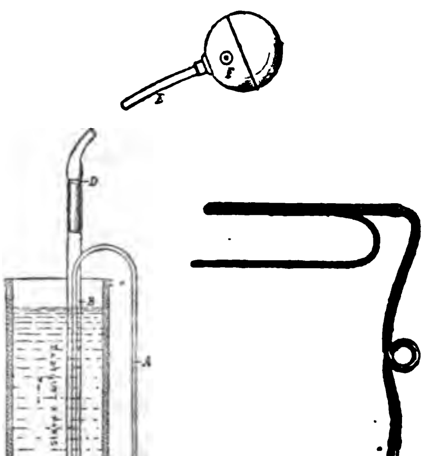


Fig. 3.—Radiguet's Two-Liquid Battery.

In order to render this system still more convenient and practical, M. Radiguet has devised some new apparatus, which do away with the replacing of the zinc electrodes and the dismounting of the batteries, thanks to the adaptation of a special negative electrode and the use of a siphon, which is primed and unprimed by blowing, for the changing of the liquids. The ordinary siphons are primed by suction. This method, which is dangerous in the handling of acid liquids, has prevented its application to the manœuvring of batteries of large discharge. The Radiguet siphon (Figs. 4 and 5), permits of blowing with the mouth (without any fear of the liquids rising to the lips), or of employing blowing apparatus, such as rubber bulbs, &c., which, never being in contact with the corrosive liquids, last indefinitely. Fig. 4 represents a section of this siphon dipping into a vessel from which it is desired to remove the liquid. It consists essentially of two concentric tubes. One branch of the siphon is inclosed in a tube B of larger diameter, having at its lower part an orifice smaller than the section of the tube A. At its upper part it is provided with an adjutage D, connected with the tube F through a flexible tube, E. When B is immersed in any liquid, the level in the tube B and the tube A is the same as in the vessel. Things being in this state, if the tube B be blown into, the pressure therein abruptly increases, and the liquid contained therein tends to escape through two apertures—the lower orifice of B and the branch A of the siphon, into which it is forced until the flow through A (that is, the priming) takes place.

It is easy to see that the apparatus may serve for the complete or partial emptying of a vessel of any depth by causing the length of the tube and branch A to vary. If, when the siphon is in operation, it is desired to stop it, it suffices to blow in a volume of air greater than the capacity of the large tube B. This air, forced through the tube A, drives out the liquid contained therein and unprimes the siphon. It will be seen, then, that, through the same manœuvre, it is possible at any moment to effect a flow or stoppage of a liquid, as conveniently as by the use of a cock, without having to touch the liquid, and whatever be the form and location of the vessel containing it.



Figs. 4 and 5.—Radiguet's Siphon.

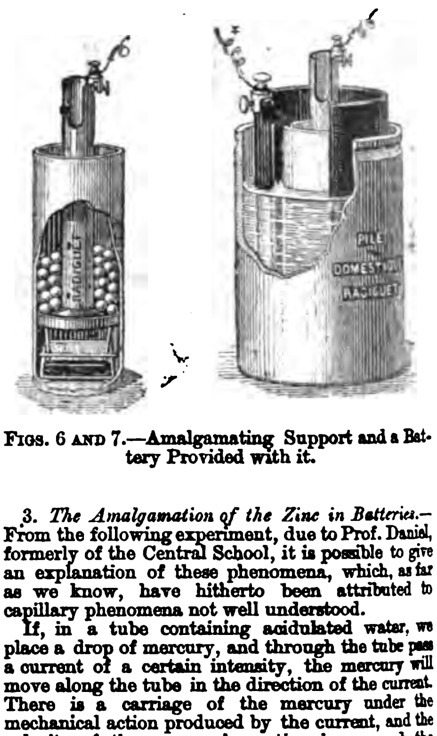
By means of this apparatus, then, it is possible, without disturbing a battery of piles or accumulators, to empty any element and wash it as carefully as may be desired.

But the most original part of this new style of bichromate battery is undoubtedly the amalgamating support, for, as its name indicates, it permits not only of keeping up the amalgamation of the zincs, but also of using (instead of plates and cylinders of zinc of determinate size) shavings, scrap of all shapes, or spheres prepared especially for this purpose.

This electrode is formed as follows (Fig. 6). Into a cup of porcelain, or of any other substance not attacked by acid, there is put some mercury containing traces of zinc. Above this cup is placed a copper receptacle fixed to a hollow rod of the same metal. This is designed to receive fragments of zinc of variable form and size. The central rod constitutes the negative electrode, and contains apertures that permit of the free circulation of the liquid. Its diameter is greater than that of the cup, so that the sulphate of zinc may not fall upon the surface of the mercury and finally put an end to the amalgamation.

In Fig. 6 the mercury cup is connected with the central rod through two strips of copper containing apertures into which passes a pin that likewise traverses the porcelain cup. In this way, all the parts of the electrodes are mechanically connected with each other and electrically with the mercury.

If acidulated water be introduced into a porous vessel containing an electrode of this kind, the following phenomenon will occur: The mercury will rise upon the copper and zinc, and rapidly cover them with a layer of mercury, which will soon protect them from the action of the acidulated water. If the circuit of the battery be closed, and it be made to discharge a current of normal intensity, the amalgamation will proceed during the operation. If the battery be made to discharge a very intense current, the mercury will soon disappear from the surface of the zinc; when the battery ceases to discharge, the mercury will ascend the surface of the electrode again and protect it against the action of the acid.



Figs. 6 and 7.—Amalgamating Support and a Battery Provided with it.

3. *The Amalgamation of the Zinc in Batteries.*—From the following experiment, due to Prof. Daniel, formerly of the Central School, it is possible to give an explanation of these phenomena, which, as far as we know, have hitherto been attributed to capillary phenomena not well understood.

If, in a tube containing acidulated water, we place a drop of mercury, and through the tube pass a current of a certain intensity, the mercury will move along the tube in the direction of the current. There is a carriage of the mercury under the mechanical action produced by the current, and the velocity of the mercury's motion is so much the greater in proportion as the current is intenser.

Analogous phenomena must take place in M. Radiguet's battery. In consequence of the attack of the zinc, and of the currents produced within the battery, a transfer of the mercury takes place. But, as the pellicle of mercury that has formed protects the metal upon which it has deposited from chemical action, the reaction can continue to occur only in the parts not yet amalgamated; consequently the mechanical effects of the internal currents of the battery cause the mercury to rise progressively to the surface of the liquid, that is to say, until the negative electrode is completely protected by the mercury from the attack of the acidulated water.

In support of this view, we shall cite a few experiments made by M. Radiguet, which are very easily explained through the aid of the theory of mechanical effects of the current upon the mercury, while an explanation of them is impossible if we admit the effects of capillarity solely:—

1. In a glass vessel, let us place a plate of non-amalgamated zinc, dipping below in a mercury cup, and let us pour in pure water. The mercury, even after several weeks, will not have risen upon the zinc. If into a vessel containing a plate of zinc dipping in mercury we pour acidulated instead of pure water, the mercury will gradually rise on the surface of the zinc and stop at the level of the liquid. These comparative experiments prove, evidently, that the actions of the acidulated water and zinc have an influence upon the amalgamation,

since the ascent of the mercury occurs only in the case in which the zinc is attacked, and the mercury is deposited only upon the parts that have been attacked, since the ascent is arrested at the level of the liquid.

2. Let us again take the vessel containing acidulated water and the plate of amalgamated zinc, then place therein a plate of carbon, and unite them by a metallic conductor without resistance. In a very short time the layer of mercury will disappear and leave the zinc bare. If the zinc and carbon be united by a resistant wire, the mercury will disappear much more slowly from the surface of the zinc. The two phases of this new experiment are very easily explained. On connecting the zinc and carbon mechanically, we closed the circuit of this voltaic couple, and the current extended into the external wire from the positive to the negative, and, through the battery, from the negative to the positive—that is to say, from the zinc towards the carbon (Fig. 7). Now, as the current is capable of carrying the molecules of mercury in the direction of its propagation, it tends to detach them from the surface of the zinc, whence they fall back into the cup beneath.

3. If, in a vessel containg acidulated water and mercury, we place a plate of copper, the mercury will not ascend along it, because there is no chemical action, and consequently no energy capable of lifting the mercury. But if we throw a bit of zinc into the acidulated water, the current produced will have the immediate effect of causing the mercury to rise on the copper up to the surface of the liquid.

These few experiments show sufficiently what the actions are that must take place in the new element of M. Radiguet. Let us add that this view likewise explains the almost indefinite duration of mercury in batteries.

Upon the whole, in this element, the internal currents, when any are produced, are utilised in the amalgamation of the zincs attacked, and that, too, the more quickly in proportion as the reaction is more energetic.

Despite these important improvements, direct lighting by batteries with two liquids is not yet perfect. As it is possible to supply but one incandescent lamp per battery, the applications are necessarily limited to small spaces. Nevertheless, the improvements that we have pointed out are interesting to register, for it is not very probable that, in the future, mechanical energy will be capable of being utilised for the lighting of a single lamp, and this application, as modest as it is, justifies the use of direct lighting by batteries. Moreover, the combined use of the amalgamating support and of the siphon primer by blowing allows of the batteries being left mounted for a relatively long time, without appreciable wear in open circuit. The maintenance is very easy, since it suffices to throw zinc scrap into the vessel from time to time, in measure as it is consumed, just as we throw coal into a stove, care only being taken to stir the upper fragments, and to brush them, now and then, with a hair pencil (like the pencils used by artists) in order to clean the surfaces of contact.—*Le Génie Civil.*

PRACTICAL DETAILS OF BLACKSMITHING.*

ONE of the early jobs of my apprenticeship was to bend some rings, about 10in. in diameter, from stock ⅝in. by ⅛in. They were to be bent edgewise, and I found that, although it was small iron, it was not as small a job as it looked to be.

There was, if I remember aright, only one to each milling machine—some shield for a gear that was in the path of falling chips probably. As in those days there were not perhaps fifty milling machines made yearly, there were not enough of these rings needed to make an object to construct any very elaborate machines for bending them.

It is a very slow process to bend stock which is wide and thin over the horn of the anvil edgewise; for, as soon as it is struck, it wriggles into any shape but the right one, like an intractable colt. It will start to bend very well on the end if the hammer is kept firm and level; but after enough of the circle has been formed, so that the part already bent reaches beyond the point struck by the hammer three or four inches, the trouble increases, for there is then not only a tendency for the stock to bend sidewise, but—unless it is cooled as fast as progress is made, and the blows are let fall on the cool part—there is also the tendency of inertia against the blow, which bends the straight portion, to take out a part of the bend which has already been put in. It is very convenient, therefore, to have some kind of tool to assist in the operation, even if it is nothing more than a few pins driven into a levelling block, or a segment of a circle fastened temporarily on a flat iron surface; or where there are but a few to make at a time, but the demand constantly recurs, a simple tool like that shown in Fig. 1 answers the purpose very well, and possesses the advantage of being always in readiness. A piece is got out for the centre, which is a section of the right circle for the inside of the ring, and is a trifle thicker than the stock which is to be bent. This centre is to form the inside of the ring. Two other plates are then made, which project beyond this nearly to the width of the iron, and serve as guides to keep the iron from twisting in bending. There are also two lugs fastened to this arrangement, to receive the key which keeps the stock from slipping. It is not a tool for doing the work very expeditiously, but it is much better than none, and does the work well. It is designed to be screwed into the vice. The rod, after it is made hot for what distance it is intended to bend at one beat, is put into the groove, the key is inserted to hold it, and then, by taking hold with the tongs as near as is convenient to the tool, the iron can be bent down between the guiding sides for some distance on the circular form, causing it to assume the required curve, and at another heat another portion may be bent, and so on until a full circle is made. This, after truing up sufficiently to get the exact length, is then cut off and welded, and finally trued up and levelled and perfected on a proper-sized mandrel.

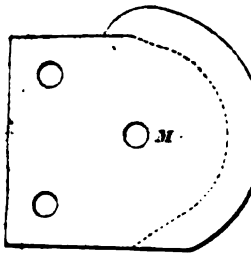


Fig. 6.

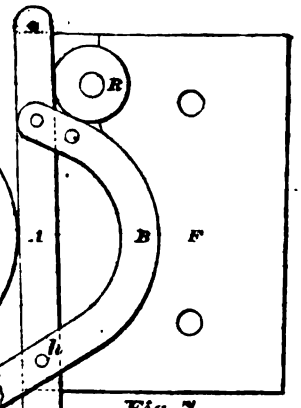


Fig. 7.

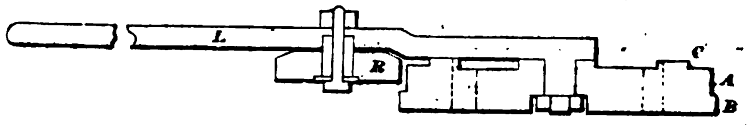


Fig. 5.

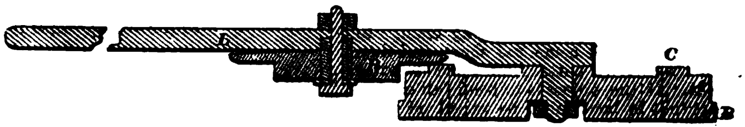


Fig. 3.

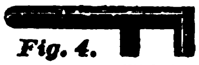


Fig. 4.

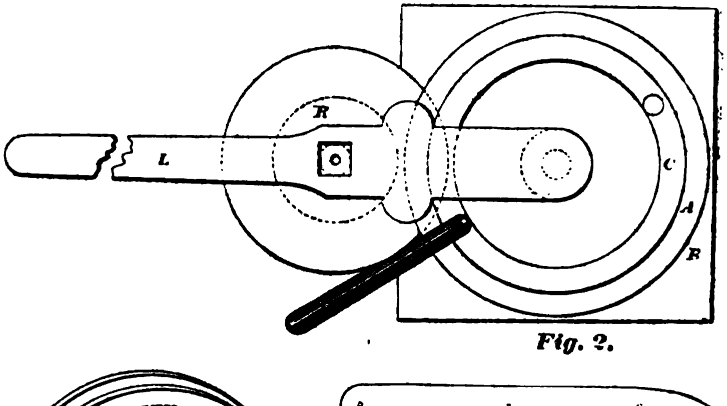


Fig. 2.

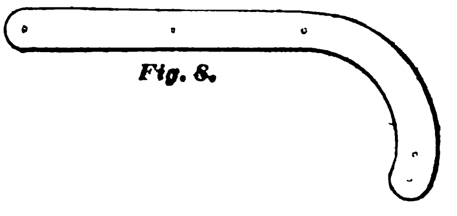


Fig. 8.

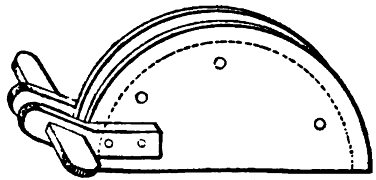


Fig. 1.

Where there are enough rings of this kind to warrant more expenditure for tools, they may be bent with a lever carrying a roll around a former of the right size, as shown in Fig. 2.

The base is square or of any other convenient shape to fasten to a wooden block, or it may have cast upon it lugs for the reception of set screws, with which to attach it on the top of an anvil. On this base is raised a circular piece A, about an inch in thickness, and a trifle—$\frac{1}{16}$in. or ⅛in.—smaller than the diameter of the outside of the ring which is to be bent; on this a circle is raised, which is of the thickness of the stock which is to be used, and of the diameter of the inner side of the finished ring. This circle is the former, around which the ring is to be bent. The lever L has securely fastened to it a pin on which it swings, from a hole in the centre of the circle. The roll R is connected with the lever by a spindle on which it can revolve. Its periphery is at a distance somewhat greater than the width of the stock, from the periphery of the forming circle.

Two side views are given of Fig. 2, to illustrate different methods of keeping the stock from twisting. Fig. 3 shows how this effect is produced by means of a flange on the roll, and Fig. 5 how it is done by the bearing of the lever itself upon it, the lever being expanded in width at the proper place for this purpose. (Fig. 2 should be without this expansion if used with Fig. 3, and without the outer circle of the roll if used with Fig. 5).

It is evident that, if a piece of hot iron is placed in this machine, and the end held by the holdfast H, it must conform to the shape of the circle when the lever is swung around. The action of the holdfast in gripping the stock is on the same principle as the grip which was formerly used on the Finkle and Lyon sewing-machine wheel feed, and is now used on some portable forge blowers. It is made like a carriage smith's bending fork, Fig. 4. One prong being inserted in a hole provided for the purpose in the former, the handle is swung around until the other prong impinges upon and binds the stock firmly.

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* By B. F. Spalding, in *American Machinist.*

The circle C is raised as a ring, and not as a disc, because it is desirable to present little surface for the scales to abrade, as they will if they have no place to go, except to lie in wait and get jammed between the surfaces of the lever and former. The stock to be worked being heated all over, the scale which is on it is raised, even if there is no new one formed, and this is sure to come off when the iron is bent, for it is a rather curious fact, that the scale of iron is nearly as absolutely inflexible as a cold fire-brick. The whole surface of the stock scales, and therefore, on such work, provision must be made to keep it from where it can do harm.

If full circles are to be bent, it is necessary to shift the position of the holdfast, to allow the lever to be swung all the way around. Another little matter which may be mentioned is that the roller need not, and should not be so close to the former as to have the hot stock be a tight fit between them: a quarter of an inch is not too much leeway. I have seen them made so close as to sometimes pull the stock apart. If they are given a good wide clearance, they will not fail to press the stock to the former, except at the end. The too great closeness of the roll is also one cause of the variations which occur in the length of the rings bent from straight pieces of stock which were uniform in length; but there are also other causes. They are to be sought in some original irregularity in the size or quality of the stock, of the heat, or of something perhaps more obscure. Whenever these variations occur, it is only necessary to cut the pieces long enough to make sure that none will come too short, and then equalise the lengths by cutting off the ends after they are bent. If the object is to bend full circles, the first part that is bent must be raised off from the former when the position of the holdfast is changed, then when the lever swings around to complete the last half of the circle, it will pass under the first half, and, as soon as it has rolled off from the end of the stock, the ring is free to be lifted out on the release of the holdfast. Any length may thus be helically bent to a given circle. A slight motion or pressure on a levelling block in its heated state restores the ring to shape.

Rings can also be bent to advantage with the horizontal bending machine, and such shapes of flat iron bent edgewise, as cultivator plough beams, are fashioned by it with great facility. Thousands of them are shaped in this manner with uniformity and rapidity. A very good plan of making the shaping dies for this purpose is shown by Figs. 6 and 7. Fig. 5, the convex form, is the one to be attached to the movable crosshead, and Fig. 7, the one which remains stationary, is attached to the bed-plate of the machine. The straight stock which is to be bent in this instance has a hole punched in it at *h*, not for this purpose, but for its own completeness. It is utilised, however, in bending, to gauge from; the bent section is beyond it, and the bar is not red-hot at this point when the piece is bent. A steel pin is made fast in the die at *h*, and when the bar A is put on to be bent, the hole is placed over the pin, while the hot end rests against the face of the roll R. When the die M presses forward, the stock cannot slide away from the pin, and therefore, as it is forced into the recess in F, it is obliged to slide on the front face of M—shown in the broken line—and the roll R revolves as it moves on and away from it. The stock is kept from twisting by its confinement between the flange on M and the base of F, between which two level surfaces it is forced to keep true, although it sometimes manifests a strong tendency not to conform to its set limits, especially if of steel, and not sufficiently heated. Fig. 7 represents the strange anomaly of two pieces, A and B, occupying the same place at the same time, and the reader is requested to imagine one removed when the other is on. B represents the appearance of A after it has been bent.

With the machine running six strokes a minute, 2,400 bars 1½in. by 9/16in. have been bent in ten hours. This was thought to be a very fair output, and it undoubtedly was. There are 600 minutes in ten hours, and this, at 6 strokes per minute, would give the number 3,600, of which 2,400 is ⅔, showing that two strokes out of three were utilised, or, in Creedmoor parlance, a score of 2,400 out of a possible 3,600. What became of the extra one-third of the time? This was the question which the men who were working by the piece endeavoured to solve for their own satisfaction, for the rates were fixed for the season. They figured it thus: getting the fire ready, morning and noon, one hour; slacking off, morning and noon, twenty minutes; coking up twelve times during the day, one hour; laying up the work, half an hour; loss on missed strokes, adjusting dies, repairing crooked or broken pins, one half-hour. Decency requires that persons engaged in such work as blacksmithing should devote a few moments to cleanliness before leaving the shop. The most promising method of saving a part of the lost third is in the substitution of some better fuel for coke or coal. If the fire had been on tap, instantaneously at all times, as is said to be the case when gas or the air-sprayed petroleum process is used, there could easily have been one-half of the time saved. The electric-heating system is not yet far enough advanced, probably, to come in competition with these in doing such work. These 2,400 pieces 1½in. by 9/16in. were each put into the fire, and when brought to a white heat for a length of 12in., were handed to the machine tender by one heater, and there are the reasons already stated, for supposing that much more than this can be done with gas, natural, or produced from coal or petroleum, or from sprayed petroleum, at an expense which will not be greater; and with the further advantage, whatever it may be, which is to be derived from the facility with which fuel in this condition can be freed from impurities which are deleterious to the properties of iron; or can be made remedial to anything injurious which the iron itself already contains.

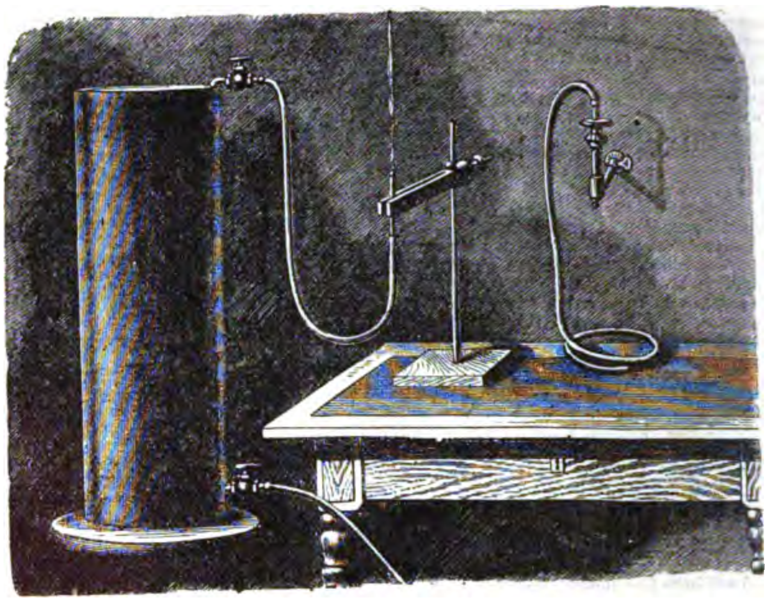


Fig. 4.—Apparatus for Producing Gas Pressure for the Sensitive Flame.

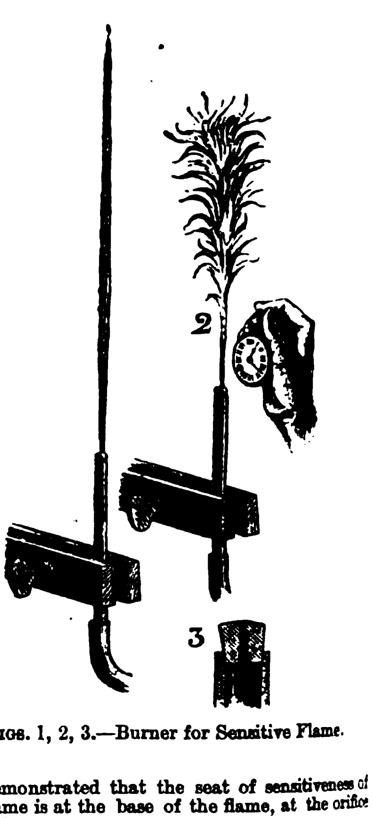
As a probability of there being a variation in length in circles bent edgewise has been alluded to, it may not be amiss to say here, in the nature of a counter statement, that I have known of more than 100,000 of the plough beams represented in Fig. 8 to be bent over a circle of about 10in. after the holes were made, and the variation in length seldom exceeded ¼in. As any variation in the width of stock creates a seemingly undue diversity in the lengths of curves, this speaks well for the uniformity of the stock.

SENSITIVE FLAMES.*

THE sensitive flame observed by Dr. Le Conte and afterwards developed by Tyndall exhibits some of the curious effects of sound. For its production it is necessary that the gas be under a pressure equal to that of a column of water 6in. or 8in. high. The common method of securing the required pressure is to take the gas from a cylinder of compressed illuminating gas, such as is used for calcium lights. Another method is to take the gas from a weighted gas bag, and still another is to fill a sheet-metal tank with gas and displace it with water in the manner illustrated in Fig. 4.

The burner is shown in Figs. 1, 2, and 3. It consists of a small tip inserted in the end of a suitable tube. The tip in the present case is made of brass, but those commonly used for this purpose are of steatite. They are superior to the metal ones, but quite expensive. The writer is indebted to Prof. W. Le Conte Stevens, of Brooklyn, for a hint on this point. Prof. Stevens has found that some of the lava pinhole burner tips used in certain kinds of gas-stoves answer admirably for this purpose, and cost very little. A tip with a round, smooth hole is to be selected. The bore of the tip is here shown tapering. Its smaller diameter is 0·035in. The burner is supported in the manner shown in Figs. 1 and 2, or in any other convenient manner, and gas under a suitable pressure flows through and is ignited. The flame will be tall and slender as shown in Fig. 1. By regulating the gas pressure carefully, an adjustment will be reached at which the flame will be on the very verge of flaring. A very slight increase of pressure beyond this point will cause the flame to shorten and roar. When the flame is at the point of flaring, it is extremely sensitive to certain sounds, particularly those of high pitch. A shrill whistle or a hiss will cause it to flare. The rattle of a bunch of keys will produce the same result. It will respond to every tick of a watch held near it.

Tyndall says that when the gas pressure is increased beyond a certain limit, vibrations are set up in the gas-jet by the friction of the gas in the orifice of the burner. These vibrations cause the flame to quiver and shorten. When the flame burns steadily, any sound to which the gas-jet will respond will throw it into sympathetic vibration. Experiment has demonstrated that the seat of sensitiveness of the flame is at the base of the flame, at the orifice of the burner.



Figs. 1, 2, 3.—Burner for Sensitive Flame.

The method of producing the required gas pressure illustrated in Fig. 4 is available when gas bags or cylinders of compressed gas are not to be had. A tin cylinder of about 15 gallons capacity is provided at the top and bottom with valves. The lower valve is connected with a hydrant, and the cylinder is filled with water, while the upper valve is left open to allow of the escape of air. When the cylinder is filled with water, the supply is shut off and a tube from a gas-burner is connected with the upper valve, and the gas is turned on. Then the water is allowed to escape from the cylinder, thereby drawing in the gas. When the cylinder is filled with gas, the valves are closed and the lower one is again connected with the hydrant, while the upper one is connected with the pinhole burner. The valves on the cylinder are again opened and water is admitted at the rate required to produce the desired gas pressure. Only two precautions are necessary in this experiment; one is to avoid a mixture of air and gas in the cylinder by driving out all the air, the other is to avoid the straining of the cylinder by water pressure.

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* By Geo. M. Hopkins, in the *Scientific American*.

Another sensitive flame, which has several advantages over the one described, is shown in Fig. 5. It requires no extra gas pressure, and it is more readily controlled than the tall jet. It was discovered by Mr. Philip Barry, and the discoverer's letter to Mr. Tyndall concerning it is found in Tyndall's work on Sound. In the production of this flame a pinhole burner, like that already described, is employed. Two inches above the burner is supported a piece of 32-mesh wire gauze, about 6in. square. The gas is turned on and lit above the wire gauze. It burns in a conical flame, which is yellow at the top and blue at the base. When the gas pressure is strong, the flame roars continuously. When the gas is turned off, so as to stop the roaring altogether, the flame burns steadily and exhibits no more sensitiveness than an ordinary flame. By turning on the gas slowly and steadily, a critical point will be reached at which almost any noise will cause it to roar and become non-luminous. Any degree of sensitiveness may be attained by careful adjustment of the gas supply. A quiet room is required for this experiment. The rustle of clothes, the ticking of a clock, a whisper, a snap of the finger, the dropping of a pencil, or in fact almost any noise, will cause it to drop, become non-luminous, and roar. It dances perfect time to a tune whistled *staccato*, and not too rapidly. The flame at its base presents a large surface to the air, so that any disturbance of the air sets the flame in active vibration.

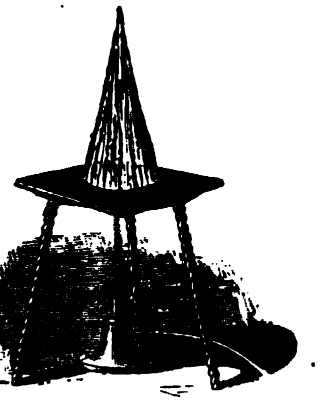


Fig. 5.—Sensitive Flame with Gas at Ordinary Pressure.

New Microphone Membrane.—The Mix and Genest microphone has lately undergone an important improvement. It is well known that the sound-plate of this microphone consists of a thin diaphragm of finely fibred fir-wood; but the dry fir-wood is very susceptible to dampness. Under its influence the plates get curved and cause very often a disturbing alteration in the contact points of the carbon rollers, and consequently of the transmission of the voice. The plates have been carefully lacquered for protection, and several varnishes were tried, but these could protect the sound-plates against dampness only for a short time. The evaporation of the water drops condensing on the plate during the conversation, soon caused small cracks in the lac, which accelerated the introduction of dampness into the wood plate. After many trials the sound-plate has been covered on both sides with a thin plate of mica, which, not being of hygroscopic nature, protects the wood plate completely from dampness, if the edge of the plate is surrounded by an indiarubber ring, as formerly. It has been stated that the forms of oscillation of the sound-plate suffer no perceptible alterations, provided the mica plates are very thin. It has further been observed that the phonic capacity of the wood plate has suffered by cementing the mica plates, whereas no prejudice arose from piercing the same with screws fixing the carbon rollers. Little or no success has been obtained by making use of celluloid, fibre, indiarubber, oiled paper, or by covering the plate with collodion. This invention of Messrs. Mix and Genest, of Berlin (patented in Germany and other countries), not only avoids the drawbacks found in the use of wood plates, but renders the microphone completely efficacious in damp places and in Tropical countries, where the mere wood plate could not be used.

The Norddeutscher Lloyd steamer, *Lahn*, has recently accomplished the voyage from Sandy Hook to the Needles, a distance of 3,100 miles, in 7 days 1 hour, 30 minutes, which gives an average speed of 18·23 knots. In comparing the voyages of the steamers on the Southampton line with those calling at Queenstown, it must be borne in mind that the Irish port is nearer to New York by nearly 300 miles.

SCIENTIFIC SOCIETIES.

ASTRONOMICAL SOCIETY OF FRANCE.

The March meeting took place on the 6th, M. Flammarion in the chair.

M. Gerigny, secretary, thanked M. Flammarion, in the name of the Society, for the brilliant and interesting lecture on Mars which he delivered on Feb. 27th.

M. Armelin made some remarks regarding the analogy between the canals of Mars and some phenomena which present themselves on our earth in certain estuaries, and particularly in the bay du Mont St. Michel, which is traversed by three rivers which often completely change the place of their bed after the highest tides.

M. Gaudibert sent drawings of the rills near the lunar crater Sirsalis. M. Guillaume, drawing of Parry.

M. Guerin sent an observation of a fine meteor seen near Sens on Feb. 3rd, at sunset. M. Duprat sent an observation of a slow-moving meteor which was seen at Bône on Sept. 15th, 1873, at 6h. 45m. p.m. It was also seen at Marseilles.

M. Faye presented some remarks on the observation of sunspots. He reminded that the solar activity was not the same in both hemispheres, and the maxima and minima did not coincide in the northern and in the southern hemisphere. It was, therefore, important in drawings of the sun to distinguish the two hemispheres, which is easily done by the use of Thomson's discs, for instance. As regards photographs of the moon, M. Faye thought that the Lick photographs were the best he had ever seen.

M. Schmoll showed a drawing of Saturn and vicinity.

M. Renet proposed new method of making plates for stellar photography.

M. Gunziger read a note on the solar prominences observed at Kalosea during 1886.

M. Roger Martinet showed some apparatus illustrating the movements of the planets.

USEFUL AND SCIENTIFIC NOTES.

Discharge of Pipes.—In a paper in the "Proceedings of the Royal Society," vol. xiv., "On the Maximum Discharge through a Pipe of Circular Section when the effective Head is due only to the Pipe's Inclination," Mr. Henry Hennessy, F.R.S., says:—"The maximum discharge will be when the pipe is filled up to the segment of 308° 10′. The supplemental arc being 51° 50′, the maximum discharge would occur when the liquid falls below the summit of the inner surface of the pipe by about the twentieth of the diameter. This result might be called a hydraulic paradox, or the condition of a pipe carrying liquid at a small inclination giving a greater discharge when filled up to nineteen-twentieths of its diameter than when completely full. The hydraulic paradox here referred to as a deduction from the expression for hydraulic mean depth is not so practically important as the question of velocity of the liquid passing through the section of greatest hydraulic mean depth. The maximum hydraulic mean depth for the pipe was found to be 0·6086r, while it is 0·5r for a full pipe. As the velocities may be taken as very approximately proportional to the square roots of the hydraulic mean depths, we shall have for v^1, the maximum velocity,

$$v^1 = v\sqrt{\frac{6086}{5000}} = 1{\cdot}1033v.$$

Or the velocity for the maximum hydraulic depth exceeds the velocity for a full pipe under the conditions specified by 10½ per cent. This result may possibly be utilised in circular drain pipes liable to be coated with deposits.

Dr. J. Hann, Director of the Austrian Meteorological Service, has laid before the Vienna Academy of Sciences an exhaustive investigation of the diurnal range of the barometer over the globe. He has calculated the harmonic coefficients for each month, and for the year, for a large number of places, and has investigated the variation both of the phases and of the amplitudes of the single and double daily oscillations. The latter show a remarkable independence of geographical and seasonal influence (as before pointed out by Lamont and others), and appear to be connected with a cosmical origin. The investigation also shows that the amplitudes of the semi-diurnal oscillation decrease with height in exact proportion to the pressure, and have a marked dependence upon latitude. The yearly range exhibits two maxima at the periods of the equinoxes, and also a third maximum which falls in January in both hemispheres, while in July the amplitude of the double daily oscillation is smallest over the whole globe. The author also investigates the single daily oscillation, in connection with the influence exerted by the position of the station, as well as the range of the barometer at sea, and arrives at some interesting results.

SCIENTIFIC NEWS.

From the Dun Echt Circular No. 170 we learn that Prof. Krueger has telegraphed the discovery of a faint comet by Mr. E. E. Barnard, of the Lick Observatory, on March 31 at 9h. 12·3m. local time. Its exact position then was R.A. 5h. 20m. 49·67s., N. Dec. 16° 6′; daily motion 52s. decreasing in R.A., and 2′ increasing in Dec. The "control word" of the telegram deviates by 1 from the sum of the checked words thus indicating a possible small error. Dr. Copeland announces in this circular that he removed to Edinburgh on the 10th inst., and that his address will be the Royal Observatory and 15, Royal-terrace. The Circulars will continue to be issued for some time under the care of Dr. L. Becker.

The ephemeris of Barnard's comet 1888 *e* (Sept. 2) computed by Herr A. Berberich reads for Berlin midnight on April 14, R.A. 23h. 32m. 4s., N. Dec. 0° 27′; the brightness increasing slightly, being 1·7 as compared with unity at time of discovery. Barnard's comet 1888 *f* (Oct. 30) is of little interest, but the following ephemeris may be useful: it is by Dr. Spitaler for Berlin midnight April 14, R.A. 9h. 23m. 22s., N. Dec. 37° 33·4′; the brightness decreasing, being only 0·12 of unity at time of discovery.

Mr. Burnham, observing with the great Lick refractor, gives the place of the companion of Sirius as—Date, 1888·97; dist., 5·27″; position angle, 13·9°. He did not see any other near companion.

Mr. Keeler, also observing with the 36in. refractor, says that the fine division on Saturn's outer ring detected early last year has been again seen; but specially favourable conditions are required to observe it, including a large instrument. The marking is considered to be a permanent feature of the planet. The shadow of the ball on the ring has been carefully observed, but so far no deformation has been detected.

Circular No. 23 of the Wolsingham Observatory (Rev. T. E. Espin) states that the spectra of R Leonis and R Hydræ contain bright (hydrogen ?) lines, first seen on Feb. 25th. Observations confirmed, through the kindness of Mr. Common, by Mr. Taylor, at Ealing, who sees two in R Leonis and one in R Hydræ.

Astronomers will regret to hear of the death of Ernst Wilhelm L. Tempel at the age of 68. He was born at a place in Lusatia, and commenced his real astronomical work at Venice in 1859, when he discovered the only comet of that year. In 1860 he removed to Marseilles, and while there discovered five small planets and several comets, one of the latter (found on the 19th of December, 1865) proving of great interest on account of its identity of orbit with that of the Leonid meteors, which made such a brilliant appearance in November, 1866. Two of the comets discovered by M. Tempel at Marseilles (on the 3rd of April, 1867, and the 27th of November, 1869) were found to be of short period, although the last was not recognised as such until a later appearance (after an unobserved return in 1875) in 1880. In 1870 M. Tempel (being as a German expelled from France) removed to Milan, and was for some time assistant to Prof. Schiaparelli at the Bréra Observatory, Milan, where he discovered several other comets, one of which (found on July 3rd, 1873) was also of short period, revolving round the sun in a little more than five years. His last cometary discovery (Comet V., 1877) was made on the 3rd of October in that year at Arcetri, Florence, where, until his health began to fail, he diligently made the best use of the instrumental means at his disposal. M. Tempel had, in early years, followed lithography as a profession, and his skill as a draughtsman was often of great advantage to him as an astronomer in making drawings of comets and nebulæ. He was appointed to succeed Donati in 1873 as director of the then new observatory on Arcetri Hill, near the old dwelling-place of Galileo, and there he continued his work until last year, when failing health compelled him to rest.

M. Chevreul, the famous French chemist, died on Tuesday last at the ripe age of 103 years.

The death is also announced of Dr. Joseph Rogers, ex-president of the Poor Law Medical Officers' Association, a well-known and deservedly respected member of the medical profession, who did much for the reform of the poor-law medical service.

The Hopkins prize of the Cambridge Philosophical Society has been awarded to Sir William Thomson "for his mathematical researches upon the theory of the tides, and other important investigations in mathematical physics."

Next Tuesday, at the Royal Victoria Hall, Dr. Heming lectures on "Electric Tramcars."

The discourse which Mr. W. Gardiner, M.A., is to deliver on the Monday evening during the meeting of the British Association will be on "How Plants Maintain Themselves in the Struggle for Existence."

In the "Guide to Alston," Mr. W. Nall has some remarks on "The Helm Wind," which may interest readers. He says that the Helm prevails only when the ordinary wind is from the East; that it begins to blow somewhat suddenly after calm weather or after a thunderstorm, and is always accompanied by the appearance on the mountains of the Helm cloud and the Helm bar. Its force is greatest near or actually upon the surface of the earth, and travellers who are caught by it on the open moor, and seek shelter under the lee of a hill are astonished to find themselves exposed to its utmost fury in the very places where they supposed they would be protected; for, sweeping along the surface, it breaks over the hills and dips into the hollows like a flood of water.

The Executive Committee of the International Exhibition of Geographical, Commercial, and Industrial Botany, to be held at Antwerp in 1890, has decided to celebrate on this occasion the three hundredth anniversay of the invention of the microscope, and hold an exhibition of instruments produced by living makers. Conferences relating to all important questions connected with the microscope will also be held.

On the occasion of the Paris Exhibition the Société de Géologique de France has determined to hold a geological congress, commencing on Aug. 18, and there will be excursions to Auvergne and Brittany.

A sum of £1,000 has been granted by the Association of the Edinburgh International Exhibition of 1886 towards the completion of the Ben Nevis Observatory, the money to be expended, we believe, in establishing the low-level observatory at Fort William.

At a recent meeting of the Physical Society of Berlin Dr. Rubens described the experiments he has made on the selective reflection of light by metals. The light emitted by an incandescent plate of zirconium was concentrated by a lens on to a mirror-surface of the metal under investigation, and the reflected rays were then allowed to fall into a spectroscope with flint-glass prism, whose ocular had been replaced by a bolometer. In this way the intensity of each part of the spectrum could be determined. The next step consisted in removing the mirror and putting the glowing zirconium in the place of the virtual image of the first source of light, in such a way that the rays of light, coming from the point previously occupied by the mirror, pursued the same course as in the first experiment. These rays were then allowed to fall into the spectroscope, and the intensity of each part of the spectrum thus formed by light which had undergone no change by reflection was measured by the bolometer. The results obtained showed that silver possesses even for blue rays a very considerable reflective power, which gradually increases and reaches its maximum in the red, at which maximum the intensity of the reflected light then remains constant even for rays of the greatest wave-length. Gold possesses a much smaller reflective power for blue and green rays; the curve then rises very rapidly to a maximum in the yellow and falls again towards the red. Copper reflects the blue and green rays even less than gold does: its reflective power then increases rapidly into the red, and then somewhat more slowly, until in the ultra-red it reaches a value equal to that for silver. Iron and nickel gave similar curves, rising at first somewhat rapidly, but subsequently more slowly and continuously into the ultra-red, without, however, reaching the values observed for copper or silver.

It is stated that the experiments with high potential in connection with the Deptford Electric Lighting Works and the Ferranti "mains" have been carried up to one million volts, and that that E.M.F. failed to break down the insulation, which is, we believe, made up of brown paper and ozokerite.

The risks run by having overhead wires carrying current for electric lighting and motive purposes is well shown by an incident which occurred recently in Cleveland, Ohio. A lineman engaged in stringing a wire for the police telephone service accidentally dropped it on to the line carrying the current for the motor cars, and the result was the "burning-out" of a number of telephones. Now it is asked who should pay the damage?

At the Institution of Electrical Engineers the other day, Mr. Preece read a paper "On the Disturbances Arising from the Use of 'Earth' for Electric-Lighting Purposes," in concluding which he stated that before the Grosvenor Gallery Company established their metallic loop system, all the telephones around and about Bond-street were disturbed. In order, however to settle the matter, he has carefully experimented with the currents produced by the alternate current machines at West Brompton and at Eastbourne, and finds that it is quite impossible to detect any difference between the effects of Wheatstone transmitters and alternating-current dynamos. The experiments taken alone are sufficiently definite to render it decisive that the use of the earth in such instances cannot be allowed; but it may happen that in other systems of distribution where the currents are continuous and steady, such as the systems by which it is proposed to distribute by means of batteries, the earth under exceptional circumstances may be permitted.

Drs. Strauss and Dubarry say that pathogenic microbes can live a long time in water, whether it is distilled or charged with organic or inorganic matter. The microbes do not appear to lose much of their virulent properties in mediums containing but little nutritive matter.

It has been decided to adopt the Westinghouse brake as the standard upon the trunk lines of Switzerland.

In Michigan a railway three miles long is to be worked by electricity, the current being obtained by water power ten miles distant.

"Persian Insect Powder."—A Russian journal devoted to the industrial interests of the Caucasus describes the cultivation of the pyrethrum plant in the Caucasus. The flowers of the pyrethrum (*pyrethrum roseum*) are used for making the powder, which is sold under various names—"insect powder," "Persian powder," "death to insects," &c. In Europe these flowers are only found in Dalmatia, but these are white, and not rose-violet, like those of the Caucasus. The Dalmatian pyrethrum is greatly appreciated, and when its crop is scarce the Caucasian flowers are eagerly sought for, and their price increases by from 200 to 300 per cent.; this was the case in 1887 and 1888. Prices, which had varied between three and seven roubles for the previous ten years, reached all at once, in 1887, 15 and 16 roubles at Tiflis. Formerly a certain quantity of pyrethrum in powder was exported from the Caucasus, but Europeans were not satisfied with receiving this delicate article in this form because it was discovered to be mixed with foreign substances, and growers in the Caucasus could not reduce it to the impalpable state requisite to preserve its efficacy. At the present time the flowers only are exported. It is necessary that they should be cut as short as possible at the stalk, gathered when ripe, dried in the shade and in a current of air, because in the sun the bloom and rose colour are lost, and, lastly, that they should not be mixed with other herbs when being gathered. Recently a fraud has been noticed in the packages of Caucasian flowers, other flowers resembling the pyrethrum, and dyed the same colour, being found. The exports amounted to between 175,000 and 200,000 kilogrammes last year; of those three-fourths were badly prepared, the season having been a very rainy one.

According to French official returns, the consumption of meat between 1860 and 1882 rose from 51lb. to 72lb. avoirdupois per head per annum. It appears that in Paris the consumption of meat (pork not included) rose from 152,004,219 kilos. in 1886, to 160,763,180 kilos. in 1888; whilst as regards pork, the increase for the same period was from 176,000,000 to 189,000,000 kilos. This increase was coincident with a gradual decline in prices. In Paris alone over 16,000 horses are now slaughtered for food every year. The statistics of this trade for 1887 in the Department of the Seine alone are 16,200 head, yielding 3,529,430 kilos. of meat, of which the fillets were quoted at 2f. per kilo., the ribs and sirloins 1f. to 1f. 20c., and the rest 20c. to 60c. Two-thirds of the whole supply were used for sausages.

A seam of natural gas, with a daily flow of 14,000,000 cubic feet, has been struck near Columbus, Ohio.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

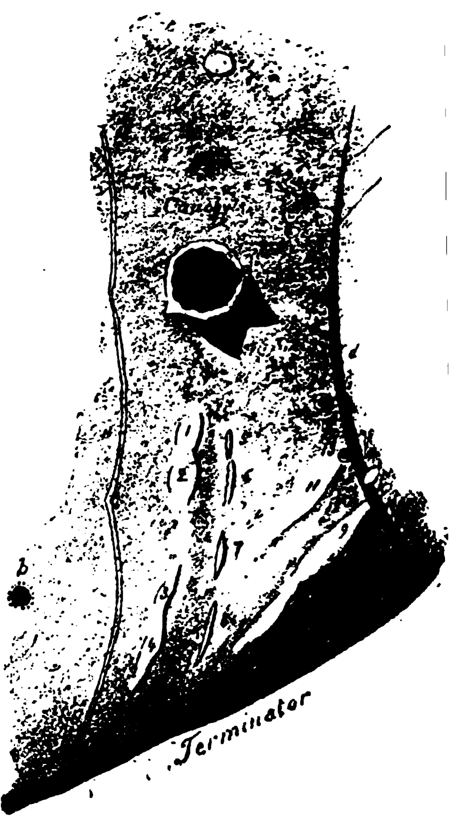
All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

SELENOGRAPHICAL — THE REGION NEAR CAUCHY.

[29808.]—On page 55 of the English Mechanic, No. 1251, you publish a sketch of this region by Mr. G. T. Davis. As I was also observing it about the same time, it will perhaps interest Mr. Davis and other selenograph readers if you can find place for the sketch I made with my 10¼in. telescope, and for a short description of the same. As the air was very bad, the best power I could use was about 100. The floor of Cauchy was entirely immersed in shadow, and its east wall cast a double-pointed shadow over the plain, the two points being produced by the small crater on the S. wall of Cauchy, and by a peak on the N., which bulged slightly northward. But besides these two objects I was impressed as if the E. wall was lower than the rest. η is the real and only cleft in existence here, and was seen curved about the middle, as in the sketch. δ, which Mr. Davis, Neison, and Mädler represent as a cleft, is simply a ridge, broken between 9 and 12, where some hillocks or craterlets are seen. At times, it is true, it has very much the appearance of a cleft, and it is not at all surprising that Mr. Davis has taken it for one. But careful observations under various angles of illumination have shown it to be a ridge, and it is so represented by Schmidt on his large map. The aperture used by Mr. Davis could not show the details which exist where he has placed some shadow. I am happy to give them, so far as I could see them, at the time of this observation. They are not shown on Schmidt's map, and I am not aware they have been ever published. 1 to 4 seems to be a long, soft, ridge running nearly parallel with cleft η, and the points where the figures stand are the culminating points of the ridge. 5 to 8 are four distinct ridges very sharp



and sufficiently high like the preceding ones, to cast a shadow under the angle of illumination. Between these ridges there is a darkish shallow valley. 9 to 10 is another low soft ridge, running slantingly from the ridge δ towards cleft η, but does not reach it, I believe. It was lost near the terminator. 11 a lower and even a softer ridge, and 12 a valley, very shallow, running along the E. border of 11 towards ridge 7. An observer believes he has seen a true cleft here, joining ridge δ with cleft η at the point where the terminator cuts this cleft. This place, therefore, is to be watched. 13 is a small crater on ridge δ: 14 a crater rather larger, at a short distance from δ; and 15 a crater smaller than 13, further away from ridge δ. 17 a mountain, shown by Mr. Davis. *b* is a crater without a wall above the surrounding plain.

May I be permitted to advise "East Lothian" (letter 29547, p. 398 of your last volume), whenever he again observes Posidonius, to look closer on the floor of that interesting wall plain than he seems to have done? Surely, with a 10in. mirror by Calver, he must be able to give many more details than those represented in his sketch. Why does not "East Lothian" represent that object as seen in an inverting telescope, as that is always done by observers? **C. M. Gaudibert.**

OCCULTATION OF JUPITER.

[29809.]—THE occultation of Jupiter yesterday morning was well observed here with the 10½ equatorial, the sky being very clear indeed. The first contact of moon and planet was noted at 18h. 45m. 47s. local sidereal time, and the last contact at emersion from dark limb at 19h. 37m. 31s. My young daughter, Anna, who observed with the 3in. finder attached to the large instrument independently recorded the first contact one second earlier than above. Although in full sunshine, Jupiter was distinctly seen, and the belts were visible. **William R. Brooks.**

Smith Observatory, Geneva, N.Y., March 25.

OCCULTATIONS DURING APRIL.

[29810.]—ALLOW me to call attention to the number of interesting occultations which will occur this month, in the hope that your astronomical readers will be busy in observing and recording for your pages these interesting phenomena so well suited for amateur work. For those who have adequate apertures, ε Cancri (Præsepe) will be of special interest. **W. R. Waugh, F.R.A.S.**

Portland, April 2.

ON THE RELATION OF THE RAISED RINGS TO THE EXCAVATED INCLOSURES IN WALLED PLAINS.

[29811.]—IN case Mr. A. Mee's remarks in No. 1,242 *re* deserting the "E.M." for the *J.L.A.S.* may even remotely apply to me, I beg to send you a few remarks on lunar matters.

I have always had a wholesome dread of the valuable paragraph from Montaigne's essays heading our correspondence columns, and not long ago our valued friend, "F.R.A.S.," page 156, distinctly sat on me *re* "glaciation," so I feared to weary your readers; but in the present letter I will eschew all reference to glaciation, and confine my remarks to a peculiar feature of lunar surfacing which selenographers as a rule seem to have overlooked.

All over the lunar surface we see the well-known circular formations called walled plains, ring plains, and craters, that have, when examined, some six or seven distinct features in common. The smaller forms, say, six to ten miles in diameter, have usually been looked on as due to igneous volcanic action, and the largest ones of the series, such as "Bailly," are thought to be related in some way to the smaller maria or seas. The great majority of those intermediate, such as the ring plains, of smaller walled plains, like Plato, Theophilus, Archimedes, &c., are an admitted mystery, totally unlike anything we see on our earth. Taking the two chief features of all these formations, first, the central excavation, second, the raised ring, we find a very peculiar association in regard to these two.

In the first place, we never see the excavation without the raised ring. There is not on the entire lunar surface a deep circular depression, say, 20 to 50 miles diameter, 2 to 4,000ft. deep (such a depression as that of Theophilus, or even Kepler), without the raised ring. By itself the excavation is enigmatical, but when *invariably* associated with a raised ring the form becomes doubly mysterious; but the mystery does not end here, for we find that this raised rampart always *accurately fits* the edge of the excavation in such a way as to leave no berme or portion of the original surface between.

No matter how the margin of the excavation is indented, the slope of the raised ring follows that of the excavation in all cases, indicating a structural relationship. There are no instances of an excavation 20 miles in diameter, the size of Euler say, surrounded, either concentrically or eccentrically, by a ring 60 miles in diameter, like the raised ring of Posidonius; each ring absolutely fits the excavation, and this peculiarity extends down to the smallest craters with sunk floors and up to the largest walled plains, such as Bailly 150 miles in diameter on the other, and, indeed, may be said to apply to the smaller regular seas. It is singular that neither Webb, Proctor, nor Neison draw attention pointedly to this peculiar association of the rings to the excavations they surround, for it is necessarily a structural relationship.

Neison, indeed, considers walled plains to be simply "spaces inclosed by intersecting mountain chains, rather than as true independent formations" ("The Moon," page 55), and hence avoids, or evades, the crux of the difficulty.

How are we to account for Pythagoras, Schickard, and Bailly, the latter a vast circular depression, 150 miles in diameter. The coincidence of the great mountain ranges all around their margins (as a circle) cannot be accidental. So that, in studying all these forms, large or small, the very first thing to realise seemingly is a necessary structural relationship between the excavation and the raised ring. Where has the excavated material from the interior gone to? and where has the material of the raised mountainous rampart come from? are twin questions. The solution of one seems to involve that of the other.

In such a form as Theophilus some 2,000,000,000 cubic acres appears to have been removed from the sunk inclosure. In smaller forms, such as Messier, that are not greatly deformed, it is possible to get more approximately the cubic contents of the rings, and it has been noticed that this approaches to the cubic contents of the excavation, measured from the level of the outer surface.

But we shall probably never get nearer than a good guess at the relative cubic contents of ring and excavation, and hence, at least, it would never rise above an inference that the ring was derived from the excavation.

As the case stands, however, such an inference seems to be warranted by the peculiarities of the association above noted, and I would commend this measurement of rings and inclosures to the attention of all lunar students who may have fairly large telescopes. My own of 3·5 o.g. is too small for such a purpose.

I would also suggest the study of a question that naturally arises, that if it is probable that the ring material has been taken from the excavation, i.e., on the floors of ring-plains and walled-plains, we often see other rings much smaller. In these, presumably, the rings are composed of the material flooring the larger inclosure, and when we scan the entire series of circular forms, it leads us to momentous issues. If the ringlets on the floors of, say, Cassini and Posidon are of the same material as the floors of these latter, then is the ring of Picard of the same material as the vast highlands surrounding Mare Crisium.

Again, we should note that all these floors are practically liquid contours. There are none tilted or highly inclined, as among terrestrial sedimentary rocks. Some are convex, and many of the large ones partake of the normal curvature of the globe.

Lastly, we should note that the rings are often of a brightness equal to that of newly-fallen snow, or 0·783 per 1. (See Proctor's "Moon," pp. 160-7.)

At p. 149, Vol. I. of "Darwin's Life," we see he says that "No one can be a good observer unless he is an active theoriser." At p. 108, Vol. II., he says, "I am a firm believer that without speculation there is no good and original observation." So that the remarks "too theoretical," "too speculative," should not daunt us when trying to solve the (admitted) mystery of lunar-surfacing. I commend the above to fellow students.

Sibsagar, Asam, Feb. 16. **S. E. Peal.**

SKETCHES OF CELESTIAL OBJECTS—SATURN.

[29812.]—ALTHOUGH I have no wish to engage in controversy of a personal nature, I must beg to be allowed a little space in which to answer the letter of "Star Gazer," No. 29795, p. 110, who, commenting on a drawing of Saturn, which appeared in a recent issue (on p. 72), states roundly that it is misleading, his reason for doing so apparently being that he himself is not very successful in making out the detail of Saturn. He also gives as his opinion that the author of the sketch in question has been aided "too much by his own imagination." It would have been more satisfactory if "S. G." had been a little more explicit, and indicated the particular features which (according to him) are so utterly beyond 8½in. and even of 18½in. of aperture. If he had done so, no one need have been misled by the drawing; but as it is, it is difficult to know what the features are to which he alludes.

Sketches of Saturn made with an aperture of 8½in., or less, have from time to time appeared in the "E. M.," in some of which more detail is shown than in my drawing, and a case in point occurs in the same issue in which "S. G.'s" letter appears; but I presume "S. G." will not go so far as to say that all the contributors of such sketches, some of them well-known observers, have drawn on their imagination.

As Mr. May remarks (letter 29794), it is very difficult to get delicate shadings reproduced exactly as one draws them; and in the case of the drawing on p. 72 (which is *not* a very careful copy of the original drawing), the shading, especially that of the globe, has come out much darker and more definite than was intended; but this, I submit, is no reason why the whole drawing should be stigmatised as misleading.

I have to thank Mr. Kempthorne for responding to my request with the excellent drawing of Saturn on page 110. There can, I think, be no doubt as to the present visibility of Encke's division, and the "anneau brillant" of the MM. Henri, though I have been able to see the first-named feature in the *p.* ansa only. Has Mr. Kempthorne any note as to the appearance of the shadow on the ring about the time of opposition? On the 29th, 30th Jan., and 4th Feb. I thought the shadow visible on both sides of the globe. Dr. Terby has observed shadow on the *p.* side of the globe some days after opposition.

Didsbury. **Geo. P. B. Hallowes.**

COPERNICUS AND THE "PRIMER OF ASTRONOMY."

[29813.]—SINCE writing (letter 29728, page 55) concerning "Copernicus and the Transits of Venus v. the 'Primer of Astronomy,'" I have invested in a copy of Prof. Lockyer's "Elementary Lessons in Astronomy," edition 1888, in which I find the answers to my queries given in the clearest manner, as Mr. Arman (letter 29792, p. 110) expressly states. The plate (numbered VI.) representing Copernicus, given at p. 100, is an exact reproduction of the one in the "Primer," and has "Lunar Craters, Copernicus," written plainly over the top; so "F.R.A.S." is confuted at once in his very discourteous allusion to the Professor, as to the latter's being ignorant of the identity of his own frontispiece! Again, on p. 294 of the "Lessons" the author gives the correct epoch of the next Transit of Venus (2004), showing that the defect in the "Primer" was more a slip of the pen than anything else, and therefore perfectly excusable.

I was indeed surprised to hear that "F.R.A.S." had never seen the "Primer of Astronomy" in his life (perhaps the case may be the same also with regard to the "Elementary Lessons in Astronomy"!) and still more surprised to hear that he has "not the very smallest interest in, or curiosity on, the subject." His astronomical enthusiasm, in that case, must be of an extremely lukewarm character. **Autolycus.**

[29814.]—WHEN I saw the letter of "Autolycus," on p. 55, I thought of comparing Nasmyth and Lockyer. I have Nasmyth's "Moon," published in 1874 by John Murray; I do admire the photographs in it. The major details are the same, but most of the small craters and ridges are somewhat different. There is not a shadow of doubt but that it is Copernicus. I, like R. Arman, received my first astronomical ideas from Lockyer's book. I have an 8in. reflector, 11½ft. focus, which has been put by for several years. The next suitable evening I intend to look at Saturn, and I will give my opinion on "Star Gazer's" letter (29795).

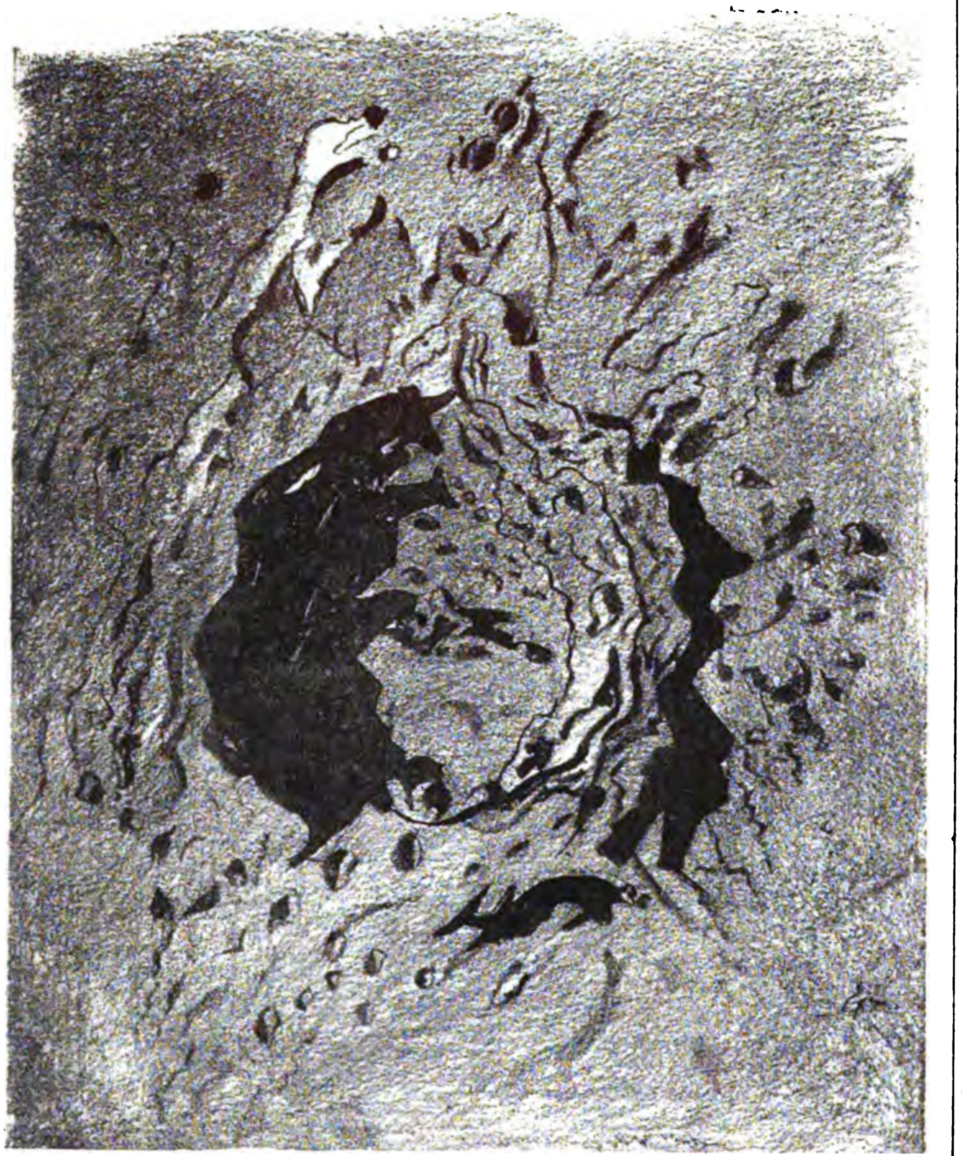
Bournemouth. **Copernicus.**

LOCKYER'S "ASTRONOMY" AND "F.R.A.S."

[29815.]—THE lunar crater in Lockyer's frontispiece is a very inaccurate representation of Copernicus, as anyone with a small telescope may judge for himself. It has been pointed out many times that Nasmyth's drawings and models of lunar craters are very far from truthful representations of the lunar surface, though they are the work of an artist, and the artistic effect is excellent. Consequently Webb, Proctor, and other like people of accuracy, have been careful, when they have copied Nasmyth's drawings, to describe them as "a drawing by Nasmyth" intended to represent so-and-so. But Mr. Lockyer letters Nasmyth's block as "a lunar crater," and it might be one of his own drawings for anything stated to the contrary.

Mr. Arman confesses that he has only recently taken to learning astronomy from Lockyer's primer, and we may judge of the value of his broad statement that Lockyer's "Meteoric theory is at least as good as Laplace's nebular hypothesis." I wonder how much Mr. Arman knows of the history of either hypothesis, and what he considers to be Mr. Lockyer's theory as compared with the earlier meteoric theories of Proctor, Croll, and Tait. I will venture to make a broad statement, too. Mr. Lockyer's part of the meteoric theory of nebulæ is about as valuable as the other five or six theories which he has kept before the public for the last 20 years. The first of these which I remember was that the Corona was an atmospheric phenomenon. Anyone who chooses can turn to the old numbers of *Nature* from 1870 to 1876, and see how dogmatically he held to this theory and denounced his opponents, in spite of the most obvious demonstrations of the geometrical impossibility of the sun's light reaching the region around the moon during a total eclipse, and being brightest close to the moon's limb. Then came a period when Mr. Lockyer's favourite theory was the connection between sunspots and rainfall, temperature and Indian famines. Give him a physical observatory, and he would predict famines and commercial panics. It was only slowly that the folly of this sunspot astrology was rendered apparent, and he then changed his ground and turned to alchemy. He was ready to prove the non-elementary character of the metals, and advanced statements with regard to the existence of common lines in the spectra of different metals, which were soon either contradicted or shown to be due to careless experimenting and the use of impure elements. **A Sympathiser with "F.R.A.S."**

COPERNICUS—TO "REFLECTOR."



[29816.]—I think the accompanying sketch of Copernicus, made on March 11th, with 6¼in. mirror and powers of 165 and 325, will give "Reflector" some idea what such an aperture will show. Of course, all the detail cannot be seen at the first glance; in fact, this sketch occupied me nearly three hours at the telescope. Apparently "Reflector" thinks that drawings are made the same size as they appear in the telescope; but it would be impossible to crowd in so much detail into a sketch of that size. I think lunar objects are the only ones worth drawing with a 6¼in., as but few interesting points can be seen on Saturn—or indeed any of the planets—with such an aperture. Still, I cannot understand his difficulty with Saturn, as I never have the slightest difficulty in tracing Cassini's division up to the globe, and can often see Encke's in one ansa or the other. I have had several undoubted observations of Enceladus this winter. In conclusion, I can assure "Reflector" that my sketch is not at all "overdone," and I think Mr. Elger's splendid drawings should be above any such suspicion.

Ipswich. **A. Southgate.**

SATURN.

[29817.]—Will you allow me to correct a mistake, no doubt due to my indifferent drawing, in the engraving of Saturn published in your last number? North of the bright equatorial band there is a light and then a dark shading. The inner edge of ring C should be continuous with the latter, not with the former.

April 6. **P. H. Kempthorne.**

VENUS—SNOW SEEN IN TELESCOPE—LUNAR HALO.

[29818.]—In reply to Mr. Gemmill (letter 29729), I may say that I have never observed the phosphorescence of the dark side of Venus, although I have often looked for it with a 2¼in. refractor. At the memorable transit in 1882, while in Natal, I had a splendid view of the dark side with this same 2¼in. When half on the sun's disc a smoky circle of light could be seen surrounding the planet, outside the sun's limb. Of course, the planet looked intensely black.

The phosphorescence must be a very beautiful phenomenon, and I think Mr. Gemmill may be congratulated on his observation, as it seems rather rarely seen. I looked specially for it a few days ago, but could not detect a sign of it. 'SEED'

I have noted the blunting of the southern horn and recorded it in this journal some years ago.

In Natal I saw Venus on 13th July, 1884, at 10.45 a.m., only 31 hours after inferior conjunction with the sun. It appeared an exquisitely delicate crescent, pearly-looking against the blue sky.

With reference to letters 29739 and 29791, I find that on the 11th April, 1879, while observing the sun, I noticed (in the telescope) a shower of snow passing rapidly over the sun's disc. It had a very pretty effect. The sun, to the naked eye, seemed quite unobscured by cloud of any description.

On 11th March, this year, a very fine lunar halo was seen. It was greyish-white in hue. Quite bright, and yet soft. There was a thin stratum of haze over the sky at the time, which caused the phenomenon, and it was fairly evenly distributed over the sky, so that there were no breaks in the circle of the halo. At 8.25 p.m. Saturn was well outside the ring, and the distance from Saturn to the middle point of the ring was estimated to be ¼th of the distance from moon to Saturn. A little later the halo was much feebler, and broken by gaps. At 9.40 halo was still visible, although not so perfect. β Tauri was not far from the middle point of the halo ring. **E. E. M.**

THE LIVERPOOL ASTRONOMICAL SOCIETY.

[29819.]—Your correspondent, "A Fellow of the Royal Astronomical Society," has thought fit to ignore the editorial note attached to my letter of last week, and started anew with questionable propriety, and with a series of fresh charges which, if true, would be damaging in the extreme. In his letter (No. 29783), he devotes a paragraph to the Liverpool Astronomical Society. "I can scarcely feel," says this gentleman, "that the Liverpool Astronomical Society has lately been proceeding in a way calculated either to extend its usefulness, or to tempt correspondents to transfer their communications from the columns of the English Mechanic to the pages of the *Journal*." And what has made this contributor of yours so delicately nice; but this simple fact: that the reports of the society's meetings do not appear in your columns, nor in those of the *Observatory*? And because of this "A Fellow of the Royal Astronomical Society" would not advise correspondents to contribute to the *Journal*. I am, Sir, astonished that a gentleman who, in other portions of his letter, shows himself a learned and acute thinker, should here give expression to such indescribable puerilities. I will not remark on the discourtesy and the injustice contained in his reasons for the omission; but I will offer him the explanation that although I had myself undertaken to furnish reports for the two journals named, yet lately, through illness, I had been obliged to absent myself from the society's meetings.

I do not know if "A Fellow of the Royal Astronomical Society" be also a member of the Liverpool Astronomical Society; but in any case I may refer him to the pages of the society's *Journal*, and he will find there the explanation for the omission of the Rev. T. E. Espin's name from the list of members. Mr. Espin's name, with several other names of members, were inadvertently omitted from the list, and when the mistake was discovered it was immediately rectified. Why your correspondent should have singled out for special mention this particular gentleman's name I do not know. I had nothing whatever to do with the printing of the list, and when I was asked to rectify certain omissions, I made a note of them in the *Journal*.

Your correspondent "learns, in a very roundabout way, that the library of the society is kept in a fashion which would astonish the donors of many of the really valuable books it contains." Is it permitted me to remind the worthy gentleman that it might have helped him to the truth of the matter had he written to the librarian or to the secretary, and learnt from one or the other the facts of the case before he undertook to collect the dirty linen of other people? It is but a sorry office at best. I may tell "A Fellow of the Royal Astronomical Society" that the books are in as good condition now as they have been; that they were not stored on two shelves; that if they were placed "in the upper room of a second-hand book-shop" they were placed there with the express purpose of convenience for town members, and that the Council of the Society had some weeks ago decided that the books should be kept at their meeting-room if space could be found, and if the funds of the Society would admit of the purchase of a bookcase. Perhaps "A Fellow of the Royal Astronomical Society" will present us with one? I can assure him it will be very welcome.

Isaac H. Isaacs.

Liverpool Astronomical Society, April 5.

[This controversy *must* end here. We really have something else to do than to devote space to the supposed merits or demerits of societies and their journals.—Ed.]

REFLECTING TELESCOPE.

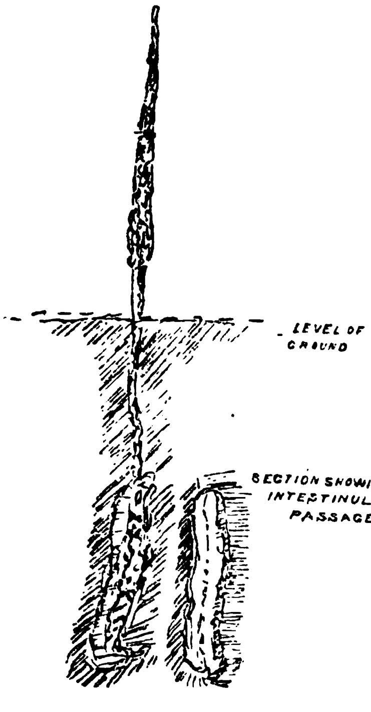
[29820.]—I wrote last week upon the arrangement proposed by Mr. Davis in letter 29767, on p. 92; but the letter evidently was rejected for want of space by the Editor. I should like to say that I pointed out the total impracticability of the idea as there put forward, for the reason that nothing but a distorted image could result if the total reflection back-surface of the prism was worked convex, or, indeed, to any other shape or figure than that of a perfect plane, although the incident and emergent surfaces may be worked convex or concave according to the effect desired—a convex surface on one or both faces giving refraction, and a concave one giving divergence. About the only practicable plan would be to allow the incident rays to impinge upon a convex surface, the refracted rays to then fall upon a total reflection plane surface at the back of prism, and the emergent rays from the remaining face to pass ultimately through a concave surface of flint to correct the chromatic aberration caused by the previous passage of the light rays through the substance of the prism, which must almost necessarily be of crown glass. The cost of such an arrangement—say, from 6in. to 12in. diameter—would no doubt surprise Mr. Davis, and the difficulty of procuring a suitable piece of glass pure enough would be enormous.

In reply to "A. S. L.'s" letter on p. 110, his plan was proposed in some respects by Mr. Brashear in the "E. M." some years ago, with a silvered plane mirror placed at an angle of 45° and deflecting through 90° the refracted cone of rays from an o.g.

The late Dr. Draper made use of the eyepiece tube as one of the trunnions for his 15in. reflecting telescope, the mirror end of the tube being manipulated by means of a wire rope. As a curiosity in old telescopes, I may mention I possess a small Gregorian in perfect order. The diameter of the larger mirror is 1in., and that of the smaller $\frac{4}{16}$in. The tube is 5in. long, and has a two-lens eyepiece 2in. long. The polish of the mirrors is remarkably brilliant. This tiny one has a grotesque appearance compared with a 15in. metal Cassegrain (which I have lately repolished) with its tube of 17-18in. diameter. **J. C. Linscott.**

A REMARKABLE CATERPILLAR.

[29821.]—FROM a new book on New Zealand called "Kaipara," by P. W. Barlow, I copy the description and illustration now sent to "E. M."



"*Sphæria Robertsia*, Bulrush Caterpillar—native name, Hweto, becomes changed into a white vegetable substance while still retaining its caterpillar shape. It is from 3in. to 3½in. in length, and when about to assume its chrysalis state, buries itself in the ground, and it is supposed that in doing so some of the minute spores of a fungus become inserted in the scales of its neck. These the insect, being in a sickly condition, is unable to rid itself of, and they vegetate and spread through the whole of the body, completely filling and changing it entirely into a vegetable substance, though retaining exactly the caterpillar form, even to the legs, head, mandibles, and claws. From the nape of the neck shoots one single stem, which grows to a height of 8in. o[illegible] 10in., its apex resembling very closely the clu[illegible] headed bulrush in miniature. This insect-pla[illegible] usually found growing at the root of the Rat[illegible] It has no leaves, and if the stem becomes by[illegible] broken off, another arises in its place, tho[illegible] stems are never found growing simultan[illegible] the same caterpillar. When fresh the substance of which it is composed i[illegible] strong nutty flavour, and the native[illegible] eating it; they also use it burnt[illegible] powder as colouring matter for tatt[illegible]

PHRENOL

[29822.]—LAST week "[illegible] should be surprised to [illegible] Bridges' book before [illegible]

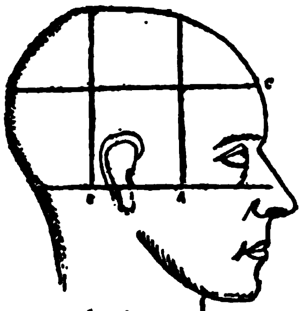


fig 1

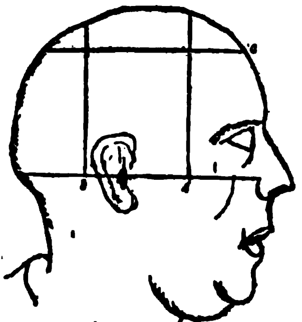


fig 2

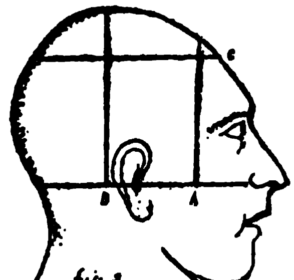


fig 3

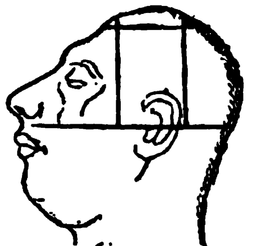


fig 4

remarks about phrenology. I am not surprised at his having the book, but I am surprised at him writing his paragraph if he has ever put the teachings of the book into practice. I have done so for sixteen years now in over 50,000 cases. I have also a large number of casts of heads of well-known good, bad, clever, and idioti[illegible] ople, and yet I have to find a single clear case [illegible] the measurements of Mr. Bridges will not [illegible] to the head and character. In his work [illegible] ges points out that a line drawn from th[illegible] ossification of the frontal bone through [illegible] rallel with a line drawn through the [illegible] e ear, will give, if we measure upw[illegible] at line, a measure of the real moral [illegible] person's mind; if compared [illegible] that line, to the opening of [illegible] above the top line is the way to [illegible] the different signs of the moral [illegible]

In order to illustrate this I se[illegible] o-type of four heads. The sketche[illegible] in every detail, as they were made by p[illegible] hotographs of the heads over black par[illegible] raced with a sharp point, then reproduced [illegible] lithography.

Fig. 1 is the head of George [illegible], who gave abundant proof of his mor[illegible] intellectual powers; compare the top a[illegible] of the head. Fig. 2 is the head of Dr. [illegible] oisoner, &c.; note how small the top hea[illegible] is the head of Dove murder; compare [illegible] and below the line (*c*). Fig. 4 is an idi[illegible]

These are not sketch[illegible] ative heads, but from casts of heads [illegible] lived, and prove that phrenology ha[illegible] foundation for its signs of character [illegible] say that I knew where photos. of [illegible] e got, but I said if Piggot's could [illegible] ording to the above measurements [illegible] a deficient top head. Since I wrot[illegible] r I have purchased the special num[illegible] c, in which it gives an engraving [illegible] from a photograph after death. [illegible] reproduction of the man's head, i[illegible] of of what I said.

Wi[illegible] stian's work on the brain, I hav[illegible] was first published, and read an[illegible] pied almost every one of its il[illegible] brain. The book contains [illegible] n the phrenologist has anything [illegible] as it does with descriptions of the [illegible] es of brain and manifestations of [illegible] n to describe the more highly- [illegible] of brain, and then shows, by illus- [illegible] brains of an educated white man [illegible] developed than the brains of a [illegible] rly showing, as one writer says, [illegible] ew development of mind-power is [illegible] panied with some addition of brain. [illegible] ctically acquainted with phrenology will [illegible] e worthlessness of Dr. Bastian's remarks [illegible] enology.

[illegible] t intend to take up any more of your space after this, as there is a phrenological [illegible] London where the subject is taught, in- [illegible] on concerning which may be had from Mr. [illegible] r, Ludgate-circus. Yet I do not think [illegible] A.S.," and others whose valuable talents [illegible] ble them to guard us aright in things for which [illegible] ey are gifted and educated, should be allowed to cavil and bark at phrenology (without being put right) every time it is mentioned in a respectable journal like yours. Gall and Spurzheim did not pretend to give to the world a perfect system of mental and moral system of philosophy. Nature showed them some of her secrets, and they told the world what they saw; and, as Dr. Forbes said in 1840, to entitle the judgment of anyone to the least weight, either for or against the reality of the discovery, it must be based upon careful examination of the facts and evidences. **Mark Moores.**

Phrenological Museum, Morecambe.

[29823.]—IT is four years ago since I lived at [illegible] ancaster, and every fine evening during the [illegible] mer I walked over to Morecambe. I know [illegible] at the Phrenological Museum at Morecambe is [illegible] ke pretty well, and will give a description of its scientific character. It was located in a back room, about 5yds. long and same in breadth, and the objects which composed the museum were about a dozen smeary sketches of well-known faces, a skeleton, and the ordinary phrenological model head. In a little front room the professor waited to examine people's heads.

One evening (for the fun of the thing) I went to him to have my organs examined. He said I should make a splendid musician. In one sense he was right. I cannot play any musical instrument, but can whistle very well. That I had the capacity of making a clever and keen merchant. That was all rubbish, as my business lies in the mechanical line, and, as for making a bargain, a child could buy me at one end of the market and sell me at the other—in fact, I never tried to make a bargain in my life but what I lost considerably by it.

The same professor was daily lecturing on the sea-wall among a few fishermen, a few country lasses and their swains, &c., and was clever enough to point out that the former were good at catching fish, and the latter by practice could milk a cow.

I have no faith in phrenology, and am supported in my views by never having yet met any doctor but who calls the whole thing humbug. And as for phrenologists who style themselves professors, their little game should be stopped. It is a shame that they should be allowed to make money in so indolent a manner by trading on credulous people's believing powers.

A Continental Anti-Phrenologist.

Rotterdam, April 2.

PLATINUM PLATING.

[29824.]—I FEEL much obliged for the practical statements contained in Mr. F. W. Mason's letter, and am sorry I did not give Sprague's formula, but somehow I imagined it was so well known. The following is my rendering of it: "To 2oz. platinum bichloride in 1 quart of water, add ¼oz. of chloride of sodium, and 3oz. of oxalic acid (pure crystallised), rendering the whole solution alkaline with caustic soda, afterwards filtering while warm."

The copper I used was ordinary mesh, obtained through a sieve-maker; the silver and platinum mesh was obtained through an assayer of precious metals. As for a bright polished surface on the wire mesh plates, let alone the impossibility of burnishing them owing to their fragileness, it is against all practical experience, and is a great mistake, since the gas adheres by capillary attraction, and runs together on the plate, whereas a rough surface tends towards the disengagement of the gas. I never did more than use a small, hard oil-colour paintbrush passed over the surface during plating; and I think perhaps I did very well in platinum plating; only, being unaccustomed to it, I formed too high a standard of excellence, expecting it to turn out like silver, and I merely wished to know of a bath that would work at a low temperature.

With regard to my battery, I do not think it is a question of carrying out my experiments further either with or without the help of others, as I have practically run dry in experimenting, having spent some hundreds of pounds in the last few years on gas-batteries, working sometimes ten and twelve hours a day for eight months on a stretch, without a holiday, and this, too, for the love of the thing, and not for profit, so Mr. Mason may imagine how infatuated I was in my research, and with what regret I gave it up. I do not think Mr. Mason has any idea of the time and patience I have spent on the above, using every expedient ingenuity and experience could suggest.

The plate Mr. Mason mentions is an old idea of mine, and he will see I have mentioned it in my letter dated April 3rd, and if he will burnish his lead plate, using 3oz. or 4oz. paper lead over iron wire mesh, as I mention in the former letter, keeping it moist with water, he will obtain what he requires—viz., a sheet pierced with holes; then, if he will put it into a platinum bath, dusting it over whilst in the bath from time to time with a mixture of pure oxide and carbon dust, half and half by weight, he will obtain a medium plate of rather high resistance, with an envelope of platinum round every particle of carbon and lead. I have made several plates of the above, sometimes using a lead bath and at others a platinum; but the platinising protects the metal underneath, and this is the reason why platinum is the best metal for the purpose. I have also used a platinum foundation, dusted over with rather coarse platinum black whilst in a platinum bath, and this is a most excellent plate, especially for the negative plate; also a silver wire mesh plate platinised and dusted with the platinised carbon dust described in letter No. 29631, page 482, is the best positive plate I have used, and requires no loose carbon on the top; but both of these are more expensive to make than the one I have previously described in my battery, in fact, the experiments I have tried are innumerable, having made pretty nearly fifty different plates; but, of course, it is utterly impossible for me to write down every detail; but of the seven materials, platinum, silver, copper, lead, iron, carbon, pumice, there is hardly a combination I have not tried, mentioning in my letters the most economical results, and not altogether the most efficient, taking as the standard of cost a gas-engine of the present day. Mr. Mason does not seem to think the price of palladium is anything out of the way or deterrent to use in gas batteries, whereas I think a platinum-wire mesh or foundation is too expensive to use in an ordinary battery, otherwise one covered with platinum black is a beautiful negative plate, and very easy to make; but even this is far too expensive to compete with a gas-engine, and utterly fails in any other solution than H_2SO_4.

Mr. Mason seems to insinuate I have evolved the cell described in letter No. 29773 out of my inner consciousness, since he asks what percentage of acid I am going to use. The strength of solution I have hitherto used in the past, and hope again sometime to use in the future, is one of pure acid to eight of water, and I beg to state that what I have written is no created chimerical phantasy of a visionary enthusiast, but is founded on actual experiment, together with the theory I have formed of my own, which is compatible with the results obtained.

I do not say it is right; but I wait to be proved wrong. I am much obliged also for his offer of assistance in gas batteries; but as he has only lately taken up the discussion which was begun in the beginning of January last, I naturally imagine his experience in them has been quite recent, for there were many opportunities given before now of his entering this discussion, of which he did not avail himself; besides, when he speaks of using polished surfaces in gas batteries it shows his experience of the above subject is but slight and against all experiment, and in suggesting the use of such metals as palladium, rhodium, lithium, &c., that he believes in the occlusion of the gas, and not in the molecular porosity of the plate itself.

The mode of so-called dusting in the above letter is practically using the platinum or other metal or material as pepper out of a pepper-box, sprinkling it either on the plate itself or on the solution above the plate, the receiving plate being laid on the bottom of the tray or bath in which the solution is contained, making the plate $\frac{1}{32}$in. thick or less, and using the metal which is being deposited simply as a cementing medium, or a protection against acids or alkalies used in the battery cell.

April 8. **Alfred Treeby.**

ROTARY ENGINES.

[29825.]—MR. FRED. R. MARTIN, in letter 29688, introduces with much modesty a design for a reversible rotary engine, which, as a matter of course, he thinks superior to all others. In the first place, very little can be said for the novelty of the design, except in the said defects, as a reference to your back vols. will show. Then, again, there are no means provided for packing—a very important factor in any kind of engine. The steel roller would perform very efficient service in crushing the surface of the central cam out of true; but would offer as much resistance to the passage of the steam as does a jerry-builder's door to the blasts of winter. And again, the "novelty" for which Mr. Martin takes so much unction to himself—to wit, the method of reversing—can be accomplished in a much simpler manner by bringing the steam and exhaust pipes direct to the cylinder, one on each side of the slide: and this has the further advantage that the slide can be properly lubricated, which is impossible in his plan, where the steam comes into direct contact with the working surfaces.

It is unnecessary to say more. The small size of the steam and exhaust pipes, the absence of any bearings for the shaft, the bad form of the cam, &c., are draughting errors, which may be seen at a glance; and, with the general crudity of the whole affair, they only serve to show that Mr. Martin has no knowledge of that which he essays to improve. Albeit they reflect a somewhat peculiar light upon the reputation of those engineers who held out to him such a rich banquet of hope.

I will not say that the design cannot be amended; but then, the more it is amended, the more will it become like unto certain relics of antiquity, which lived out their fitful existence long, long ago. The fact is, it belongs to what I may call the great cam class of rotary engines—great, not because of its intrinsic merits, but because of the immense number of variations that have been played upon it by ambitious but short-sighted inventors. In this class are included all those the cross-sections of whose surfaces are otherwise than a true circle. Their number is legion, but it is unnecessary to enumerate. Whether the outer or inner surface be the cam, they one and all have the same defects. In their fundamental conception they violate a principle, which, in the construction of pressure engines, should be considered above all sacred and inviolate. They cannot be properly packed. An efficient system of packing should provide that a certain width of metal (I am ignoring the old systems, which are useless with the high speeds now in vogue) should fit closely and accurately against the opposing surface at every position in the revolution or stroke. It is plain that this cannot be done where the curve varies, as in a cam; and the result is, that instead of the packing-strip fitting over the whole of its width, which is generally about ¼in., it only touches the opposing surface in a mere line, which certainly cannot afford a very effective impediment to the leakage of the steam. This evil is aggravated or lessened as the section of the cam differs from, or approximates to) the circle; but it can never be entirely absent. Only those surfaces can be perfectly packed whose section, in the plane of motion, is either a straight or circular line, the motion being respectively rectilinear or rotary; and, as stated above, the mechanism must be such that the normals to the two opposing surfaces shall coincide at every position in the stroke. And there is another objection to this class—that is, in its simpler and usual form, where the steam is admitted at only one point in the revolution—which becomes serious when high pressures are employed; which is, that the steam, acting in only one half of the casing, causes an excessive pressure upon the opposite side of the bearings.

I think this is sufficient to show that, although the class has superlative advantages in other respects, in practice it is almost sure to fail; and I may add that there is a very long list of failures, which fully bear out what I have advanced. There is only one instance, that I know, which has had any practical success, and that is one that has lately been introduced, and is far and away the best of its class. I mean the Leitch engine, which is advertised in your columns. Here the outside surface is the cam, and in section differs very little from a true circle. Steam-tightness is obtained by a sacrifice of the original simplicity of the packing-strip, which here consists of a split tube, which springs to fit the varying contour of the surface.

This blessed steam age in which we live is getting well on in years, and some are already beginning to talk glibly of its demise, though, it appears, with very vague notions of what they discuss. Seeing this, one might well imagine that the "elementaries" of its application were as well known as the A B C of the alphabet. Yet startling fallacies continue to crop up—fallacies that have been exploded long ago and many times since, and still they come, as though inventors' brains contained an inexhaustible supply of dynamite. Would not it be well, then, if the Government were to arrest all these under a recent Act? Only lately we have had a notable instance of the dangerous propensities of the inventive faculty when combined with an inclination to the blacksmithing and blackmailing arts. But, seriously, such palpable ignorance is hardly to be laughed at—it is rather to be feared. Your paper is doing a great work in clearing away the cobwebs of paradox and error, that gather too thickly round one's brain. I myself owe most of my scientific knowledge to its pages, and so, I expect do many others. Still, the paradoxer is abroad, as large as ever, although he rarely gets an opportunity to air his pretensions. Here we see an instance of engineers predicting a gain of one-third in economy! Their case is evidently hopeless; they are unmitigated fools or unmitigated something else. But, for Mr. Martin's information, he being evidently afflicted with the *cacoethes inveniendi*—of which rampant malady I am myself a victim—I will say that he can never expect to make such an immense gain, and will put it to him as plainly as possible the reason why. First, then, there is a simple axiom that the power to be got out of a certain quantity of confined steam is directly proportionate to the degree by which the said steam is expanded in use. When we calculate the I.H.P. we really calculate the work done in expanding to that extent. It matters not how the expansive force is applied; the result in theory will be the same—that is, supposing there be no loss of heat, a phase of the question which does not concern us here. The factor of efficiency, therefore, resides only in the mechanism employed. A pressure engine may be primarily considered as an expanding box, which is alternately expanded and contracted by the intermittent application of the fluid pressure. Its comparative value as a motive power depends mainly upon its freedom from friction and leakage. Hence the only opening for economy—apart from considerations which involve the laws of heat and need not be entered into here—is in the reduction of loss from these sources, and to say that it is possible to gain yet a third therefrom is a monstrous libel on the intellect of the age.

Now a word or two as to the advantages of rotary engines over the ordinary reciprocating type. I do not think much can be claimed to their credit against the score of friction, and they are certainly more liable to leakage, some forms being very difficult to pack. This being so, there is, in reality, only one advantage, and that is their freedom from vibration, which allows them to be run at high velocities. But this in itself is a very great advantage, enabling direct driving to be used in the now numerous cases where the gearing up necessary to obtain the high speed required would entail a great loss of power. Yet this advantage is sometimes negatived by improper balancing. It is not only necessary that all rotating masses should be balanced, but also that the centres of gravity of the weights should be equally distant from the centre of rotation. And I am inclined to think myself that the moments of the actuating forces should be accurately balanced as well. This may not be so important as I imagine, but still it is worthy of consideration. And, apropos of the reversibility, which Mr. Martin thinks such a desirable object, and so difficult to obtain, I may remark that, to the best of my knowledge, there is not one that has come into any practical use (and, sad to say, they are very few) that cannot be reversed by turning the steam into the exhaust, and vice-versâ. As these passages, in a properly-designed engine, should be of different size, there is some inconvenience and loss attached to this method, which can only be obviated by complicating the valve-gear. But, in reality, to make any provision for this, unless it can be accomplished in a very simple manner, is to leave the substance to grasp at a shadow, for the sphere of utility of these engines does not require that they should run reversed for any length of time at a stretch.

One more paragraph, and I have done with what is, in truth, an inexhaustible subject. It is a very interesting one to me, and, with the Editor's permission, I may perhaps revert to it on another occasion. I am collecting all the information I can, and should be glad of the assistance of your readers. Can anyone tell me what literature there is upon the question, or of any peculiar form of rotary which they may have seen or heard of? As far as my present knowledge extends, I find there are six different classes, each dependent on a distinct principle. These are—

1. The Emissive, including the Parsons turbine motor. These are not strictly pressure engines, but they are admirably suited for very high speeds, where the load is invariable, and well within their power.

2. The Root's Blower class, which comprises all those which consist of irregular-shaped drums, rolling together. They have nothing to recommend them, except as blowers, for the leakage must be enormous.

3. The Cam class, which I have already noticed.

4. A class, with eccentric boss but radial pistons, as "E. M.," Vol. XI. page 417, Fig. 27, also at page 561 Vol. XXI.; and certain improvements I have devised upon the same.

5. The disc engine class, including the Tower spherical, and Fielding engines: perfectly worked out in the two mentioned, which are very serviceable motors, albeit they have their defects.

6. There is only one belonging to this class, the Parson's high-speed engine, a most ingenious application of a mathematical principle, and especially noteworthy for its circular slide-valve.

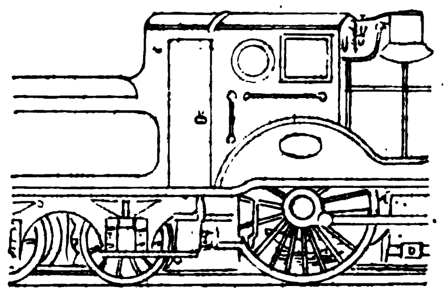
To the above, I add two other classes which I have invented, but not patented; over one of which a paternal, yet critical, spirit inclines me to write, not superior, but supremus.

I cannot further incroach on your space to comment upon the peculiar advantages appertaining to each class. The above is merely intended as a brief exposition of the various pathways, on which "rotary inventive talent" (a patched up phrase, but singularly appropriate, seeing the aggravating manner in which one's ideas will circle round a purpose; rarely attaining sufficient centrifugal tendency to fly off into "fresh woods and pastures new") has been working.

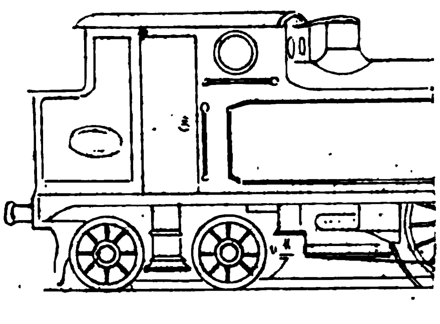
Cowes. I. Q.

LOCOMOTIVE CABS.

[29826.]—I AGREE with Mr. Reynolds, who says, in his "Locomotive Engine Driving": "The life of the engineman has in recent years undergone great changes for the better. In the improvements of engines and in personal comforts introduced even during the last twenty years, locomotive enginemen may find much upon which to congratulate themselves." Thus we see much has been done to diminish both the dangers and hardships to which the engine-driver is exposed from the nature of his calling. Still, I hold that a great deal ought yet to be done to add to his comfort when on the foot-plate. I consider that the men should be better protected from the weather than they are at present with the ordinary form of cab adopted. A locomotive without a cab to shelter the men is a disgrace for any railway company to have upon their line; where a cab is provided it is certainly a great boon. I am inclined to believe that with all its advantages the cab does not afford so much protection from wind and rain as it ought to do. A tank loco., for instance, having a weather-board both in front and behind with the cab extending over the foot-plate so as to cover it in entirely, seems to me to afford the greatest amount of protection that any cab gives as constructed at present. I could fancy, however, that with an open space on each side of the foot-plate there must often be—depending on the wind—a considerable draught blowing through, which is shown by the following incident: One bitter cold day in winter, with east wind and snow, I happened to be waiting for a train at a large railway station, and noticed a tank-engine with a cab of the same description as above doing shunting work, and as both wind and snow was beating against the driver's side of the loco., the men, in order to protect themselves, had put up a wooden board which extended from the foot-plate to the roof of the cab, entirely closing on the windward side the space between the cab and coal bunker, which usually is left open. I looked upon this plan as a very good one, and thought the men quite right in looking after their own comfort, as the railway companies do not seem to trouble themselves about their servants working long hours, being exposed to all kinds of weather by night and day, and standing with wet clothes on, so long as they get their trains run regularly and kept up to time. Since then it has occurred to me that by a slight alteration in the form of cab it would be quite easy to provide tank-engines, having the same kind of cab as above, with two iron doors either hinged or sliding in a frame, one on each side; these, when closed, would cover in the sides of the cab, and when open would lie against the sides of the tender or coal-bunker, and be quite out of the way; one of the doors could be shut in bad weather on the windward side, or both of them be closed at the same time, if proper provision was made for ventilation of the cab. Where there is a separate tender possibly a similar arrangement might hold good, provided a weatherboard was put up on each tender, and its roof projected forward so as to meet the roof of the cab, with an iron pl
overlapping the seam on the top. The doors w
fit the space between the cab and sides of te
shutting out the wind on either side when c
(See sketches.) The windows on both sides
the doors might be made smaller than
front of them, of a circular shape and wi
glasses, so that by opening one of them
doors are shut the driver could put
when required to do so to look out f
The doors ought to be made to oper
side or the inside. I am of opinion
this kind was provided on every e
ciently commodious, properly
windows in the sides in additio
two seats, the men might be
fortable and as well protect
in a third-class carriage; r
desirous of seeing, for
servant more than othe
safety should be looked after, it is the engine-driver and his stoker. I do not think this alteration in the cab would add very much to the cost of a locomotive, and could be easily fitted upon any engine on the line. I am told that in America the men are well protected from the weather by commodious cabs, some of which contain cushioned seats.



I do not happen to be a practical railway man myself; but I shall be glad to hear what Mr. Stretton and others, who have the welfare and interests of the men at heart, have to say on this subject. I. A.



BETTER METRIC SYSTEMS.

[29827.]—THE mistake of "Old Hand" (53
out
duodecimals is of prehistoric antiquity, an
less to crop up again and again, till we ha
compound arithmetic—that is, one ident
table for values of every kind, and that
than decimal. He will see, in Vol.
about two years ago it was discussed
Phi" was for making those two le
for ten and eleven. In p. 324 (N
make clear that old non-decimal
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been idiotic or aimless va
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called the *meristic* or supr
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done by multiplication, except
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y 5 and by 25. What a loss,
your inartificial round decimal
ger-counting, are not meristic, to
with these two trifling exceptions) the
od so aptly, for its utility, termed
Multiplication is unquestionably more
and liable to error than short division.

ole woe is not in each weight or measure
being non-decimal (each is *better* than
al, or it would never have been used), but in
variety. Says the March *Westminster Review*,
have "troy, avoirdupois, apothecaries', coal,
ool, and hay and straw weights; then imperial,
ry, coal, and wine measures; next land and square or superficial measures; lastly, linear, cloth, and nautical measures—seventeen in all!" Now, unless those using these ridiculous Gothic relics can agree to sink their differences, and take in common some well-devised table, not inferior to the money and troy-weight (of Roman origin), or the Babylonian surviving in modern time measures, they will have to be overridden by the hoofs of this barbarous retrograde, Chinese and Sans-culottes' decimalism, miscalled "metric."

The almost prehistoric notation of the Babylonians, let me point out to "Old Hand," was (if we had to renounce compound arithmetic) both far superior to duodecimals, and involving far less change from our mere decimalism. Though the base of the notation was 60, no other figures than ours are needed, for the difference is only in making the steps alternately by 10 and 6, instead of all by 10. The even and odd places have to be well distinguished that we may know from which to carry tens, and from which sixes; but instead of a break after every pair, and the accents °, ′, ″, &c., it would be far better to use two kinds of type, the larger figures going only from 0 up to 5, but the smaller up to 9, like ours. These ought to be much nearer the large ones in size than what our printers put for the powers of *x*, &c.; but if the printer has none better than those, they will serve here to illustrate the method. Up to 59 we need make no difference, but sixty to be figured 10°, and called a *soss*—the Chaldean name. Eighty-four would be 12^{4}—that is, "one soss and 24." The date of this year, $3^{1}29$, or "thirty-one soss 29." The initial 1 of the first two above is large, though, in the place that ought generally to have a small figure. That is merely for ornament, and every number should similarly begin with a capital, whether its places be even or odd, as this could never lead to any mistake. We should have to drop all the names "seventy, eighty, ninety, hundred, thousand, million," &c., and revive the Chaldean, for 3,600, a *sare* (Gr. saros). They also called 600 a "neros," but we need no other name for it than *ten soss*. On the analogy of *mille* giving us million and milliard, the sare could yield us a *sarrion*, 1,0°0°,0°0° = in our notation, 12,960,000, and a *sarriard* 1,0°0°,0°0°,0°0° = our 46,656,000,000. On the analogy of billion, a *bisarrion* would be 167,961,600,000,000, and so on, to *trisarrions*, &c., as far as we need.

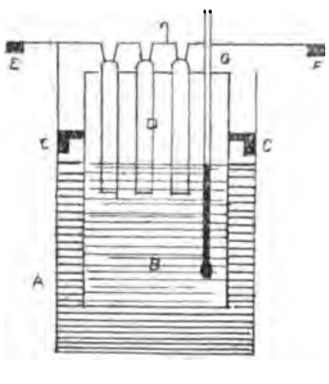
Now "Old Hand" will soon find, on comparing the number of divisors any one of the round sexagesimals admits, with those admitted by the powers of 12 next above it, that these beat the duodecimals
llow in divisibility. Yet none of these beyond
oss" (= 360) would be in the class of
" numbers, that I tabulated in Vol.
4. Each will have fewer divisors
mbers far below it in magnitude. I,
older hand on this subject, did once
opose a revival of the Babylonian system,
nd it from the division of the hour and
of angles to everything, as one Taylor also
d a century ago. (See *Proceedings* of Glasgow
sophical Society, 1873.) But I now see that no
modification of simple arithmetic can supply the
ce of compound. We must, in every metral table,
here to decimals above and below certain limits—
ay, for instance, in long measure above the fathom and below the inch; but in everything the two steps next to the commercial minim ought, instead of 10, to be 8 and 9. Those are as easy to carry in computation as tens, and 8 × 9 × 10 = 720, which is a meristic number. Money or anything else might perhaps well be decimalised with just this mitigation. We want *mitigated* decimalism to at least this degree of mitigation, perhaps more. Next above the steps 8, 9, 10, a step of 1,001 would be very useful; not steps of the three prime numbers, 7, 11, 13, but all three combined as 1,001, which is almost as easy to deal with as the decimal 1,000; thus our fourth and largest unit would be 720,720 of the smallest, and this has the biggest "practicetable" that any number under 1,081,080 can have.

E. L. G.

A PORTABLE AND STANDARD CELL.

[29828.]—MANY amateurs are constantly asking questions regarding these. Portable batteries, as their name implies, are small batteries manufactured so as to occupy little space, and also to give a minimum quantity of trouble in their manipulation. In experimenting with these—and I have done so with most of those already in the market—I have come to the conclusion that there are none that can beat the De la Rue and Miller's elements: a half-dozen of these cells, each tube 3½in. by 1in. diam., are quite sufficient for an ordinary-sized medical or shock coil; in fact, in some coils of my own manufacture I have used only three, and with these have attained sufficient current for my purpose. The construction of my cells is as follows:—Small glass tubes 3½in. by 1in. diam., with a good tight-fitting cork, through which at one side is passed a platinum wire reaching to the bottom of the cell; on the other side reaching not quite half-way down, is a thin strip of silver about 1½in. long and $\frac{3}{16}$in. wide by ⅛in thick. The glass cell is filled nearly half-way up with silver chloride (AgCl) (this should not, of course, touch the silver strip), and over this a solution of chloride of ammonia (NH_4Cl)—sal-ammoniac. Thus the chloride of silver is one element of which the platinum wire makes contact, and the silver strip which is immersed in the sal-ammoniac solution the other element. Each glass tube should have black paper pasted round it so as to prevent the action of light on the silver chloride. My method of making the silver chloride is to dissolve 260gr. of silver nitrate ($AgNO_3$) in distilled water, adding a solution of chloride of sodium (common salt—NaCl). This should be made with chemically pure salt and distilled water. This precipitates the silver as silver chloride. We shall obtain, by using the above-named amount of silver nitrate, about ½oz. of silver chloride (220gr.). This will be sufficient for three cells; in fact, I may say four, giving to each tube, at this rate, 55gr. of AgCl. But I myself prefer to use the 220gr. of AgCl with only the three cells, as I find, by practice, that this is much better. The chloride of ammonia (salammoniac) solution should be made by dissolving 1,000 grains of this salt (chemically pure) in 4,000 grains of distilled water. The cells should be filled within about ½in. from the top; it is much the best to add this when the cells are required. The action of this cell is as follows:—The hydrogen evolved at the plate reduces the chloride to metallic silver, which is thereby recovered; these elements are only acted upon when the circuit is shut, which is thus the beauty of it. The E.M.F. is about ·34 of an ohm, which thus gives, with the six cells, ·34 × 6 = 2·04 volts. This cell is also of very great use as a standard. With three cells we obtain ·34 × 3 = 1·02 volt, or about 1 volt, and it is not subjected to as many changes as the Daniell. My standard cells of this kind consist of three cells, fitted up as sketch.

A is an external vessel, preferably of copper; in this, which is half-full of water, is immersed another vessel, B, also of copper, resting upon two small ledges in A, as C C. This vessel contains the three cells D, which are connected in series with poles at E and F. These should be made of mercury cups, though with these cells is also placed a thermometer, G. This is for the purpose of keeping the water in B at a constant temperature. To use this arrangement, heat is applied under A till the water in B rises to 90° Fahr. When this is the case, the three cells give a voltage of exactly 1· volt. I find, from practical experience, the water in B must be kept from 85° to 95° Fahr., and it must not, on any account, go above or below the above-named temperatures. With this arrangement, and with the above-named temperatures, and with the cells containing the following proportions, I have obtained excellent results—in fact, far exceeding a standard Daniell formerly employed by me:—Sal-ammoniac solution: 1,025gr. of pure salammoniac, 3,800gr. of distilled water. Chloride of silver: Pure argentic nitrate, 260gr., precipitated as argentic chloride by the addition of 106·22gr. of pure chloride of sodium. The AgCl is used at the rate of 66·66gr. for each cell; the platinum wire is No. 22 B.W.G. With this arrangement, as stated before, the voltage is exactly 1· volt. Any queries that may arise on this arrangement I shall be very pleased indeed to answer, and also shall be very pleased to assist any amateur who may desire to make a similar arrangement. My arrangement of the three cells for the standard cost me exactly 14s. 6d., and has been used by me in a few hundred experiments.



F. W. Mason, Consulting Electrician.

THE HAYDON CUTTER-BAR.

[29829.]—If, besides the amusingly transparent purpose of the first part of letter 29805 and the cuttle-fish purpose of its latter part, it has any *raison d'être*, it is not very apparent.

If Edward Hines wants to say plainly that no bar, unless made by his incomparable workmen—of whom, no doubt, "Mechanic" is one—can be correct or worth anything, I know of no hindrance to his doing so, nor anything to require him to go round about the bush. Only I suppose no one is bound to accept such statement, whether made direct or indirect, any more than he is bound without proof to believe his other statements *re* lathes, planers, and their tools.

If forbidden to regard the letter as a fine piece of Pecksniffian writing, we must seek for some other meaning. It says: "A Haydon bar not working satisfactorily in a planing machine is no way against its value as a lathe tool." Is it that a lathe tool *will not work*, and is not to be expected to work satisfactorily in a planer? Is this true?

No one, I fancy, who knows what the two machines are, imagines that their "*construction*" is alike. But will Edward Hines point out to "one who does not know" wherein "the conditions under which the cutting edges work" *are not practically alike?* Will he also show wherein "the *construction* of the cutting tool, either a solid forged tool or a cutter-bar carrying a tool, is necessarily (if best results are desired from its use) in accordance with certain conditions appertaining to its position" in a *lathe, different to the construction* of a similar tool in conditions appertaining to its position in a *planer?* Or, to leave out all the fine language—in fact, to kick away the cuttle-fish—How does a lathe tool differ from a planer tool? How can a good lathe tool make a bad planer tool?

This, as far as I can understand it, is the statement Mr. Hines has committed himself to in his efforts to prove that I know nothing about a Haydon bar. It was certainly news to me when I heard that lathe tools are not suitable for planer use, and that "it can only end in vexation and annoyance" to make the attempt, because "they have not been practically designed to suit the circumstances under which they are used."

When Ed. Hines can establish these opinions, which, whether it be disgusting or not to have to do, he must do, before we can accept his workman's estimate of him, and admit him to be "one who knows," and not rather one who is known.

Fred. Carre.

["Mechanic" is *not* one of Mr. Hine's workmen; and we fail to see the "amusing transparency" of the purpose of the first part of Mr. Hine's letter. How *is* it correspondents cannot discuss such a thing as a cutter-bar without growing unmannerly?—Ed.]

VASELINE.

[29830.]—I have been reading the correspondence on the above subject, and agree with Mr. Chas. E. Sohn as regards the composition of the olefines and paraffins. The olefines, having a lower number of atoms of carbon and hydrogen, are liquid. The sp.gr. of the olefines got from shale range from ·700 to ·900 or more. The lower sp. grs. are used for burning, and contain a less number of atoms of carbon and hydrogen than the higher. The higher sp. grs. are used for lubricating, and are less volatile than the others. The paraffins obtained from shale contain a greater number of atoms of carbon and hydrogen than the olefines, and their sp. grs. from ·800 to ·810, and melting points from 100° to 130° Fahr. scale.

Vaseline I consider to be a homogeneous composition of soft paraffin. It is prepared from the residue of a petroleum distillation. I have made artificial vaseline from shale oils, and found it to have the same effects as the natural production. Most petroleums contain very little paraffin, but the paraffin they do contain is very amorphous.

If our Editor thought it would be of any interest to our readers for me to give a few articles on the production of paraffin and paraffin oil, I am sure it would be a pleasure for me to do so.

Broxburn. **Thomas Clarkson,**

[Offer accepted with best thanks.—Ed. "E.M."]

ORGAN MATTERS.

[29831.]—Mr. Dixon's scheme is, according to his own saying, for a chamber organ; but such a scheme, with its forty-three speaking stops, three independent swell-boxes, four departments, and twenty-five mechanical accessories and appliances, comes rather under the category of concert-room instruments. That it would make, if artistically carried out, a magnificent chamber organ there can be no question, and very little alteration in its tonal structure would be required to make it essentially perfect. Such being the case, I shall only suggest a few alterations for Mr. Dixon's consideration.

In the opening article on the chamber organ (English Mechanic, August 6, 1886) I remarked that "the true chamber organ must be on the concert or orchestral organ model; it must, in fact, be the orchestra *da camera*." This Mr. Dixon has evidently realised; but, in relation to so large an instrument, I think he might have improved his scheme by following to some extent the system of stop disposition laid down in my "Notes on the Concert-room Organ." Had he given those notes a little more study, the result would have been, I venture to think, a strengthening of his second organ, and the division of it into two sections, one of which would represent the string forces of the orchestra, in some pronounced degree; whilst the other would be of a rich accompanimental character. Under this arrangement the vox humana might with advantage be transferred to the third or solo organ. As Mr. Dixon's scheme stands, I cannot see that the vox humana, in the second organ, can be effectively accompanied except by a very limited range of tonal effects. This, however, is a minor matter. In so important an instrument, an open stop of 16ft. pitch, of a soft tone, ought certainly to appear in the first or Great organ, whilst in the second organ, a lieblich gedeckt, 16ft. tone, would be desirable. In the third or Solo organ, I think a concert violin, 8ft., would be preferable to the violin of 4ft. pitch, as inserted. One always associates the violin with the unison pitch. The violoncello inserted should be voiced of a much broader tone than the concert or solo violin. The octave viol should find its place amidst the viols (I do not like the term "gamba" where it can be got rid of) in the string-toned forces of the second organ, as suggested above. But, really, in connection with a scheme which displays so much thought and artistic conception in so many ways, it seems unnecessary to be hypercritical, and I hope Mr. Dixon will not consider my remarks captious. I congratulate him on the scheme for the Pedal organ, and especially in his attention to its powers of expression. This is certainly a step in the right direction.

The free reed (saxophone) in my own chamber organ is satisfactory in every sense of the word; and for a chamber organ so delicately voiced as mine, it is infinitely more refined and charming than any 16ft. striking reed stop known to me. The great drawback to such stops is the difficulty which attends their construction and voicing. The reeds in my saxophone, with their tuning appliances attached, are as highly finished as the brass-work of a microscope. No organ workshop in England knows work of this high standard. "It would not pay," I have been told. Alas for art!

G. A. Audsley.

Devon Nook, Chiswick, April 6.

ORGAN MATTERS—CORRECTIONS.

[29832.]—Allow me to correct some mistakes which appeared in my letter last week (29806, p. 114), and if not corrected read as nonsense.

On p. 114, second column, lines 16 and 17 from top, for "and with with Mr. Robinson" read "and with Mr. Robinson." In the same column, line 40, for "First Manual [Great]" read "First Manual [Lowest]." In the third column, line 2 from top, for "No. 3 Swell (back) chamber" read "No. 3 Swell chamber (back)." In the same column, line 34, for "piges" read "pipes." In lines 48 and 49, for "row above.

THIRD MANUAL."

read "row above Third Manual." In lines 59 and 60, for "department swell-box, combination levers." read "department swell-box.

Combination Levers."

G. Dixon.

Bradfield College, Berks, April 7.

Anthropotoxine.—The noxious effect of air in places where many persons have been breathing has been attributed hitherto to carbonic acid. Recent experiments, conducted by capable observers, would seem to show that this is an error. It has been found that air copiously impregnated with pure carbonic acid can be breathed with absolute impunity, but that air spoiled by the breathing of human beings contains small quantities of one or several extremely poisonous substances, which Dubois-Reymond calls human poison, or anthropotoxine, and to which alone the noxiousness of air in unventilated rooms is due. The most recent experiments of French *savants* show that these poisons come from the lungs. This fact was most strikingly proved by purifiying, by means of sulphuric acid, air exhaled by animals, which acid absorbs the lung poisons, but leaves the carbonic acid quite unchanged. The air thus purified was breathed without injurious effects, whereas the unpurified air invariably caused the death of the animal which inhaled it. The fact that one can deprive exhaled air of its noxious effect by means of alkalies, which absorb the carbonic acid, is no proof of the poisonousness of the latter gas, for the alkalies cleanse the air from lung poisons too.—*Lancet.*

At a recent meeting of the Paris Academy of Sciences a paper was read on "The Employment of Sulphite of Sodium for Developing the Picture in Photography," by M. Paul Poiré. Numerous experiments carried out by the author with a solution of sulphite of sodium and pyrogallic acid as a developing bath, show that the best results are obtained when the sulphite is in the proportion of 25 per cent. with 1·5 gramme of pyrogallic acid added. The development is slower, but more intense and clearer than when the sulphite contains carbonate, and the bath may be used repeatedly and preserved for months in corked bottles.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67559.]—**Bisulphate of Potash in Leclanche Cell.**—Thanks for particulars given. I quite agree with you—it increases the force; but I think it is a mistake to put so much in each cell. From watching the results in my own cells the zincs appear to be acted on in a peculiar manner—in fact, dissolve more rapidly in the presence of the bisulphate; besides, I think it throws down the salammoniac in long crystals at the bottom of the jar, and these seem to be insoluble. By the way, I notice most books on chemicals say the bisulphate is but sparingly soluble in water; at any rate, I have just refreshed my six cells with a clean salammoniac solution, and I shall not add any bisulphate until they get sluggish again. At some future time shall be glad to hear from you on same subject.

F.R.MET.SOC.

[67862.]—**Distribution of Weight.**—I think "T. C." is wrong in saying, "The weight will be carried by each support inversely as its distance from W." This will not be the case unless the lines of distance form equal angles among themselves at W, which they do not in this case. Take for example an extreme case. Suppose a weight, W, is in the centre of a circular plane resting on six supports at its circumference, five of which are very near both to each other and to one extremity of a diameter, and the sixth is at the other extremity of the same diameter. Will "T. C." say that the last support bears only one-sixth of the weight? Unless I am wrong, it will bear more nearly half.

ANOTHER DOCTOR.

[67862.]—**Distribution of. Weight.**—In this problem the reactions at the supports may be considered as a system of parallel forces. Taking the figures in "T. C.'s" reply (on p. 116), the resultant of the reactions at A, D, B, and B^1 will equal $\left(\frac{4}{3} + \frac{2}{\sqrt{3}}\right) x$ and pass through W. If there were no other points of support, this resultant, meeting an equal and opposite force at W, namely, the weight, would produce equilibrium; but the reactions at C and C^1 will have a resultant at a point E, midway between them, equal to $\frac{2}{\sqrt{7}} x$, so that the resultant of all the reactions would not pass through W, but through a point through W and D, and there would not be equilibrium. An infinite number of systems of parallel forces acting at the six supports have their resultants passing through W. Is the problem indeterminate, assuming that the plane on which the weight rests is perfectly rigid, weightless, and transmits force equally in all directions?

W. J. A.

[67904.]—**Round-faced Hammer.**—"Ohmi," in his reply to "L.," does not seem to know that a round-faced hammer—that is, a hammer with its face a good sixteenth of an inch rounding—is the best for driving nails. If he doubts it, he can try the experiment with two hammers, one round and the other flat-faced. I never knew a carpenter to choose a flat-faced hammer in buying one.

CARPENTER.

[67934.]—**Wire Ropes and Cables.**—Of course there are tables published for calculating the breaking strains of iron, steel, &c., wires; but when the querist asks for a formula to determine the "proper lays" in wire ropes, he must be told that he is not likely to get that except from patent specifications, the subject of wire cables and ropes being an attractive one to inventors and patentees. There is a table in Molesworth's pocket-book which may be useful.

J. T.

[67935.]—**Flues.**—The area of a chimney at the top in square inches should equal fifteen times the quantity of coal consumed per hour in pounds divided by the square root of the height of the chimney in feet. Thus, supposing 15lb. of coal are consumed per hour, and the chimney is, say, 20ft. high—that will be 15 divided by 4·5, or, say, 5, and make the area of the flue at the top rather more than 3sq.in. A pipe 50ft. high would need to be only a little more than 2sq.in. in area. A pipe 9in. in diameter has an area of 64in.

SWEEP.

[67942.]—**Accumulators.**—Full directions for making accumulators of various patterns have been given in, I should think, many back numbers, but at any rate in some. See the index to the last volume, for instance.

X.

[67943.]—**Parallel Vices.**—The instantaneous grip vices, or some of them at least, are quite serviceable, and if the querist had to work at one from week to week and year to year, he would understand that the saving in time is considerable. Several good patterns have been illustrated in back volumes, I know; but any large tool dealer can show a few.

M. C.

[67930.]—**Bicycle Cranks.**—"G. K." will probably find the following sketches suit his purpose: No. 1, suitable for a repairing shop, and will fit any size crank. H H, hubs; S, shaft; B, bearings; C C, crank. No. 2 is a simpler one that is easily made, and will suit an amateur. H H, hubs; B B, bearings; N N, nut. These sketches clearly show that if the tool be properly made it will take hold of crank without injury to same.

Tyneside. T. M.

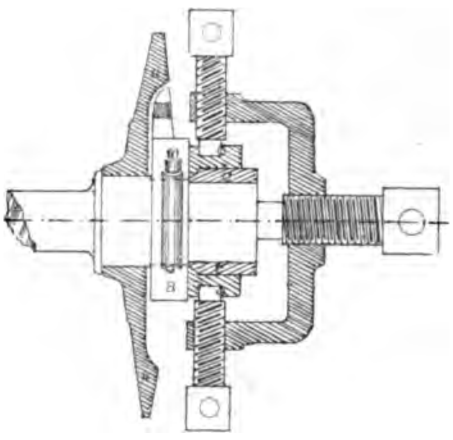


FIG. 1

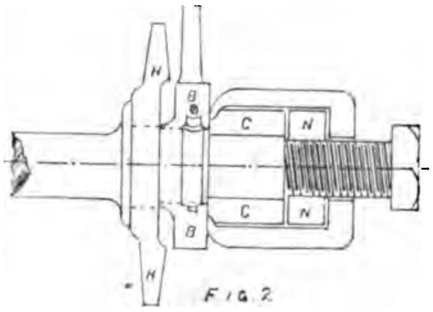


FIG. 2

[67969.]—**Oak Polishing.**—Fill up the grain with whiting and water or plaster of Paris stained to suit, and then French polish, or go over with varnish or oil.

R. S.

[67971.]—**Rhea Fibre.**—This fibre is the subject of a valuable prize offered for means of working it. Some information will be found in back volumes; but perhaps not so much as might have been given. It is scarcely a subject of popular interest, and those who are acquainted with the facts are quite capable of finding out all that is available.

C. M.

[67976.]—**Small Vertical Engine.**—The querist can find designs of such an engine as he describes in many of the catalogues, and certainly in back volumes.

P. T.

[67984.] — **Forming Accumulators.** — This query has been answered many times in a general form, but it is scarcely likely that "One in a Fix" is aware of how easy it is for him to get out of it by referring to back Nos.

N. T.

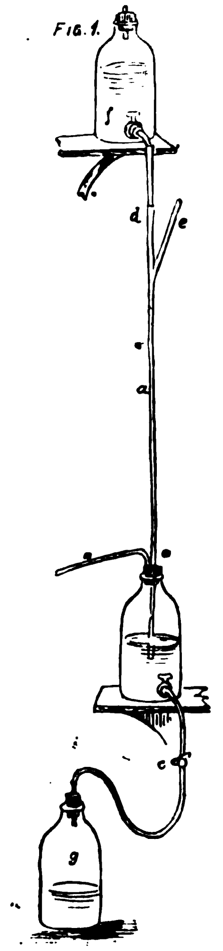
[67988.]—**Whalebone Cutter.**—To split whalebone, a tool something like a spokeshave is used. No difficulty to anyone who really tries.

C. M.

[67992.] — **Water Blower: Action of Sprengel's Blowpipe.** — Suppose the central bottle or regulator (of one gallon capacity) to be half-full of water, so as to cover the lower end of the pipe *a*, the bottle *f* to be full of water, and the bottle *g* to be empty. Then, if you open the stopcock between *f* and *d*, the water runs from *f* into the regulator, and thence into the bottle *g*. By a proper adjustment of the clamp *c*, the water can be made to run from the regulator into *g* as fast as it runs from *f* into the regulator, so that the water in the regulator remains nearly the same level. When this is the case, air enters by the tube *e*, bubbles up through the water in the regulator, and escapes by the tube *b*. If the flow of the water is well regulated by the stopcock *d* and the clamp *c*, this current of air is quite regular, and sufficiently powerful for most blowpipe experiments. To use it, the blowpipe is simply attached to the caoutchouc tube, which is connected with the bent tube *b*. It serves for most of the mouth blowpipes and for the gas blowpipes. If the water passes out of the regulator less rapidly than it passes into it, the pressure of the air is increased, but the gain of power is only of short duration, because the regulator then rapidly fills with water. When the water has all run from *f* into *g*, the bottles *f* and *g* must be made to change places. The bottle *g* is provided with a neck and stopcock that are not represented in the figure.

AQUARIUS.

FIG. 1.



[68062.] — **Wheel-Cutting.** — **Errata.** — For "slide-rest screw moves thrice" read "slide-rest screw moves twice."

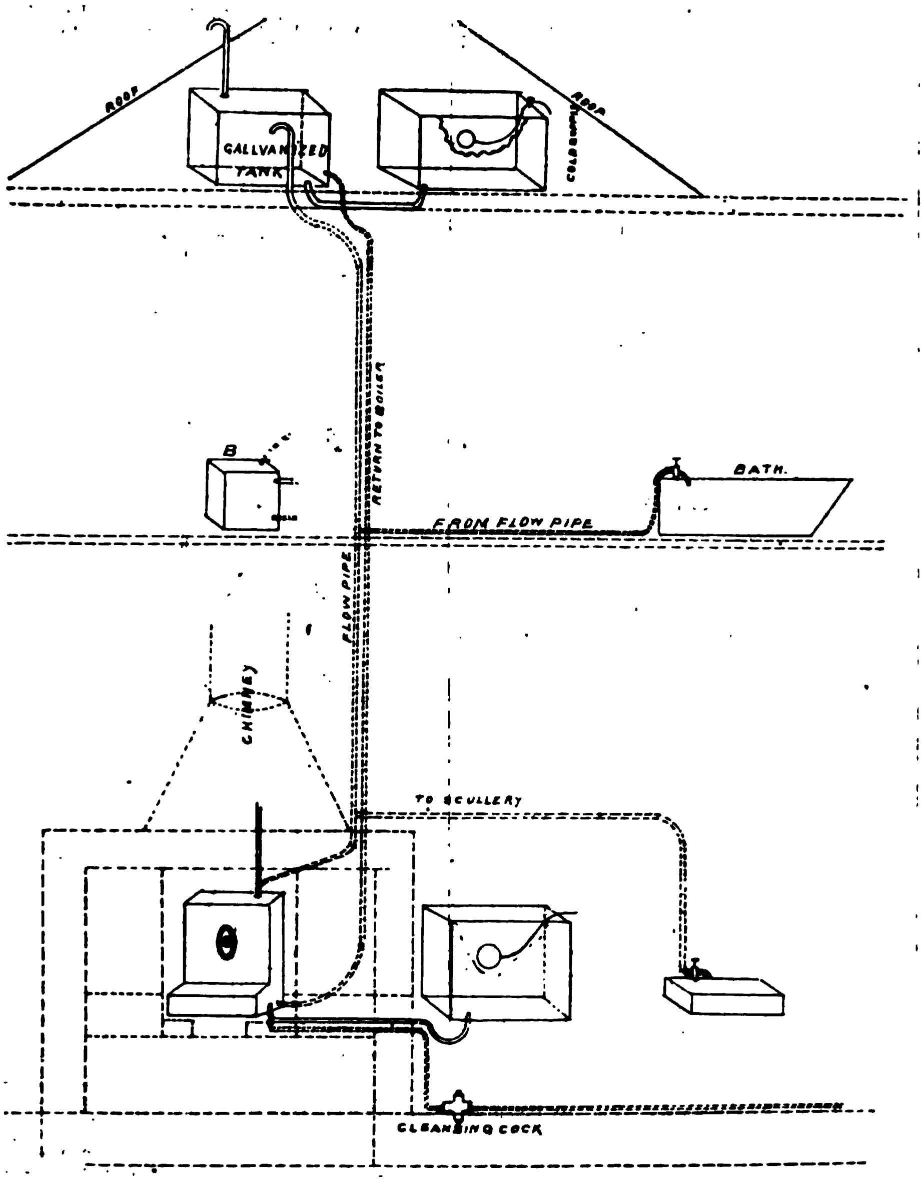
P. B.

[68062.]—**Wheel-Cutting.** — J. Wheelwright may be interested in a description of a simple device fitted to a 5in. engineer's lathe in my possession. It consists of a detent engaging into any wheel that may be on the lead screw in a manner analogous to the index used with a division-plate. It embodies all the convenience of a division-plate, has much greater range than most plates, and is accurate in its divisions. For a small number of divisions, as frequently required in mechanical or ornamental work, it can be employed with any screw-cutting train that happens to be in gear. By special setting it will divide by any number (including the primes) up to 28; above that, any number except primes up to 100. The highest number of divisions it will make is 450; to detail all the intermediate numbers would be tedious. When in use, the faces of the teeth must be kept in contact. For marking off or drilling work on face-plate, the left hand of the workman applied to mandrel pulley is sufficient. For fluting or wheel-cutting it is preferable to accomplish this by a cord coiled round the mandrel pulley, and passed over a sheave in the ceiling, a weight being attached to the cord.

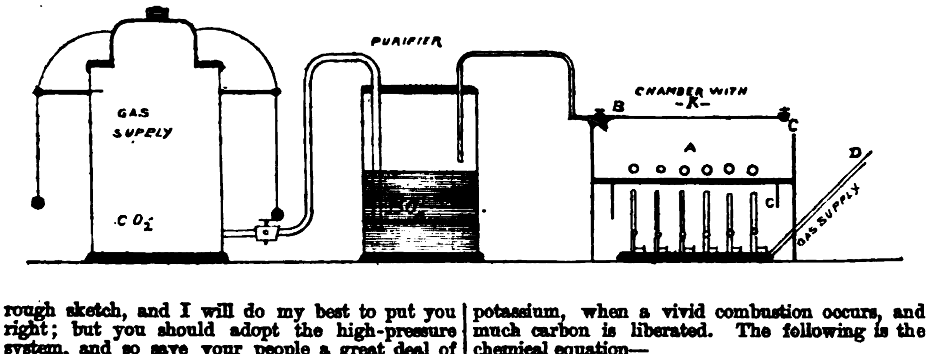
R. R. N.

[68147.]—**Photo. Enlarging Apparatus.**—The 40 or 50 candle-power Argand paraffin burners I referred to are 1⅛in. in diameter, with plenty of provision for a current of air to go up the centre. Martin (I don't know his address, but most ironmongers keep his lamps) makes one of this class, the peculiarity of which is that there are two concentric wicks. The lamps used by the Trinity House for lightships are of this description and of 50 candle-power. Mr. Harrison spoke of them at the L. and P.P.A. meeting on March 21st. Another burner is the "Rochester," an American production on sale in England. The cheapest form, however, is the common "Kosmos" of the largest size. Catterson, Newington-causeway, S.E., sells the "Kosmos" lamps wholesale, and doubtless you can get a burner there of the 14-line size or larger for a couple of shillings, the price they are sold at in Germany.

Plymouth. B.Sc.



[68909.]—**Kitchen Boiler.**—You will find the sketch below a plain and simple method of utilising your boot boiler as a high-pressure one (which, being $\frac{6}{16}$in. in thickness, is amply sufficient in strength for the purpose you require), and will give you a constant supply of hot water in every part of the house if desired. In place of having the hot-water tank in attics as shown, you could put it in any recess of landing or lobby, and so use it as a heating power for same, provided it is above boiler level (see B). Say if sketch as shown is something like its present state, and if not, kindly make a rough sketch, and I will do my best to put you right; but you should adopt the high-pressure system, and so save your people a great deal of labour. If boiler is put in, as you say, with siphon, it has not a large enough steam-pipe, or may be choked with soot or grit. JOHN MAXWELL.



[68016.]—**Carbon.**—"Leeds" will find the following method a good one. Carbon is obtained from CO_2 by means of burning potassium or sodium in a current of CO_2, which then forms in the case of potassium, carbonate of potash and carbon. The following is the chemical equation represented by the change—

$$3CO_2 + K_2 = 2(KO . CO_2) + C.$$

To obtain 1lb. of this fine carbon we should require 104oz. of potassium and 176oz. of carbonic acid, so that "Leeds" will see it is rather a tedious and expensive affair. The sketch will explain. The potassium is put in the holder A, and the carbonic-acid gas is passed through a purifier containing strong H_2SO_4; the gas is then allowed to flow over the potassium, the gas at C is then turned on at C, the metal potassium then burns in the carbonic-acid gas, robbing it of its oxygen, liberating the carbon in the form of a fine dust; this is then found on the roof of A. But about the best method to use is put in A alternate slices of sodium and chalk (carbonate of lime $CaOCO_2$); this is then treated the same as for potassium, when a vivid combustion occurs, and much carbon is liberated. The following is the chemical equation—

$$CaOCO_2 + Na_2 = CaO + 2NaO + C.$$

To obtain 1lb. of this carbon it will require 74·66oz. of sodium, and 133·33gr. of chalk, so that "Leeds" will see that it is hardly a commercial success. Any further information "Leeds" may require I shall be very pleased to give. F. W. MASON.

[68077.]—**Water-wheel.**—I cannot get at the quantity of water from the data you give. Apparently your wheel is what I have always called a "low breast" one. Now, these wheels are essentially dependent on the pressure (or weight) of water, as distinguished from the "undershot" type, which depends on "impulse." In this latter class, the results of many experiments on a large scale (and with actual wheels) by the Rennies and Smeaton, show that the wheel-floats should have a mean velocity = 55 per cent. of velocity of water under the wheel—i.e., if N = revolutions of wheel per minute, h = head of water above wheel in feet; R = mean radius of wheel (i.e., inside of floats + $\frac{1}{2}$ depth of floats), then, $N = \frac{0·55 \times (8\sqrt{h})}{2\pi R}$; of course, this is an ideal case which cannot be realised in practice, as it takes no account of the loss of velocity due to resistance in channel; but this depends on so many causes that cannot be represented in a formula except by "x." Now, in the case of the breast wheel, taking an ideal case, there is no leakage past the wheel, except what is discharged from it at the lowest point by the buckets uncovering the step. That being so, the cubical capacity of the buckets × by their mean velocity is a measure of the water passing; in other words, given a wheel having buckets of a given capacity, then the number filled per minute will obviously depend on the quantity of water supplied; for instance, if we have 60c.ft. of water at our disposal per minute, and our buckets each have a capacity of 1c.ft., then 60 buckets can pass per minute, and if we have 30 buckets on the wheel, revolutions = 2 per minute. In your own case, presuming that the head of water above the sill of gate (I suppose from your description it is a falling hatch) is 22in. taken well back from the gate, then $v = 8\sqrt{1·833\text{ft.}} = 10·9$ft. per second, about. Now the area of opening = 1·833ft. × 8·5ft = say, 14·5sq.ft., which must be multiplied by a coefficient to get the mean area of the stream flowing through the opening (you can see what I mean by watching the water running out of a hole in the bottom of a nearly empty cistern); this = say, 0·7, or mean area = 14·5 × 0·7 = say, 10sq.ft., and cubical contents of stream flowing out per second = 10 × 10·9 = 109c.ft. per second; and since this quantity falls 6ft., the work in foot-pounds per second = 109 × 62·5 × 6 = about 41,000ft.-lb. per second; and as one "horse-power" = 550ft.-lb. per second, we have 41,000 ÷ 550 = say, 74·5 horse-power, theoretically; but since leakage past the wheel and various other causes reduce this to about 60 per cent. of theoretical power, we have, say, 45 horse-power as a maximum. Therefore, all things considered, I should certainly advise you to increase the speed to 16 revolutions per minute, always considering that the estimate of quantity of water I have given above is correct;—that is for you to decide. Shall be pleased to help you further in any way possible.

Govan. ENGINEER.

[68116.]—**Dynamic.**—The time in falling 4ft. vertically will be $\sqrt{\frac{2s}{g}}$ seconds $= \sqrt{\frac{2 \times 4}{32}} = \frac{1}{2}$ second, so we require a velocity that will project it 19ft. in that time or 38ft. per second. We may neglect the small amount of friction for the remaining 3ft. it travels along the plane, and then the problem is simply, what force must be applied to generate a velocity of 38ft. per second in 3ft.? The formula $V^2 = 2fs$, or $f = \frac{V^2}{2s}$ works out = 241, or, say, 8 times the force of gravity to be applied to the weight of 1lb. This would absorb $\frac{8 \times 3 \times 6 \times 60}{33,000}$ = at the rate of nearly $\frac{1}{4}$H.P. for the time it acts, viz., $\frac{1}{8}$ second.

Bristol. T. C.,

[68126.]—**Paris Exhibition.** — What does "Tourist" want to pay in Paris? I can tell him, if he wishes, of at least a dozen "pensions" and hotel-pensions, where he would obtain board and lodging for 7 to 10fr. (5s. 6d. to 8s.) a day, and I doubt very much whether he will manage to get anything cheaper than that, as it includes everything but wine and lights. I know Paris very fairly well, and I do not think I myself could do it for less. As to the advice of "Pekin," that "Tourist" should conceal his nationality, I fancy that would be impossible, as the English accent, even when the speaker knows French very well, is too well known to French ears. If "Tourist" takes a "chambre garnie," he will, as "Pekin" says, pay 3·50fr. a day for room and attendance, which leaves him (comparing pension prices) 3·50fr., or 2s. 9d., out of which to provide all his meals. If, however, he still wishes to adhere to this plan, he had better advertise in one of the best-known Paris papers, such as the *Petit Journal*; and if he likes to write to me, No. 28, Avenue d'Jéna, Paris, I will send him one or two papers which may help him. JAKL.

[68157.]—**Cup and Ball Microphone.**—Many thanks to "W. G." and also to Mr. Bottone for their replies. I have made ball larger, as suggested by "W. G.," but am sorry to say with no improvement. Would it be too much to ask "W. G." to kindly look at one of the microphones and receivers as he has got his at work? I should be extremely thankful and would gladly send them. In anticipation have given my name and address in the proper column. INKPOT.

[68171.]—**Brown Tiles.**—Mix about $\frac{1}{10}$ part of Blackwell's prepared oxide of manganese for tiles with your red clay. Dip the tiles direct from the moulder before pressing. Try a small quantity, varying the manganese oxide until you obtain the required colour. If "Thirteen Years' Subscriber" will advertise his address, I will give more particulars.
MANGANESE.

[68181.]—**Mechanics.**—In my answer to this interesting question (see "E. M.," March 29), in order that the expression for t should in all cases be positive, I ought to have placed the sign ± before the second, instead of the first, of the two quantities within brackets. Thus:—

$$t = w h \left(1 \pm \frac{2x + a}{l}\right) \quad \ldots\ldots\ldots\ldots\ldots (b).$$

The numerical value of t is unaffected by the change, and, as before, the double sign is positive for points on the ascending, and negative for those on the descending lap. Supposing the point P to be on the descending lap, and that the chain is in its initial position, so that $x = 0$, the formula will be found to agree with the formulæ of "Latris" and "Dubliniensis," which apply to this case only. The tension at a point on the ascending lap increases with x, and is a maximum when that point crosses the smooth point over which the chain is hung. When P reaches that position, h is the length of the ascending, and $l - h$ that of the descending lap, and $x = \frac{l - a}{2} - h$. This value of x, substituted in (b), gives—

$$t = \frac{2 w h}{l} (l - h) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (c).$$

Since this expression does not contain a, it follows that the tension at the point of support is independent of the velocity of the chain.
Charing. J. R. C.

[68218.]—**Bicycle.**—As there are two different replies on p. 119, to this query, may I say that I make the number of revs. 52·3, as "Fuzz" states?
B. H.

[68229.]—**Electric Indicator.**—Don't limewash your wires; if you do you will certainly destroy cotton covering, and unless the insulation is perfect you will possibly destroy the wire.
GENT AND CO.

[68229.]—**Electric Indicator.**—Perhaps your galvanometer is wound with two coils, one of coarse wire for quantity, the other of very fine wire for intensity. If you put the coarse wire in circuit the bell ought to ring; but if you put the fine wire in circuit the resistance will probably be too great to allow the cores of the bell magnet being sufficiently magnetised to attract the armature away from the contact-pillar. If you wish to test for a "short circuit" you should connect one terminal of the galvanometer to the battery and the other to the free end of line wire, using the coarse wire of galvanometer. I do not think the whitewash or paper will do much harm to the line wires so long as they are "under separate staples"; but it would be much better to have I.R. covered wires instead of plain cotton.
Forest-hill. J. MINUTO, Electrician.

[68231.]—**Injection of Petroleum into Steam Pipes.**—"E. C. U." can mix petroleum with his exhaust steam by having over his exhaust-pipe a vessel sufficiently strong to withstand the pressure of steam to contain the supply of oil, connected separately at top and bottom with stopcocks between to exhaust pipe, with another tap at top of vessel for filling. When the vessel is filled with oil, turn on both cocks so as to get equal pressure above and below, and the oil will flow into exhaust pipe of its own weight.
Bolton. T. S.

[68233.]—**Bell.**—No. 30 wire is too fine. You should use No. 26 or 24. Also, if you used ¾ cores about 2in. long, you would get better results than with ¼ cores. If you mean that the hammer-head itself weighs 1¼oz., that is too heavy, judging by the size of gong on your sketch. Try ¼oz. The connections, as shown in your left-hand sketch, are preferable to those on the right hand. Do not forget to "point" the tips of your spring and contact screw with platinum wire. Seven layers of wire on each bobbin will be sufficient, and the two Leclanchés ought to ring your bell on any ordinary house circuit. When connecting up, join the two inside ends of your coils.
Forest Hill. J. MINUTO, Electrician.

[68235.] — **Engine Query.** — To "T. C., BRISTOL."—Thanks for your notice of my query. What I want to know is, how many pounds' weight of steam the diagrams show to be used per I.H.P. per hour?—as we have an engine which the insurance company tell us is using 22lb. of steam per hour, so would be very glad if you would draw a diagram, showing the method of getting the weight of steam used; also the amount of heat used as a heat engine; also the weight of water passing through the cylinder per I.H.P. per hour. In measuring the quantity of steam used, is the l.p. cylinder taken into account, as it is the steam from the h.p. cylinder? Would be glad if you could tell in plain figures, as your first reply.
YOUNG ENGINEMAN.

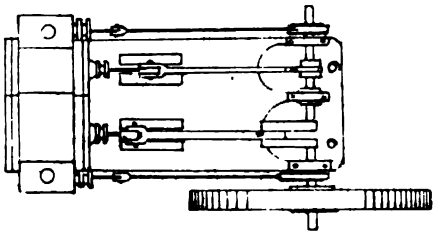
[68239.]—**Lifting Water.**—

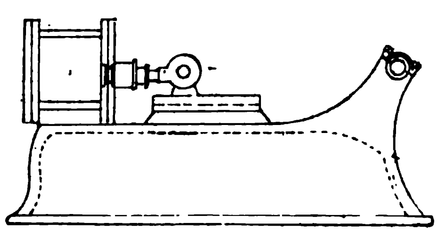
Diam. of cyl.	Diam. of pump.	Steam, 30lb.		35lb.		40lb.		50lb.	
		G	H	G	H	G	H	G	H
4	2	700	120	650	140	600	160	500	200

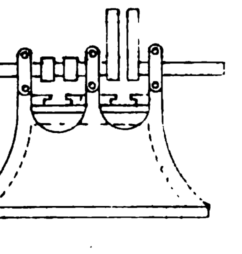
Stroke 6in.

The above is an extract from a table of a firm of eminent pump-makers, and which may be of service. Diam. of suction and delivery pipes, 1¼in. In the table G = number of gallons per hour, and H = vertical height in feet.
Longsight. J. STOKES.

[68251.]—**Horizontal Engine.**—Crank-shaft, ⅝in. in bearings; cranks, ⅝in. between webs; webs, ½in. thick; crank-pins, ⅝in.; h.p. piston-rod, ¼; l.p. piston-rod, ⅜; ports, h.p., ⅝ by $\frac{5}{32}$; l.p. ports, 1¼ by $\frac{5}{32}$; lap on each, $\frac{1}{16}$; travel, $\frac{9}{16}$; crosshead with slippers; thickness of frame, ½in., cored as dotted, and with plummer blocks cast on. Carry exhaust from h.p. to l.p. either above or below, as suits you best. Flywheel, 12in. diameter by 1¼in. wide and ⅜in. thick, for use more as a driving pulley than flywheel. Above will do for wall engine or horizontal. Scale ⅛ size.
Bristol. T. C.







[68266.]—**Parchment Paper.**—One way of preparing parchment paper is by dipping ordinary unsized paper for five or six seconds in diluted sulphuric acid, and then washing with extremely weak ammonia; but whether this would answer the purpose for the cyclostyle is for "Experimenter" to try.
LUCY GLITTERS.

[68271.]—**Manganese and Carbon Battery Plates.**—If "Student" will communicate with me, I shall be glad to correspond with him on the above subject. GEO. G. BLACKWELL.
Carbon Plate Manufacturer, Liverpool.

[68271.]—**Manganese and Carbon Battery Plates.**—These are composed of: carbon, 55 parts; manganese dioxide, 40 parts; and shellac, 5 parts. They are powdered, thoroughly mixed, and forced into steel moulds at a temperature of 100° C., and under a pressure of 300 atmospheres.
PRINCIPIA.

[68271.]—**Manganese and Carbon Battery Plates.**—Take manganese dioxide 40 parts, powdered gas carbon 55 parts, gum-lac resin 5 parts. This mixture is to be placed in steel moulds around the solid carbon core, and subjected at one and the same time to a temperature of 212° Fahr., and a pressure of 4,500lb. to the square inch. See my book, "Electric Bells," pp. 38 and 39, for further details. S. BOTTONE.

[68272.] — **Engine Speed.** — As the beam, draught, and tonnage are not given, I can only assume the following:—Beam 5ft., draught 18in., coefficient of fineness $\frac{6}{10}$. With these you would get about six miles an hour. Diameter of propeller 18in., pitch 2ft. McGILL.

[68273.]—**Dynamo.**—To MR. BOTTONE.—This must be shunt wound, and of low resistance. Put about 4oz. No. 16 on the armature, and 5 or 6lb. of the same gauge wire on the F.M.'s.
S. BOTTONE.

[68275.]—**Loco. Boiler.**—Our friend, "J. H.," will soon describe the boiler for the "loco." which will just about suit you. The following may suit you:—Barrel, 15in. by 8in.; firebox—outer, 8in. by 8in.; inner, 6½in. by 6½in.; five tubes, 1½in. diam. Of course, you can put in more tubes if you like, but I do not think you will benefit by more.
Bristol. T. C.

[68276.]—**Medical Battery.**—26 quart cells will not do so well as 40 pints, because 26 quarts only have an E.M.F. of 26 × 1·5, while 40 pints have an E.M.F. of 40 × 1·5, and that is what is required to pass the skin. Leclanchés are most convenient. S. BOTTONE.

[68278.]—**Faulty Watch.**—There is a pin in the balance of the Geneva watch, which banks against some part of the balance cock to prevent it making more than a whole turn. This pin must have come out in your watch, so that while a tooth was resting on the outside of the entrance lip, it has got fixed in the exit lip of the cylinder.
CHARLES A. JONES.

[68283.]—**Railway Shunting.**—It is hardly possible to answer this query satisfactorily, as "Antares" does not state either the train whose manœuvres perplex him or whether the L.N.W. or G.W. is the responsible company. Perhaps the additional coaches come from some other place as a separate train, which would account for the position of their engine. In some cases a leading engine is removed by means of a crossover road in the middle of the station, as at Rugby or Derby.
Uttoxeter. N. S. R.

[68284.]—**Battery Cell.**—To MR. BOTTONE.—Generally speaking, an increase in the size of the cell gives increased battery power, but not to the extent in the increase of size. The reason for this is that most batteries begin to polarise long before the acids and zincs are actually used up. This polarisation takes place just as much when the cell is large as when it is small. As to the ampères, if you double the solution, so as to double the surface of active negative, you also double the ampères.
S. BOTTONE.

[68285.]—**Obeeyahism.**—The "facts" quoted by "J. N. O." are but a few of many described from time to time in newspapers and periodicals by Europeans resident or travelling in that part of the world commonly called "the East," with every appearance of good faith. At all events, it is intolerant to dismiss with a smile the more daring flights of "Indian jugglery," and such phenomena as these are receiving their due share of attention at the hands of the Psychical Society. The matter is altogether one for specialists, and in this respect it is very satisfactory to note the impetus which has recently been given to the investigation of hypnotism in a scientific manner in England and France, and the sifting and testing of "well-founded ghost stories," both by the above named society and by Mr. Andrew Lang from the historical standpoint. That the whole matter of Eastern "manifestations" is one presenting great difficulties, of absorbing interest, and probably of great physiological importance, I know myself, as it happens, from a partial knowledge of the work of a careful investigator therein. The whole subject, treated scientifically, has as yet hardly given rise to books on the subject, and the workers are properly rather reticent for the present on what is obviously unripe for dogmatic statement, reliable investigation being of such recent date.
Uttoxeter. N. S. R.

[68286.]—**Photographic.**—Why the gold and silver chlorides precipitated on the addition of sulphuric acid, I don't know. A very acid solution of gold chloride neutralised with chalk will not tone prints; and, furthermore, the colour of the solution can hardly be depended on, even at a guess, as a measure of the amount of gold in solution. If you have a mixture of silver chloride and metallic gold, proceed as follows:—Wash the mixture with ammonia (which will dissolve out the silver halogen); then make a mixture of three volumes of hydrochloric acid and one of nitric acid, and add this to the gold, drop by drop, until it is all dissolved, which is best performed by the aid of a test-tube and spirit-lamp. Now, when all the gold is dissolved, pour the solution into a small evaporating dish (or large watch-glass), and evaporate to dryness in a water-bath; or, failing this, place it about 6in. or 8in. above the flame of the spirit-lamp, or a candle, and let it slowly evaporate; when dry wet it with diluted hydrochloric acid (1 : 2), and again evaporate to dryness; after which repeat the process with water, and you will then have a solution of neutral gold chloride. By first weighing the gold, and calculating for every grain 2gr. of chloride, you can dissolve as above, and make up in solution. Principia.

[68288.]—**Legal.**—If A. or his descendants repurchase this land, the restriction is gone, and the slaughter-house can be set up—with, of course, the kind permission of the sanitary authorities.

B. H.

[68288.]—**Legal.**—If A. made the restriction, if no adjoining property is under the same restriction, and if it did not exist in A.'s title received from his predecessor, then, of course, A. or his heirs can give their consent to a withdrawal of it whether the property is in the hands of B. or is bought back by A. or his heirs. In other circumstances the answer to the query is No.

Plymouth. B.Sc. and N.P.

[68294.]—**Small Electro-Motor.**—Say what work you want motor for. If your H pattern armature motor is very small you might get it to go round with four or six Leclanché cells; but a Manchester-type motor to work with one Leclanché cell and to do work, would want a lot of designing.

Phos.

[68296.] — **A Sensitive Galvanometer.**—I recently saw a handy little instrument, which was obtained from Messrs. King, Mendham, and Co., which would measure weak currents in the manner described by Geo. Kelman. It measured from 25 to 1,000 milli-ampères, and if one was required to measure smaller currents, no doubt that firm could supply such an instrument, if applied to. F. L.

[68297.]—**Telephone.**—Shall be pleased to send "G. T." a couple of ferrotype plates, if he will let me know his address.

Birkbeck-road, Leytonstone. J. B. Seymour.

[68297.]—**Telephone.**—To Mr. Bottone.—If you cut the bottoms out of some old Swiss milk tins, you will find these (provided you don't buckle them) nearly equal to ferrotype plates. If the depth of your box is such as not to take bobbins 1in. deep, there is no reason why you should not make them narrower. S. Bottone.

[68298.]—**Horse-Power.**—As usual, the actual point of cut-off to the cylinders is not given, so it is impossible to hit anywhere near the actual power by 30 per cent.

Bristol. T. C.

[68298.]—**Horse-Power.**—You don't give mean pressure or cut-off. Assuming mean pressure in h.p. cylinder at 27lb., and in l.p. cylinder 10lb., each cylinder would indicate 26 horse-power. With the non-condensing, assuming you cut-off at $\frac{3}{10}$ of stroke, the mean pressure would equal 22 at 20 revolutions, horse-power equal 100. McGill.

[68299.]—**Painting on Silk.**—Try sizing the silk with a solution of gelatine in water, say 20gr. to an ounce of water. Principia.

[68299.]—**Painting on Silk.** — Put on first colours mixed with body colour; but water-colours never look well on silk or satin, always chalky. Better use oil colours and Tuck's florentine medium.

Phos.

[68299.]—**Painting on Silk.**—I have painted designs on silk and satin with water-colours very successfully. I simply mix the colours up with a medium sold for the purpose; the one I am using now is called "Veloutine painting medium," sold by Raphael Tuck and Sons. There are others that answer just as well, though the secret is to mix all the colours up with Chinese white, which gives them body, and to a great extent prevents the colours running on the silk or satin. Inkpot.

[68300.]—**Mercurial Pressure-Gauge**—Will faithfully record the height in tank if a separate 1in. pipe is brought to the gauge from tank. The tube U, either of glass or of steel, 10ft. to bottom of U.

Bristol. T. C.

[68302.]—**Boring Wheel.**—Quite possible under a boring machine; or if you have a lot of patience and muscle, rig up a guide above and below the wheel, all of which must be rigidly fixed, and put a boring-bar and cutter through guides, and work bar with a ratchet-brace.

Bristol. T. C.

[68303.]—**Siemens Dynamo Construction.**—To Mr. Bottone.—With the following provisos, the same rules are applicable for the Siemens H as for the Gramme. 1. The resistance of the wire on the armature is directly proportional to its length, and not to the quarter of its length, as in the Gramme. 2. All the wire, except that at the turnings at the ends of the armature, is active, so you can generally get rather more than 1 volt per yard.

S. Bottone.

[68305.]—**Dynamo.**—To Mr. Bottone.—Field-magnets about 3in. diameter, 7in. long, armature, 6in. diameter, 4in. deep; 12 or 16 sections; speed about 1,500 revs. per minute; size of shaft, 1in. diameter. If you want to run ten 20's at 50 volts, your dynamo should give, say, 12 ampères at 55 volts pressure. S. Bottone.

[68308.]—**Cement for Pushes.**—They are probably made of gypsum (alabaster) turned in the lathe, in which case use thin plaster of Paris mixture. Principia.

[68314.]—**Wire on Coils.**—Messrs. King, Mendham, and Co.'s formula is this—"Formula for obtaining total length (b) of wire on an electro-magnet, where T = thickness of coils, L = length of coil, D = diameter of core outside insulation, d = diameter of wire in inches, including insulation,

$$b = \frac{T + D\ 3{\cdot}14 \times L \times T}{d^2}.$$

B. H.

[68314.]—**Wire on Coils.**—The formula you require, for calculating the total length (b) of wire on a circular bobbin, is—

$$b = \frac{L\ 3{\cdot}14}{4\,d^2}\,(A^2 - a^2)$$

Where—

L = length of bobbin.

d = diameter of wire in inches, including insulation.

A = outer diameter of bobbin.

a = inner diameter of bobbin.

Where you don't understand this, ask again, and I will show you another manner, longer perhaps, but not requiring a knowledge of arithmetical signs.

S. Bottone.

[68315.]—**Plates for Wimshurst.**—To Mr. Bottone.—Window glass, if fairly flat, as some of the so-called "crystal sheet" is, is better than plate glass, as the skin of the melted surface is better as an insulator than the softer polished surface of the plate glass. S. Bottone.

[68316.]—**Measuring Wind Velocity.**—A proper reply to this would take columns. The querist will do well to refer to page 130 Buchan's "Textbook of Meteorology," where the method is given of estimating the velocity by Robinson's anemometer; also the *Quarterly Journal* of the Met.Soc. for July, 1874. Mr. Scott's lecture on "An Attempt to Establish a Relation between the Velocity of Wind and its Force," and same journal for October, 1881, "Comparison of Robinson's and Osler's Anemometers, with Remarks on Anemometry in General," by Mr. Curtis.

F.R.Met.Soc.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

67655.	To Mount-cutters, &c., p. 468.
67664.	Circular Saw, 468.
67667.	Winding Motor and Coil, 468.
67668.	German Silver Balls, 468.
67670.	Railway Goods Rates, 468.
67706.	Paper Condensers, 469.

67923.	Photographic View Lens, p. 17.
67928.	Arc Lamp, 17.
67939.	Superficial Viscosity of Liquids, 18.
67941.	Wind in Raising Waves and Minimum Velocity of Waves, 18.
67953.	Battery. To "Nedraw," 18.
67961.	Finding Areas, 18.
67963.	Watch, 18.
67987.	Horse Ball, 19.
67989.	Mandolin, 19.

The discovery of the value of wood in paper-making, the *Kennebec (U.S.) Journal* says, is credited to Dr. H. H. Hill, of this city. About forty years ago the doctor visited the papermill at Vasselboro, and, after looking over the machinery, suggested the feasibility of using wood, and asked why the manufacturers did not get a few bales of excelsior from Augusta, where it was made, and try the experiment of making paper from wood. "It can't be done," said the manufacturers. "Have not you as much gumption as the hornets, whose nests are made of wood paper?" asked the doctor. The result of the conversation was a letter, some time later, from the firm's wholesale agents in Boston asking what they were putting in their paper to make it so much better than it had been. It was the wood, then first used in this way.

A cheap and efficient substitute for the hand-grenades sold for putting out fire can be made by filling ordinary quart bottles with a saturated solution of common salt. The salt forms a coating on everything the water touches, and makes it nearly incombustible.

QUERIES.

[68318.]—**Waterproofing Silk Fishing Lines.**—I shall feel grateful to any of your readers who could help me to the obtaining of a really reliable waterproofing for small silk lines for fishing purposes. It should also, if possible, render them unsinkable.—J. J. Nix.

[68319.]—**Battery for Medical Coil.**—Can any reader kindly tell me what batteries I could use in the place of three quart Bunsens that are used for a Halse's coil? The coil is used for medical purposes. Owing to the smell the Bunsens give off, I cannot use them. The coil is used two or three hours a day.—Mechanic.

[68320.]—**Watch Keys.**—Will any of our readers inform me how the common watch keys are made, how the brass portion is cast, and the process of casting the steel pipes?—Young Jeweller.

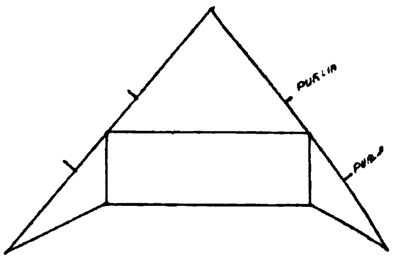
[68321.]—**Electric Bells.**—To Mr. Bottone.—I wish to run an electric bell wire from our house to the groom's, a distance of about 200yds. Would you kindly tell me what would be the best size and cheapest wire to use? Would ordinary galvanised iron wire do? Would one wire be enough, the other being connected to the ground? I think about fixing it from tree to tree, insulating from the same with guttapercha. Do you think this will do? Would one quart size Leclanché battery be sufficient to ring a bell at the distance I have mentioned.—L. Andrews.

[68322.]—**Fluting Paper like Fans.**—Will some reader inform me of the best mode of fluting semicircles of paper radially from centre to outside, so as to make them fan like? If there is a machine for this purpose, a description of it would greatly oblige.—Anxious.

[68323.]—**Electro-Motor.** — To Mr. Bottone.—I wish to make an electro-motor of 1¼ man-power. Must be a Siemens armature. Would you kindly tell me size of armature and field-magnets, size and quantity of wire on same? Also what voltage it would require to drive, and what c.p. it would give if driven as a dynamo?—H. W.

[68324.]—**Rebronzing Urn.**—I have an urn which had a tube in it to take a red-hot iron for the purpose of heating. I sent it to a local tinsmith to have it taken out, and, with their usual cleverness, he managed to burn off some of the bronze or lacquer. How can I restore this? I have advertised in the proper place my address, and would like those who are capable of doing it to communicate with me.—Annoyed.

[68325.]—**Strains on Roof.**—To "T. C., Bristol." Will you kindly assist me in working out the strains in roof shown in sketch—span 33ft., rise 20ft.? The main rafters and collar beams of timber, tie-rods iron. Having found the thrust down rafters, should I take them as long columns, or as an inclined beam with load acting at the centre?—Roof.

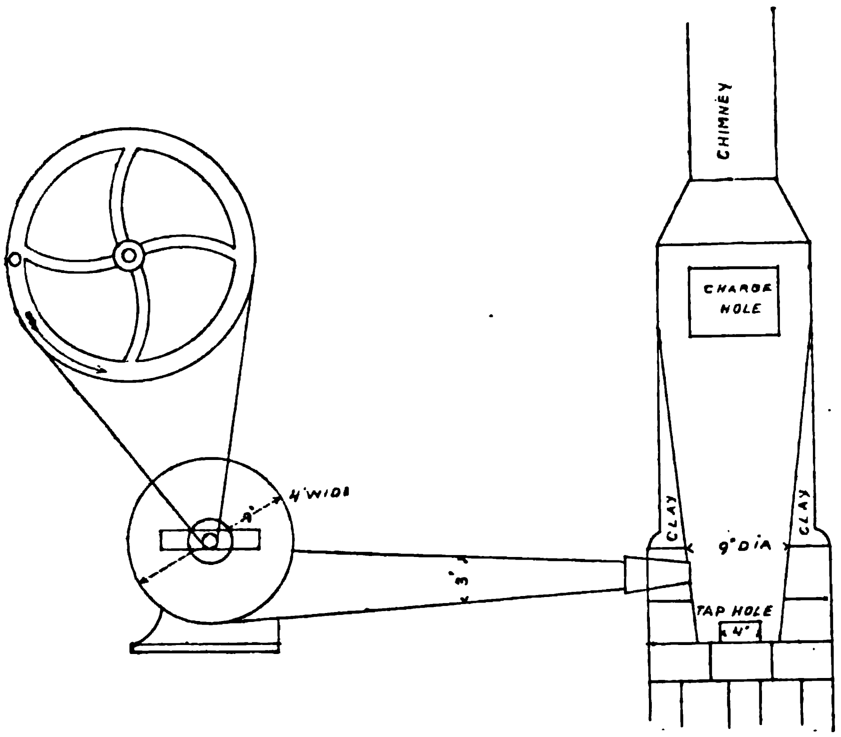


[68326.]—**Stove-Pipe Difficulties.**—For warming a warehouse on the ground floor I have a slow-combustion stove, connected by 4½in. iron piping with a chimney nearly 40ft. high, and am greatly bothered by the products of combustion refusing to travel. The tube has a perpendicular rise from stove of 5ft., then it extends 18ft. horizontally, and then 9ft. further horizontally at right angles to the previous direction. The end in the chimney carries a T piece, the arms of which are about 1ft. long. It appears to me that the four sharp turns the smoke has to make cause considerable check, and that if the changes of direction were effected by curves instead of angles, the flow would be easier. Our local tinsmiths cannot make the needful bends, and don't know where to buy them. I cannot well alter relative positions of stove and chimney. Ought the upward extension of the tube in the chimney to be longer, and should the lower end of this terminating T piece to be open or closed? Any helpful advice will be greatly appreciated by—W. H. Shrubsole.

[68327.]—**English Lever Watch.**—I have an English lever watch, fusee movement, gold balance; should be a good one; but I cannot get it to keep time, and I have had it back to the watchmaker, from whom I bought it, six times, and he says he cannot find out what is the matter with it. The fault is as follows:—It will go five minutes faster in 24 hours flat down on its back than what it will when hung up or wearing it. It consequence of this I cannot get it to keep time. Can any reader suggest what is likely to be the cause?—Bolton, Lan.

[68328.]—**The Hartz Rising Cards.**—Can any reader kindly explain to me how this illusion is worked? The effect of the trick is as follows:—A small glass box, open from end, a detachable tin bottom on a socket, and a short wooden rod, are handed for examination. The three (together forming the houlettte) are put together by one of the spectators, and retained in his own hands throughout the trick. Cards are chosen in the ordinary way and returned to the pack, which is placed in the glass box. Then at the word of command the chosen cards appear one by one. I believe he changes the ordinary pack for a special or prepared one, which has an internal clock-work arrangement that causes the effect.—R. Dunning.

[68329.]—**Cupola.**—I have a small cupola, which I want for melting a few stones of metal at one time for making small castings of engines, &c. I have it built in the corner of my workshop. The hearth is built of brick.



Above the hearth there are two courses of brick. The tap-hole is level with the hearth. The tuyere is fixed 8in. above hearth. On the bricks is placed an iron tube, 1ft. diam. and 2ft. long. Above that there is 8ft. of stove piping, 6in. diam. I have made a fan, 9in. diam., 4in. wide, with six blades, to run in centres. The pulley on fan spindle is 1½in. diam. Wheel to drive the fan is 20in. diam., and turned by hand. Pipe from fan to cupola is 3in. diam., reduced to 1¼in. in tuyere. Inside of cupola is lined with clay up to charging hole, which is 15in. above tuyere. After all is well dried, I put in some fire and then some coke, put door on charge hole and let draught pass through fan and tuyere and tap hole until there is a good fire. Then I bung tap-hole up with clay, put in cupola, some metal and more coke, start fan, and after 20 minutes' blowing, the metal is melted, but after blowing a longer time, the metal sets in bottom of cupola and will not run out. What I want to know is, how can I avoid the metal setting? What is the cause? Is fan too small, or is tuyere too small? Inside of cupola is 9ft. diam., and fan seems to blow a good blast? I hope some of my fellow-readers will be able to set me right. Inclosed is rough sketch of fan and cupola.—Blacksand.

[68330.]—**Dynamo.**—To Mr. Bottone.—Would you kindly give me a rule for finding the number of revolutions of a dynamo, the diameter of the pulley wheel being known, and the speed of the motor (steam-engine or otherwise) also being known. Also what is meant by a "45-volt 20c.p. lamp"? At what speed would a hand-wheel require to be driven to give 1,700 revs. per min. to a 125c.p. Gramme dynamo yielding 55 volts and 8 ampères? —Terminal.

[68331.]—**Coppering Carbons.**—I have broken the carbons of a bottle bichromate battery. Can any of "ours" kindly explain how to fix two more? If it is necessary to deposit a film of copper, details of copper solution, kind and number of cells required would greatly oblige.—W. G.

[68332.]—**Bichrome Battery.**—I have a four-cell battery, which after a little becomes very hot. Cells are vulcanite. Zincs are fastened to carbons with clamps, having a piece of wood between clamp end and zinc, and between zinc and carbon. In fact, the insulation appears perfect. I have had them to pieces and placed fresh pieces of wood. Zincs are well amalgamated. There is no local action visible, but after being in work 15 minutes, the vulcanite becomes soft, owing to the liquid and zincs getting very hot. Can any kind reader explain the cause and remedy?—W. G.

[68333.]—**Force of Explosions.**—Will any of "ours" inform me how to find the force of an explosion of gas when confined? For instance, the force of the violent report on the union of gases, as, e.g., the union of hydrogen and oxygen. I should like to know of a book where I would be likely to get some information on the subject.—J. S., Egypt.

[68334.]—**Chemical.**—Will some chemical reader give the answer to annexed question, which was set at the Science and Art Examination in organic chemistry in 1888? "An alcoholic solution of potassium bromide is heated with ethylene cyanide, and the liquid boiled with caustic potash. Describe the changes which occur, and the principal compound formed."—Organic.

[68335.]—**Dynamo.**—I am wanting to construct a dynamo of the Britannia type, equal to lighting 15 of S. and E. 16c.p. incandescent lamps, and shall be thankful if anyone can help me in the following particulars:—what size the field-magnets should be; also the diameter and width of the armature. I propose making the field-magnet cores of wrought iron, the pole-pieces of malleable cast, and the armature of laminated plates. If not trespassing too much on your space, I should also be glad to know what would be the necessary quantity and gauge of wire for the field-magnets and armature, shunt-wound, to secure efficiency.—Hopeful.

[68336.]—**Pocket Accumulator.**—Will Mr. Bottone or other electrical friend kindly answer the following questions? I have made up a small accumulator. The cell is 3½ by 2 by ¾ inside. The plates 3⅝ by 1⅞, with a solution of 1 sulphuric acid to 10 water. I charged it with two small-sized Bunsens for about three hours. It gave a good light, but only for about eight presses of the push, and then failed. I was told I had not charged it long enough, so I charged it for 12 hours. I lighted it just for a second to see was it all right; it gave a good light. I did not use it again for a week, but when I tried it again it would not light. Since then I opened it to see if anything had fallen between the plates, but it was just the same as when put in. What is the fault, or would a bichromate battery be more suitable? If so, kindly give full particulars. I may state the plates were old ones; but a friend of mine told me they were good enough.—Cell.

[68337.]—**Lathe Query.**—I have a 3½in. lathe by the Britannia Co. It runs very heavy. I have tried to remedy this, but cannot. Mandrel has 1in. nose cone, 1¼in. smallest part. Mandrel and collar both soft. I have tried all sorts of lubricants. Could I harden collar? It must be the mandrel, as treadle runs very light. Will any reader kindly tell me how to remedy this?—E. H. C.

[68338.]—**Savery's Engine Problem.**—Would some of our readers kindly inform me how to solve the following problem? Suppose the water in a mine to be 25ft. below the point to which it rose in Savery's receiver, and the top of the discharge pipe" 30ft. above the bottom of the receiver, what vacuum and pressure of steam in pounds per square inch would be necessary to work the engine? I am unable to solve the above, and am unable to give any details of the engine in question. How am I to proceed?—F. T. A.

[68339.]—**Paraffining Carbons.**—I have lately been doing some electric-light carbons for battery purposes, but have to buy them 3in. or 4in. longer than I actually want them, so as to get a sufficient length of uncoated surface in the cell. What I mean is this: I invert them for an hour in a shallow vessel filled with melted wax and kept liquid as advised by Culley and Ayrton in their "Electricity," and then I take them out and drive back wax from the top where I want to make contact, as advised by Mr. Barnett, p. 216, Vol. XLIII. The result is, when the operation is finished, instead of 2in. from the top of the carbon being impervious to acids, 4in. is, through the paraffin wax finding its way down whilst the top is heated with the Bunsen burner to drive wax away from point of contact. The best way of preventing this seems to be that described by "Sigma," where he mentions the original plan on p. 266, Vol. XI. He there says: "Wet the top as far down as you want to make contact, and wet upwards as far as it is wanted to be in the cell, then heat the intermediate portion and apply the wax until it will not absorb any more." Perhaps some one will suggest how this can be done. I cannot tell how to keep top and bottom of carbon wet and the other portion hot at the same time.—F.R.Met.Soc.

[68340.]—**Camera on Bicycle.**—Will some of our readers kindly inform me how to make a good camera stand with a bicycle, so that I need not carry the tripod about with me?—Brassy.

[68341.]—**Incandescent Electric Lighting.**—Experimenting with four lamps joined in parallel the other day, I noticed the lamp that was farthest from the dynamo, the fourth, was much the brightest; changing the lamps made no difference, the farthest was always brightest. How is this? Should not the one nearest the dynamo be best?—at least, I have always understood so. Why is it in lamps arranged in parallel that the first lamp does not short-circuit the dynamo, as the circuit is complete in itself through it?—M.M.I.Sc.S.

[68342.]—**To Mr. Bottone.**—I have the carcase of a Manchester dynamo, which I want to fit up. The pole-pieces are of cast iron and very massive. The armature (a laminated Pacinotti) is to be 4¼in. diam. and 6in. long, wound with 6lb. of No. 16 d.c.c. wire, and is to run at 1,000 revs. per min. The F.M. core is Swedish iron, 3in. diam. and 6in. long; each leg is to be wound with 9lb. of No. 22 and 2lb. of No. 16 d.c.c. wire. I want it to give 8 or 9 ampères (not more) at 50 volts, at 1,000 revs. per min., and I want to use it in two ways: (1) as a compound to run the lamps direct; (2) with the series coils disconnected to run as a shunt machine for charging 21 accumulators in series. If it gives 8 or 9 ampères and 50 volts as a compound at 1,000 revs. per min., will it give the same ampères and volts at the same speed when running as a shunt and charging? If not, how can I alter it?—Mechanic.

[68343.]—**Blowpipe.**—In reply No. 67925, April 5th, there is a gas furnace very nicely described, with instructions for making same. If the same author would give instructions for making a blowpipe to use with it, size of tubes, &c., he would confer a favour upon—Les Smith.

[68344.]—**How to Bore a Lathe Head.**—Will any of our kind subscribers give me a few practical hints on the above? The head is 6in. centre with conical bearing with back-gear. Could I bore otherwise than to swing in larger lathe, or on its bed (of hard wood) by a ratchet brace? Please give dimensions of mandrel bushes, &c. Please give width of cones for strap.—M. C.

[68345.]—**Bisulphate of Potash in Leclanche Cell.**—In reply No. 67559, p. 465, Mr. F. W. Mason states that 1½oz. of the above is suitable for a No. 2 Leclanché cell, and that he has had a cell so treated running for 15 months. In reply No. 67559, p. 115, only two months before, he gives ½oz. as the proper quantity. Will he kindly elucidate this, as I am desirous of adding the potash to my battery?—Agglomerate.

[68346.]—**Chemical.**—Would some reader kindly give directions how to identify each or any of the following organic substances when present in solutions? I know the individual tests, but am at a loss for a scheme for separating them from each other. Hydrocyanic acid, oxalic acid, acetic acid, tartaric acid, citric acid, salicylic acid, grape sugar, starch, morphine, and urea. I am preparing for the Science and Art Department Honours practical organic chemistry exams., and have to do all my work at home, there being no laboratory in the neighbourhood.—A Poor Lad.

[68347.]—**Mercury Removing.**—Will any reader please say how to remove mercury from aluminium?—Amateur.

[68348.]—**Air Vessel.**—To "T. C., Bristol."—Please say what size of air vessel I shall want which, when charged up to 70lb. pressure with air-pump and windmill, will work an air-engine 1⅛in. bore, 8in. stroke, for two hours a day. Also how to fix an automatic gear to safety valve to throw air-pump out of gear when fully charged. I should have the windmill working night and day, or rather as long as there was any wind. So supposing the vessel got charged full in the night and commenced to blow off, the automatic gear fixed to the safety valve would throw it out of gear and stop it from making any great noise.—Amateur.

[68349.]—**Balloon.**—I require to suspend in the air a weight of 5lb. by means of a small balloon filled with hydrogen. How many cubic feet of hydrogen gas shall I require to do same, and how much sulphuric acid and iron filings shall I require to manufacture the quantity of gas? H. Rideout.

[68350.]—**Telephones.**—I am fitting up a pair of Bell telephones as follows:—Magnets 5in. by ⅜in., with ¼oz. of No. 38 s.c. wire on each, and I should feel obliged if some one will give me a sketch with dimensions of a transmitter to work with telephones. Distance between stations ¼ mile. Am I right in size of magnets and gauge of wire? Is ordinary telegraph wire right for line wire? What battery power shall I require at each station?—Signal.

[68351.]—**Achromatic Object-Glass.**—The other day I placed our 3in. aperture, 4ft. focus, refractor on end and unscrewed the pinion of the rack, the eyepiece and tubes fell in and smashed the flint glass. Would "F.R.A.S." or other astronomical authorities kindly inform me if it would be cheaper to have a new flint glass made, or a new flint and crown? Of course I should send fragments and the crown glass with the brass cell to the maker. Would they also tell me the best maker, the probable cost, and the time it would be away? We have an 8in. reflector, 11½ft. focus, but I prefer the 4ft. for ordinary work.—Copernicus.

[68352.]—**Exhaust Steam.**—Wishing to increase the draught of a 60ft. chimney shaft, point out the principal objections to turning into it the exhaust steam from two 15in. by 30in. cylinders, after passing through feed-water super-heater.—G.

[68353.]—**Electro-Plating on Ferns, &c.**—I wish to deposit copper on ferns, flowers, &c.; also on beetles, Will some one give me instructions, or refer me to some good standard work (giving instructions on the 'subject, with publisher and price)? I have back numbers for 12 months, but can find nothing on the subject.—Beginner.

[68354.]—**Mensuration.**—Would any reader show me an easy method of finding the area of a circle in feet after deducting an arc from it?—Back End.

[68355.]—**Brass Casting.**—How can I make a core for a brass casting, so as to leave a very smooth hole?—D. W.

[68356.]—**Amber Varnish for Violin.**—Can any reader give me a recipe how to make a good amber varnish for violin?—Ashingtonian.

[68357.]—**Gramme Dynamo.**—Having obtained a set of Gramme dynamo castings, 150c.p., wound about 11lb. of No. 22 on the fields, and about 5lb. of No. 18 on the armature in 10 segments, taking great care to insulate it thoroughly, and connected the field-magnets so as a battery current can magnetise them, N. and S. respectively, I find, to my disgust, that I can only get a faint trace of electricity from the terminals, and if I connect the terminals, can get some sparks at the brushes on revolving the armature. I can get a decided current if I make the armature revolve while a battery current is circulating through the fields. I shall be truly thankful if you will help me out of this difficulty.—Patience.

[68358.]—**Small Forge.**—Will any fellow-reader send particulars and, if possible, diagrams of a small forge for amateur, and also of a small fan for same, to work by treadle? The hearth of fire to be about 1ft. square.—Amateur.

[68359.]—**Poppet.**—Will "T. C., Bristol," or any reader give me instructions? I have a good 10in. centre headstock, and an 8in. centre poppet, strong. I want to make the poppet to set over for taper turning, and then it will bring it up to 10in. Will he give sketch and instructions how to do it? Trouble no object.—Lathe.

[68360.]—**Prof. Lodge and the Leyden Jar.**—Could any reader give directions for performing Prof. Lodge's experiments with the Leyden jar? How can the waves be detected as the sparks give out light? Can the jar be charged with an induction coil?—St. Augustine.

[68361.]—**Chromic Acid.**—1. Will anyone tell me the way this acid is obtained commercially for battery purposes? Fownes says "Mix 100 parts cold saturated solution bichromate potassium with 150 parts sulphuric acid," but this must be the quality sold at about 3s. 6d. per pound, and not the dry sort at 1s. per pound. 2. What is the difference between chromic acid and chromic salt?—Wari.

[68362.]—**The Mass of a Binary Star.**—May I ask for an explanation of a difficulty in regard to the calculation of the above by the method given in Ball's "Astronomy," p. 337? Let T = periodic time of the star's satellite, and t = that of the earth calculated for a distance equal to that of the satellite from the star. Then—

$$\frac{T^2}{t^2} = \frac{\text{mass of sun and earth}}{\text{mass of star and satellite}}$$

But if this be true of the members of two systems, it must also be true of members of the same system. Thus, if T = periodic time of Jupiter, and t = that of the earth, calculated for the distance of Jupiter, then—

$$\frac{T^2}{t^2} = \frac{\text{mass of sun and earth}}{\text{mass of sun and Jupiter}}$$

But in this case T = t, therefore the mass of the earth and of Jupiter are the same, which is absurd. It is, I believe, true that satellites having the same rate of movement are distant from their primaries in the direct ratio of the masses of their primaries. Now, the proper motion of the sun is reckoned to be about 18¼ miles per second, which is about the same as that of the earth. The nearest fixed star is certainly more than 14 billions of miles distant. If, therefore, the sun revolves in an orbit, its primary must have a mass more than 150,000 times greater than itself, for—

$$\frac{\text{98 milllions}}{\text{14 billions}} = \frac{\text{mass of sun}}{\text{mass of sun's primary}}$$

Have we any knowledge of stars possessing such a stupendous mass?—Finsbury.

[68363.]—**Scientific Amusements.**—Will some of our readers kindly suggest a few scientific amusements suitable for a bazaar? Am able to obtain instruments or apparatus.—Hopeful.

ANSWERS TO CORRESPONDENTS.

_ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

_ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 10, and unacknowledged elsewhere:—

J. Francis.—G. Calver.—D. Nicol.—King, Mendham, and Co.—Beta Sigma.—W. S., Liverpool.—A. H. S.—Tyro.—One in a Fix.—Keen Competition.—Workshop.—Ne Plus Ultra.—An Old Subscriber.—Ecnal.—Electric Amateur.—H. E. H.—Baritone.—W. H. H.—Enquirer.—J. M.—Nemo.—Bath.—H. Spink.—Jim.—H. Wake.—Vooght.—F. E. C.—H. Wilkins.—J. R. Murray.—J. F. Coote.

Potential. (A reference to many Letters and Replies in our back volumes may help you; or a study of the best-known textbooks will no doubt lead to a solution of your difficulties. It is highly necessary that a thorough comprehension of the meaning of the terms used should be obtained. If you put some definite query, no doubt a definite reply will be given; but what you send now is much too long. Read up Mr. Sprague's articles in back volumes, or his work—"Electricity: its Theory, Sources, and Applications.")—Angus Macdonald. (No one can say how far a pair of given telephones will work; it is a question for experiment with the instruments and the line. Telephones are at work nowadays through some hundreds of miles of line wire.)—A Subscriber. (Friction is a question of pressure, not of surface; but as to your inquiry, the answer is simply that it depends on brake power.)—Jael. (Thanks for pointing out the errors. Those who read French will readily understand that they are what printers term "literals"—*m* for *as*, and *t* for *s*. Occurring in a book they would be unpardonable, but in the case of a newspaper which must "get to press" by a stated time, they are excusable. Of one thing you may be assured; if all our correspondents wrote as clearly as you do, printer's errors would be few indeed.)—Cambridgeshire Boy. (The eggs of the flies are laid by hundreds in a very short time, and not much space is required for them. If the remains of the manure heap were not burned, the eggs may have been in them.)—William T. Smith. (Send up the sketch of the water motor, for if it is as good as you imply, it will no doubt interest readers.)—Gospel Oak. (An advertisement might procure you a situation; but there is no lack of plumbers in London.)—P. Hewson. (See replies in back numbers. There are no trustworthy data for such small boilers. So much depends on the workmanship. See Hints No. 5.)—M. L. (You can sell an article for which an application for a patent has been made, but you must not put "patent" on it; you may put "patent applied for." The application, when accepted, protects you for nine months (or ten months if necessary by paying a small fee); but there is no "patent" until the complete specification has been sealed. The Patent Office is in Southampton-buildings, Chancery-lane, London; there are patent agents in both Durham and Newcastle-on-Tyne.)—J. H. (The pans for boiling sugar in making confectionery should be of copper, and the melted sugar should be stirred frequently to prevent it burning.)—C. R. G. (Scarcely understand what you mean. The reflectors made in these times are invariably silvered glass. See indices for references to articles giving full directions for making and testing.)—Amateur. (If you refer to back numbers you will find a great deal about winding dynamos.)—Nemo. (See the index to the last volume. There are full instructions for silver plating in that, and the first letter was published so recently as Dec. 14 last. See also indices to back volumes.)—Ignoramus. (What do you mean? What information do you want about Lord Kilmarnock? He is W. H. Hay, Earl Errol in the Scottish peerage, and the heir takes the title of Lord Kilmarnock. 2. How can anyone give any idea about your old china without the "marks," which you should find at the back? Such articles must be examined to be valued.)—J. G. (We are very much afraid you will have to work out your "idea," as you call it, for yourself. What do you want to do with a direct-vision spectroscope under the microscope? However, look up back numbers, and you will find all the directions necessary for fitting up the prisms.)—Ventilator. (Probably a cap is required on the end of the pipe which takes the fumes to the external air. That pipe should certainly be turned up, at any rate.)—Keyboard. (Yes, "methylated spirit," but ask for pure spirit, not what is known as "finish," which contains a little shellac. 2. French polish and varnishes of all kinds are cheaper to buy than to make, unless wanted in large quantities. To make the polish, dissolve 3oz. of shellac and ½oz. of gum benzoin in a pint of wood naphtha, keeping the bottle in a warm (but not hot) room.)—Manchester. (Hard water can be softened, as a rule, by stirring into it a "cream" of quicklime and water, as explained some hundreds of times in back volumes. 2. A medical man must tell you the "best remedy" for gastritis, which is really an inflammation of the membranes of the stomach, and a rather serious ailment.)—Live Frog. (We have illustrated several methods of showing the circulation of the blood in the foot of a frog, and, so far as we know, there is no law against it.)—Labourer. (A question of no interest except to the contractor. See one of the price-books.)—A Rechabite. (There is no means of testing the purity of water in a rough and ready way; but the addition of a little permanganate of potash will show by the pink colour quickly changing to a brown that water is charged with organic matter, and is, therefore, suspicious. See indices for many useful hints, but it is risky in the extreme to drink water taken from a ditch.)—E. C. (Why not look up the indices of back volumes?)—T. X. S. (See the catalogues issued by the publishers: the questions are not sufficiently definite to specify any particular works.)—Anxious. (Try again; but see that the metal is at the right heat and dust the moulds with powdered charcoal.)—Folkestone. (Scrape well, and then polish as you suggest, using the hand as the final polisher.)—D. Uren, (Cannot give any opinion without seeing the sketch or a lamp. Many forms have been patented; but a simple metal reservoir lamp is as safe as any.)—Alcol. (See the indices of back volumes. No one can possibly tell what you can see, nor even give an opinion of any value without some idea of what your near-sightedness will allow you to do. Get a look through a telescope of good make, and form your own ideas.)—Ralph Loudon. (Transactions of learned societies are usually published at the societies' offices; but all information can be obtained by addressing the secretaries.)—R. A. R. Bennett. ("Reproduced direct" probably means the now common process—photographing the drawing, transferring to zinc, and then eating away the metal, except where the lines of the drawing are. The process has been described many times.)—W. H. M. (The best way is to get someone who knows to pronounce them so that you can hear; but St. John is usually pronounced like Sinjun.)—G. T. H. (You can try bookbinders' glair, rubber solution, or gum tragacanth.)—Hot Water. (We do not know whether there is such a tap made; but we do know that it is not worth patenting anything unless people can be induced to buy it. You should have referred to previous answer at least by date, but preferably by page.)—Georgius Rex. (Get a Rapid Rectilinear lens.)—New Subscriber. (See recent back numbers—the last for one.)—M. Dickinson. (It is certainly advisable to employ an agent, but not absolutely necessary. Write the Secretary of the Mutual Aid Association, 2, Gresham-buildings, E.C., or any of the other patent agents advertising in these columns.)—Danaos. (Possibly due to some obscure skin disease. We should try a purely vegetable diet for twelve months, and consult Dr. Allinson of the *Weekly Times and Echo*.)—A Young Observer. (You have seen what other correspondents have said, and must form your own opinion. We see no use in publishing further letters with very incomplete details.)

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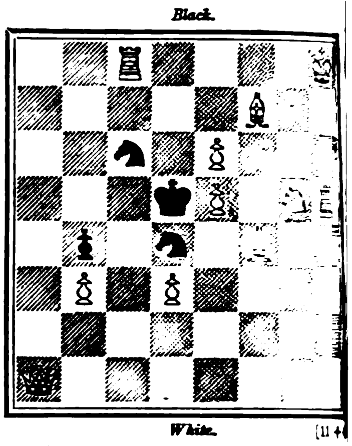
CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Uplyme, Devon."

PROBLEM MCXLIV.—By Mrs. W. J. Baird.

Black.



White.

White to play and mate in two moves.

Solution to 1,142.

White.	*Black.*
1. R-K 8.	1. Any.
2. Kt or B mates.	

Also 1. P takes P.

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,142 by Othello, Mendelssohn, A. Bolus, J. G. Hankin, F. Fernando, J. W. Read, Tattersall, J. E. Price, E. Sanders, A. Wheeler, Muzio, H. Fellows, A. Fellows, F. W. N. Lambert, F. C. C. (2), E. Retchford; to 1,141 by King's Dean, J. E. Price, E. Sanders, J. W. Read, J. G. Mendelssohn, E. Retchford, A. Wheeler (duals), Muzio (ditto), J. Keeble (duals), W. C. Martin continuation), A. Bolus (ditto with quintuple (duals), J. Bryden (ditto), J. C. Bremner (duals), Hensing (ditto), A. C. Wissenden, and G. A.

F. Fernando.—How is it impossible if White Kt-Q B 2, &c.

J. Ough.—We should consider, in the case that there were more than one continuation, but the others were marred by duals.

F. W. N. Lambert.—You are entered for the section. A sui-mate is that in which White to mate him in a certain number of moves. if you send the key move.

J. W. Read, A. Wheeler, J. C. Bremner, and are entered for (A), E. Retchford for (A) and B.

R. Nixon.—If 1. $\frac{\text{R-K B 3}}{\text{P takes R}}$.

A. C. Wissenden.—Mr. Abbott's three-move first Tourney problem in section A. Your do very well, but you have omitted the duals, which the problem abounds.

Muzio.—We are not sure that after 8. $\frac{\text{B takes P}}{\text{K takes}}$

9. $\frac{\text{P-Q 4}}{\text{Q takes P}}$, 10. $\frac{\text{B-K 3}}{\text{Q-B 3}}$, 11. Q-B 3 (ch), that White the best of it, as he is minus two pieces. How proceed if 11. $\frac{\quad}{\text{K-K 2}}$? If 12. $\frac{\text{B takes P}}{\text{B-B 3}}$. Perhaps ever, Black's 6th move may be improved on. We prefer 6. $\frac{\quad}{\text{P-Q 4}}$, 7. $\frac{\text{B takes P}}{\text{Kt-B 3}}$.

The *Leamington Chronicle* will start a new Tourney on May 1st, and a Solution Tourney on April For the former, prizes of 10s., 6s., and 3s. 6d. are for the three best two-movers sent in. For the prizes of 5s., 3s., and 2s., together with portion of entrance fees (6d.) if there are more than 30 competitors.

Western Magazine Portfolio for April received with thanks.

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Advertisements must reach the Office by 12 on Tuesday to insure insertion in the following Friday's number.

he English Mechanic
D WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 19, 1889.

ECTRIC-BELL CONSTRUCTION.—IX.

By F. C. Allsop.

AVING constructed several forms of indicator movements, we will now turn attention to the fitting of the movements ide the indicator cases. Fig. 56 is a four-drop indicator with the front of the case removed, showing the four movements (which are of the form illustrated in Fig. 36, article VI.), and the throwback gear. The movements are about half-size; but neither in this or the following figure must the case shown be taken as the right-sized one for the number of movements, as, for the sake of clearness, the case has been made larger. In practice it is rarely so much space can be allotted to each movement. In fitting up an indicator of this form, the case having been made, the movements are screwed against the back of the case in such a position that the vanes, when released, come opposite the perforations in the dial. Five terminals must then be fitted at the top of the case, and the movements connected up to these terminals previous to fitting the throwback gear. The connections are shown by the dotted lines, and, as will be seen from the figure, there is a terminal to each movement, the remaining one being common to the lot. The connecting wire should consist of No. 18 B.W.G. naked copper wire, the wire being either stapled round on the inside of the case, or let into grooves at the back of the case, which grooves are afterwards filled in with paraffin wax.

We can now fit the "throwback gear." Looking at Fig. 56, it will be seen that this consists of the two horizontal rods *a*, which are joined across by the five upright rods *b*, the outer two of these five rods sliding in the four guides *c*. On these two outer rods *b* are fixed the washers *d*, against which press the spiral springs *e*. Into the bottom rod *a* is fixed the rod *f*, which carries at its lower end the knob *g*. Four pins, *h*, project out from four of the upright rods *b*. The action of the gear is as follows:—When the knob *g* is pulled, the whole framework moves downwards against the pressure of the spiral spring *e*, causing the pins *h* to engage with the ends of the vane-levers, thus resetting the vanes. The framework, in obedience to the springs *e*, returns to its normal position when the knob is released.

The two rods *a* should be made out of brass tube, holes being drilled in them, into which solder the brass rods *b*. The pins *h* are made out of brass wire, and screw into the rods *b*. The guides *c* should be made out of 1-16 sheet brass, being cut off to the requisite length, and then bent at right angles.

Fig. 57 shows a three-drop indicator, wit pendulum or self-replacing movements, relay being fitted inside the case for closi the bell-circuit. The movements, the co

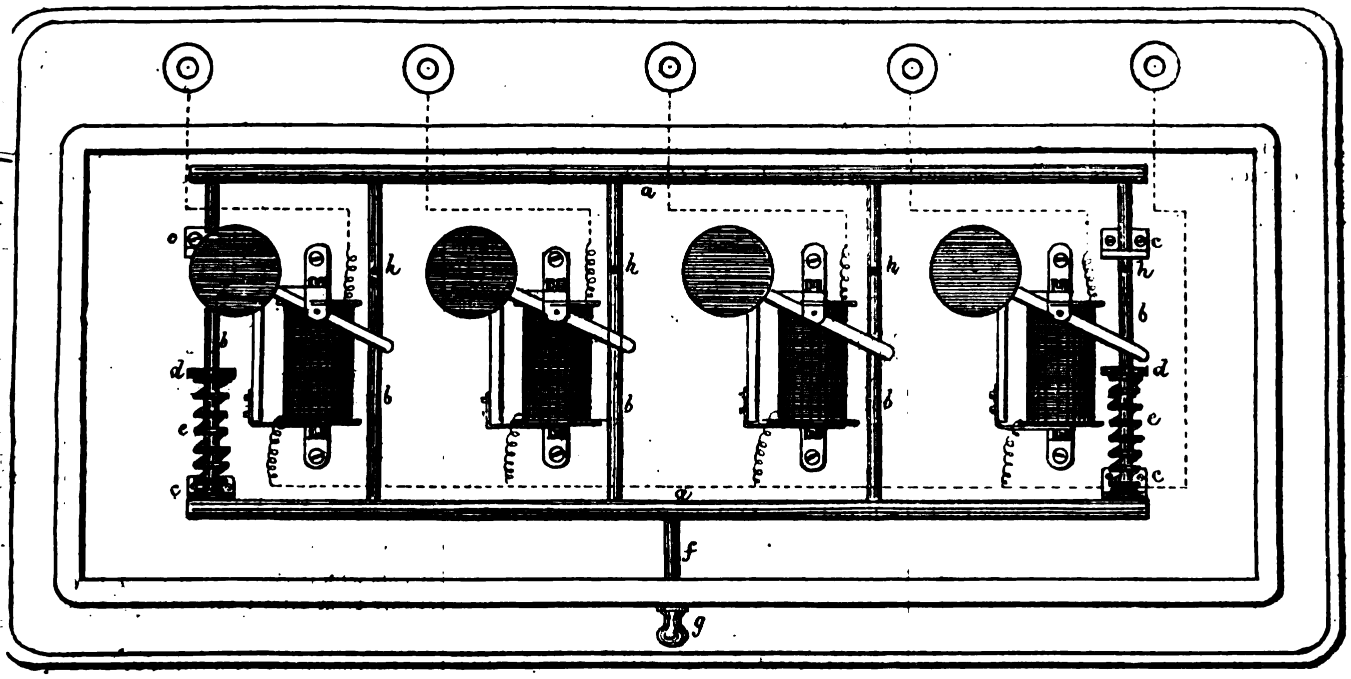


Fig 56

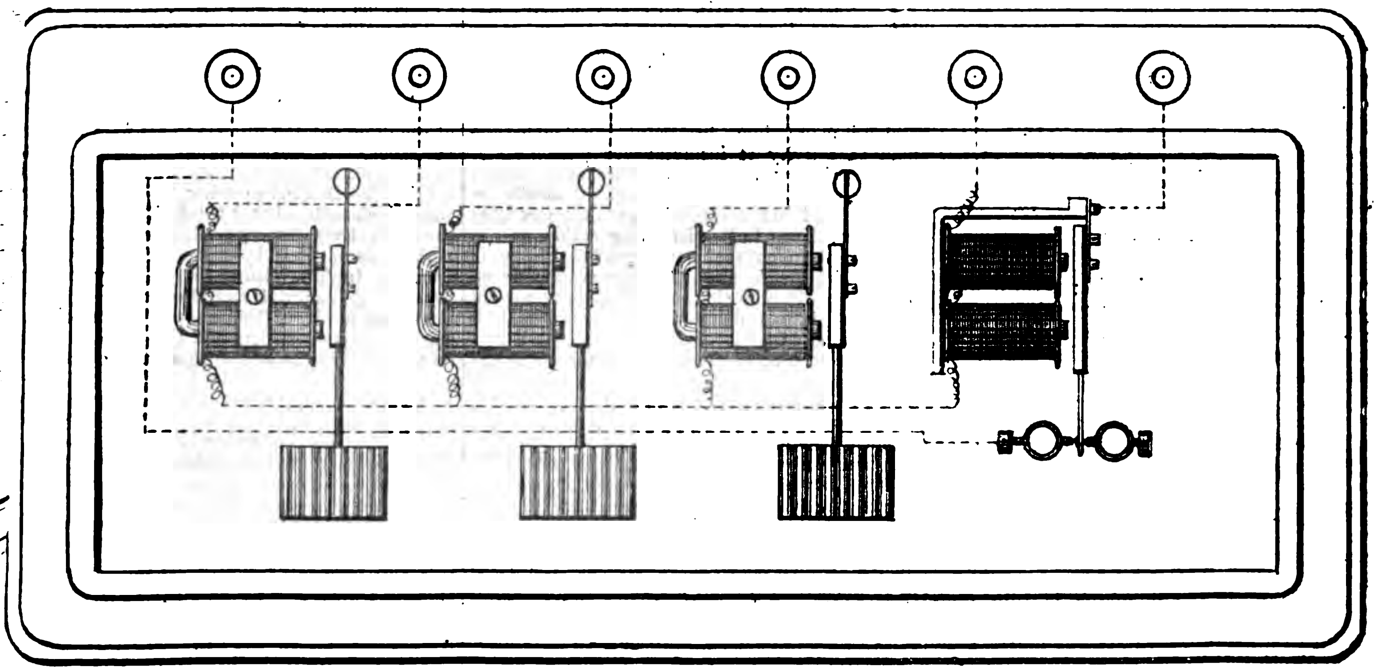


Fig 57

struction of which was described in the last article, are fixed to the baseboard of the indicator case, the connections to the terminals being either fixed inside or let into the back in the manner described for the previous indicator. There are six terminals to the indicator, the two outermost being inserted in the local bell-circuit. Of the remaining four, one goes to each of the three movements, while the fourth goes to the relay coils, and afterwards the free ends of all the movements. All the joints inside the indicator must be soldered, resin (and on no account "spirits") being used as a flux. Fig. 66 in "Practical Electric-Bell Fitting," shows the external connections of an indicator of this sort. The indicator shown there, however, is a six-drop one, and there is a slight difference in the arrangement of the terminals; but if the left-hand terminal in Fig. 57 is put over to the right-hand side, the arrangement of the terminals in the two figures will be the same.

Since the space required for the different forms of movements varies so, it is obvious that no standard size of case can be given for a certain number of movements. One form of movement occupies perhaps a large amount of space, while another requires a lot of room for the vane to swing in; a third, also, though of small size, may require a great depth of case. Thus a case made for one kind of movement is generally eminently unsuitable for another form. For such as may like to construct their own indicator cases, the dimensions given below are for an indicator case suitable for eight movements of the form shown in Fig. 56. Fig. 59 shows the back and body of the case, while Fig. 58 is the lid.

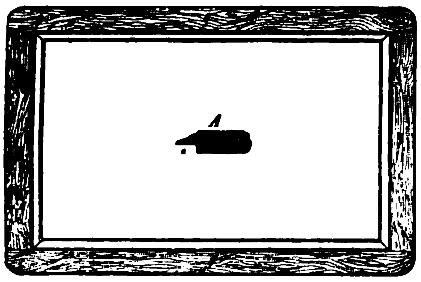


Fig. 58.

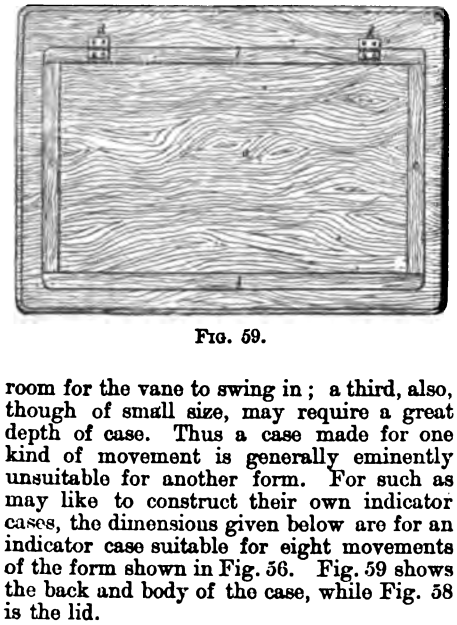


Fig. 59.

In order to construct the case we shall require some five-eighth walnut, mahogany, or teak. Out of this wood we first cut the backboard *a* (Fig. 59), which is 16in. long by 11½ broad, the corners being rounded off and a small moulding run round for the sake of appearance. Next the two pieces (*b b*) which form the top and bottom of the case are cut out, these pieces being 14¼ long by 1⅝ deep and ⅝ thick. The side pieces (*c c*), which are 9¼ long by 1⅝ deep and ⅝ thick, are then cut off, the ends of these pieces being let into the top and bottom pieces (*b b*) so as to form the body of the case, whose internal dimensions are 13 by 8. It will be best, previous to fixing this framework on to the back of the case, to prepare the surfaces for French-polishing, which being done, the framework is placed on the back into the position shown in Fig. 59, and fixed by nailing through from the back. For the lid (Fig. 58), the two pieces (*f f*), 15in. long by 1¾, and the two pieces (*g g*), 10in. long by 1¾, are cut out of the ⅝ wood, being afterwards cut to the shape shown in section A, by a moulding plane. The slot (*e*), which is on the inside of the lid, is to receive the glass and dial. The ends of the pieces (*g g*) are then cut to a tenon, and the ends of the pieces (*f f*) mortised to receive them; the pieces being afterwards secured together by gluing. The parts of the lid and case that are exposed to view should now be French-polished, the lid being afterwards fixed to the case by means of the hinges (*d*).

There are two ways in which the indicator dial may be made. 1st, there may be a plain glass front, behind which comes a sheet of zinc, the zinc being cut away to show the vanes; or 2nd, the glass itself may be painted and lettered, thus doing away with the necessity for the zinc. The first method, though the easiest (owing to the difficult process of painting the glass), does not look so well as the second, where black ground relieved by gold lines gives a good finish to the indicator.

(*To be continued.*)

A SMALL PORTABLE APPARATUS FOR THE SAFE AND EASY PRODUCTION OF MAGNESIUM LIGHT.

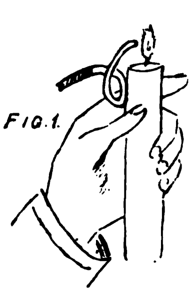
At a recent meeting of the Academy of Sciences at Paris, Messrs. Guébhard and Ranque described a new portable apparatus for the production of magnesic light, which is likely to attract much attention.

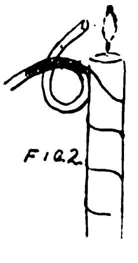
The use of "photo-powders"—that is explosive light-producing mixtures, the basis of which is magnesium—has more than doubled the field of activity of instantaneous photography. But there is very great inconvenience, even danger, on account of the explosiveness of the substances which enter into the composition of these powders; then, too, there is the irritating action on the lungs of the clouds of smoke produced by combustion in the confined atmosphere of a room. The direct combustion of magnesium powder projected into a flame does away with these inconveniences.

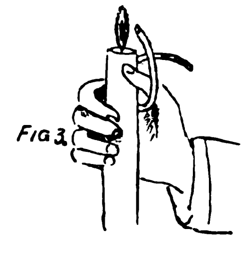
The apparatus which is now proposed is extremely simple, small, and portable, easy to construct and to use, a vast improvement on the cumbrous and costly arrangements which have hitherto been in vogue.

A small tube about 10cm. long and 0·4c.m. in calibre, twisted like a huntsman's horn, constitutes the whole apparatus (vide Fig. 1 and 2). At one of the ends, slightly widened, a small quantity of the powder is introduced. 0·2grm. (a quantity which can roughly be judged by means of two marks graven on the tube) will produce a light amply sufficient at a distance of 3 mètres for an object-glass of 2cm. aperture and 10cm. focal length. At the opposite end of the tube is a small indiarubber bulb, such as is used for ejecting a liquid from a bottle in the form of spray.

The ring of the tube is then simply passed over the index finger, as in Fig. 1, or over the thumb, as in Fig. 2, the hand holding a lighted candle. Thus, the open end of the tube is presented obliquely to the largest part of the flame. All that is necessary now is to squeeze with the free hand the indiarubber ball, when the powder is projected into the candle-flame. A flash is produced instantaneously, which gives a light, rich in actinic power, sufficiently strong for the purpose of photography.







Other forms of attaching the tube to the candle can readily be devised—e.g., Fig. 3 shows the use of a coiled wire, thus leaving the hand free; or the tube itself may be coiled round the candle, or held with a clip, or by any other convenient means which the operator may devise.

The greatest advantage of this arrangement is, perhaps, the certainty and ease with which an operator can illuminate the field at the precise instant he may desire.

Again, several of these candles may be arranged in position, the tubes connected with one indiarubber ball, which places them all under the control of the operator, who can thus produce a number of simultaneous flashes.

A MODEL LOCOMOTIVE.—VI.

Axles.

Fig. 14 shows the crank-axle dimensioned for our model, and approximately proportioned. By this it is seen that the largest portion is that which enters into the nave of the wheel, and that the crank-pin A is larger than the body of the axle. In an ordinary engine the diameter of the portion B entering the nave may be 8½in., of the journal C, 7in. to 7½in., of the pin A, 7in. to 7½in., and the axle D, 6½in. to 7in. The weakest portion of the axle is that where the junction of the pin with the webs E occurs. I have departed slighly from correct proportions in the relative lengths of crank-pin and web thicknesses, in order to give a trifle more room for the fitting of the big ends of the connecting rod. The pin is longer, and the webs a trifle thinner than would coincide with correct proportions, the three dimensions being usually alike, or nearly so.

The making of a crank-axle even for a model involves a deal of labour—so much, in fact, that I feel almost disposed to suggest some very unorthodox alternative, such as making a pattern and casting in phosphor-bronze, whereby a deal of roughing-out and filing, and lathe-work would be saved. I only suggest phosphor-bronze because it is one of the toughest materials easily obtainable—that is, by casting. Malleable cast iron would look better, but I think it would scarcely stand the stress of work in the model. It might perhaps be adopted by increasing the diameter from ⅞in. to 1⅜in. However, the way to make a proper forged crank is as follows:

Procure a bit of Bessemer-steel bar, either of square or round section, and get a smith to weld on two blocks to form the dips of the crank. If a square bar is used, its flat faces will afford good jointing surfaces for the welds. The ends and the portion intermediate can be roughly swaged to the circular form before the blocks are welded on. The complete soundness of these welds is a matter of the first importance, else when much labour has been bestowed on the crank, it may have to be thrown to the scrap-heap. Hence a better way in which a crank can be made, because avoiding welding, is as follows:—

Get a rectangular slab of mild steel of suitable size, and marking dimensions of the crank roughly with chalk, cut out pieces at middle and ends, as shown in Fig. 15. Swage down the ends to form the journal portions, and swage the middle to form the intermediate part, allowing ample material for waste in turning, not less than ⅜in. in diameter even for the model. This large allowance is necessary because of the irregular and inaccurate character of forged work such as this. Now take a good white heat, almost a welding heat, about the central swaged portion, localising the heat as much as possible by enclosing the other portions with damped slack. By means of two pairs of tongs, turn the cranked portions in opposite directions to one another until they are brought into positions at approximate right angles with each other.

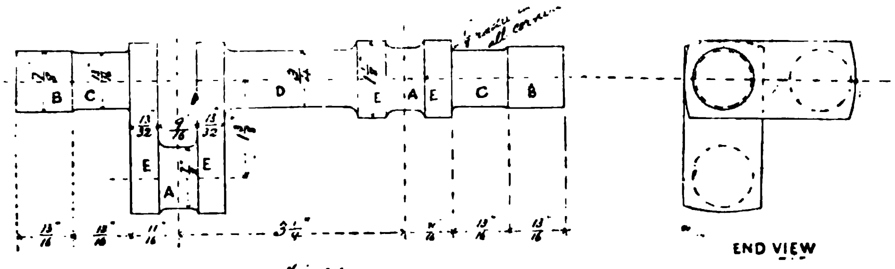


Fig 14

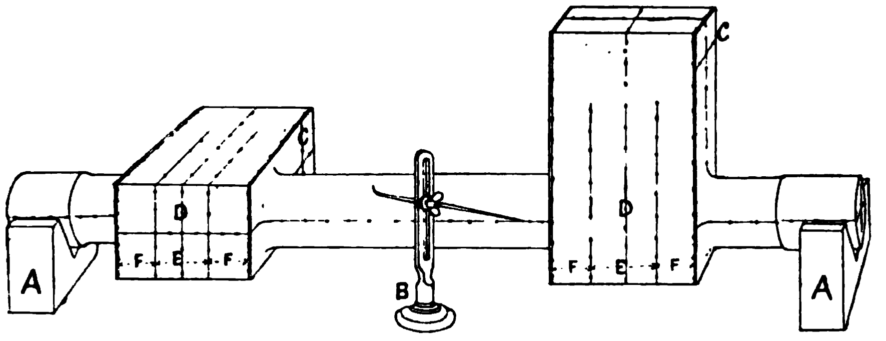


Fig. 16.

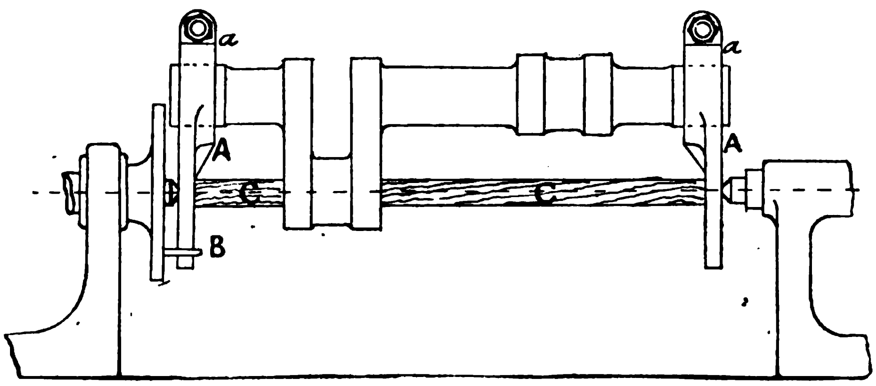


Fig. 18.

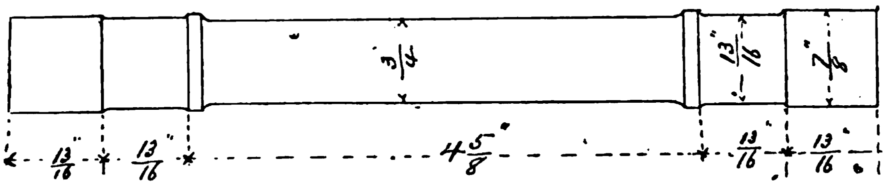


Fig. 19.

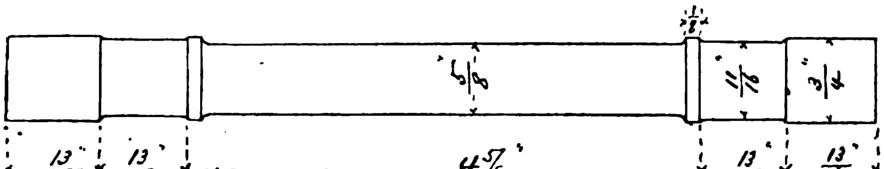


Fig. 20.

Before any machining is done, lining out is necessary; or, alternatively, the crank journals and ends can be turned before lining out the centres of the pins, only then we must be sure that there is metal enough about the pins to hold up to the correct diameter at their proper centres. The first thing is to get two lines at absolute right angles with each other, passing through the centre of the axle and of the cranks, averaging equal quantities of metal in the rough forging on each side of these lines, so that the amounts to be removed in machining shall be fairly equal all round. This is done as follows:—

Lay the crank (Fig. 16) on the vee-blocks A A upon a level table, properly one of iron, planed true, and called a marking-off table. If such is not available, use the top of a lathe-bed, or, if that is not broad enough, the table of a planing machine, or, failing that, the surface of a very true piece of well-battened board. Whiten the forging with chalk, and, with a scribing-block, B, set to appropriate position, mark a centre-line all round, which line will be parallel with the plane of the table, the latter supplying that base of operation which is wanting in the rough and irregular outline of the forging. Then turn the forging round to right angles in the blocks, testing the lines just struck with a set square from the table, taking measurements from the vertical edge of the square to the scribed lines up and down with calipers. When thus correctly set at right angles with its former position, scribe the second centre line all round transversely to the first.

While one of the cranks with its centre line is thus in the vertical position, mark off transversely to that centre line the position of the centre of the crank-pin belonging thereto. To do so, take with the scribing-block the centre of the axle, and mark that on the vertical face of an independent squared block (Fig. 17, A), such as is commonly used on marking-off tables. On the face of that block set off with compasses another line, B, at a distance from A equal to the distance apart of the centres of the axle and the crank-pin = 1⅜in. Set the scriber to B, transfer to the crank ends, and mark across (Fig. 16, C). The intersection of these lines with the vertical will be the centres of the crank-pins, coincident with which their chucking will be done. The second crank will be turned into the vertical position, and marked similarly.

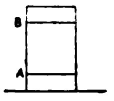


Fig 17

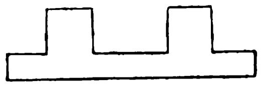


Fig. 15.

Next we may obtain those centres for the crank pins which correspond with the connecting-rod centres—3¼in. These will be marked on one face of each crank when set in the vertical direction—squared over in the horizontal direction, and further squared on the opposite vertical, Fig. 16, D. From these centres the distances E between the webs, and also the web thicknesses F, will be marked with dividers and squared and scribed. All these centre lines and working lines will now be centre-popped previous to putting the work in the lathe, in order to prevent their obliteration.

Drill and countersink the axle-centres, and chuck in the lathe with carrier and driver. Turn down first that end next the sliding poppet, the outside faces of the crank webs, and the straight portion between the cranks which the eccentrics embrace; then, reversing the axle in the lathe, turn the opposite end.

Fig. 18 illustrates the method of chucking which is adopted for turning the crank-pins. Two cast-iron chucking-plates A are made of suitable size. The bosses *a* are bored to take the turned ends of the axle, and being parted with a thin core at *a*, are pinched with a bolt or a set screw, thus holding the axle by a frictional grip. At a distance from the centre of the boss equal to the distance between the centres of the axle and crank pin, a chucking centre is drilled and countersunk on each plate; the point centres of the lathe enter these, and the driver B is brought into contact with the edge of the plate next the headstock. If the centres on the plates are truly marked, and the forging brought into such alignment with them that the crank-pin to the left will hold up to dimensions, the bolts in the two lugs can be tightened for turning. The proper way to get the chucking-centres and the crank-pin centres in line is to remove the axle to the marking-off table; block it up on vee-pieces, and adjust the chucking-plates until their centres coincide with the crank-pin centres already obtained, the scribing-block being used for the purpose.

Two stiff wooden struts, C, stretching between the crank webs and the chucking plates prevent the bending of the crank under the end-pressure of the lathe centres, and minimise chatter. A counterweight should be bolted to the chuck to balance its weight.

If the metal between the webs has been slotted out with some measure of accuracy, we may now turn the left-hand pin and the inside faces of its webs. Then the pinching-screws will be slackened and the axle readjusted in the plates A, until the second pin—that to the right—is brought into alignment with the lathe-centres, and that, with its web-faces, will be also turned. By using a triangular plate, the centres corresponding with *both* crank-pins can be marked near the corresponding corners of the triangle, and no second adjustment of the chucking-plate will then be required; but the point-centres of the lathe will be moved from one pair of plate-centres to the other. The ends of the webs are turned also in the lathe, their radii being struck from the axle, and the pin centres respectively. (See Fig. 14, end view.) The edges of the web are done away from the lathe in planing or shaping machine, or with files. They are parallel with, and equidistant from, the centres of the axle and pins.

Mr. Worsdell, of the N.E.R., adopts the unique practice of making cranks of the circular or disc form, to reduce the cost of machining, all the work being thus done in the lathe. They are about 15in. in diameter.

I may mention, by the way, that the first cranked driving-axles were made and designed by Timothy Hackworth in 1830. Previous to this the driving-wheels had been revolved directly from the connecting-rods.

Our trailing-axle is dimensioned in Fig. 19, and our leading-axle in Fig. 20. These call for no remarks, the work being of a simple character. I have given the neat dimensions—$4\frac{5}{8}$in.—over the shoulders of the journals; properly the dimensions should be $\frac{1}{32}$in. less, both in these and in the driving-axle, to allow for "end play." I show no reduction in diameter at the centre, although by rendering axles more elastic their liability to fracture is lessened. This practice may or may not be followed in our model, according to pleasure.

J. H.

HAUFF'S IMPROVEMENTS IN TANNING.

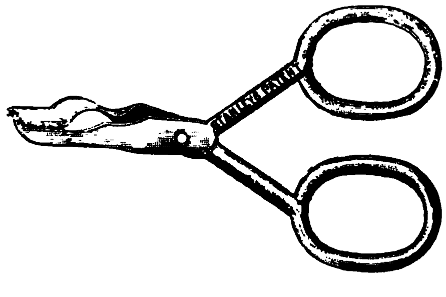
THE old-fashioned methods of tanning are being gradually supplanted by what are called improved chemical processes, and amongst these we find that of Herr J. Hauff, of Feuerbach, near Stuttgart, which has been recently patented in this country. It is generally known that tannin becomes split or cracked under the influence of the oxygen from the air, and particularly through the living process of a lower form of organism in sugar, gallic acid, and other secondary products of decomposition, such as the acids of milk, of butter, of vinegar, and the like. Recent experiments made in this direction have proved that the above causes were capable of entirely destroying, within a few days, the tannin contained in the diluted solutions of that compound, such as used for tanning purposes. It is hence obvious that the tanner suffers thereby important losses in tanning material, while the tanned article is so altered in its fundamental properties through the action of the above acids carried out under such injurious conditions, that it sometimes ceases to be marketable. In order to remedy the above defects, known antiseptics such as phenol and salicylic acid have already been resorted to. With the first substance the action is so slight that its price fully precludes the use thereof. The salicylic acid, on the other hand, has, when the decomposition of the tannic lye or solution is sought to be prevented, to be employed in such doses, that it introduces by itself in the process the injurious by-action of an acid, and thus actually produces that which it was intended to avoid. Its object is consequently only half-fulfilled, as it defeats its own purpose. The mercurial compounds operate in the most radical manner: but they have, however, to be strictly excluded on account of their poisonous properties, as a continuous wetting of the hands by the poisonous liquids can in practice seldom be avoided. The experiments undertaken on a large scale in tanyards for the removal of lime by means of creasotic acid have demonstrated that the liquids in which were immersed the kips, skins, and hides after this treatment in a solution of creasotic acid resisted decomposition and mouldiness for a much longer time than had been observable heretofore. It appears, therefore, obvious, that the small amount of acids still left in the kips, skins, or hides has already sufficed to energetically combat the above destroying influences.

Direct experiments with creasotic acid have demonstrated the above remarks in the most conclusive manner. Added to the proportion of 1 : 2000 to the liquid requiring to be preserved, the destruction or mouldiness mentioned is completely prevented. This is effected in a higher degree than with creasotic acid, by employing the two oxi-naphthoic acids, which operate infallibly when diluted in the proportions of 1 to 5,000. Similar, although not quite such important, results can be obtained by the use of creasol and naphthol. Owing to the small solubility of these compounds, which rapidly disappears in the case of the naphthoic acid, it is desirable to use them in the form of their easily soluble salts, which operate even more efficiently than the acids.

The use of the compounds above mentioned for the preservation of tannic extracts and tannin containing lyes or liquids is very simple. A suitable solution thereof can be readily prepared by mixing the substances named with water and diligently stirring the same, particularly when the soluble salts are used. In practice it is better, when these substances are not employed as salts, to dissolve them in alcohol, and to add this solution to the liquid requiring to be preserved while continuously stirring the liquor. The price of alcohol need not have much weight in small operations, as the addition of the alcoholic solution to the liquids which are constantly kept to their standard by fresh quantities of extracts, is only necessary once. The selection of the preserving means must therefore depend upon the fact whether they can serve for the treatment of sweet or somewhat sour tannic lyes or liquids; in the latter case, the use of creasotic acid is of importance, as its sourness enables it to effect the treatment of slightly sour liquids required for many varieties of leather, without there being any danger of its possessing the defects attached to salicylic acid and to the above-mentioned destroying acids, such as lactic acid, acetic acid, and the like, in consequence of their small solubility and of the small doses in which they have to be used. For very sweet lyes, the salts of the naphthoic acids which are found in commerce with a small excess of free alkali are most suitable, as a portion of the acids already in existence is thereby neutralised. The simplest method is to incorporate with the extract the necessary quantity of the substance required for its future solution according to its strength, which are determined by the following calculation, given here by way of example. Supposing that 100kg. of an extract which contains 25 per cent. of tannin is required to be preserved, this extract will have to be dissolved until a lye having a percentage of 5 per cent. is obtained. The 100 kilos of extract will consequently produce 500 kilos of liquor, for the full preservation of which 100gr. of naphthoic acid and soda is required. In this case for each 100kg. of extract 100gr. of this substance will have to be added in order to prevent the destruction of the tannin when diluted with five times its weight of liquid. The substances mentioned can be used advantageously for the preservation of kips, skins, or hides, as compared with other means of preservation, such as heretofore used. These substances are either rubbed in their natural state over the kips, skins, and hides, or the latter are treated with aqueous or diluted alcoholic solutions of the former and subsequently dried. Or the above substances may be dissolved in glycerine or melted therewith. In all cases it is thereby rendered possible to preserve for years kips, skins, and hides free from destruction and mouldiness, for the purpose of preserving them for tanning at convenience.

STANLEY'S PATENT "PEN EXTRACTOR."

THIS useful invention meets a want long felt by all, and more especially by the business man, as with it a dirty or worn pen of any size or description may be quickly, easily, and cleanly removed from its holder, and a new one inserted, without soiling the hands.



It has always been a dirty job to remove a nib; but when one gets rusted in the holder, great inconvenience is caused in extracting it, and such methods are usually adopted as gripping it beneath the lid of one's polished mahogany desk, or screwing it in the copying press, &c., &c., all causing great waste of time, much trouble, and annoyance through the ink getting upon the articles of everyday use, besides frequently damaging the steel part of the holder, and inking one's fingers. The price is only 6d., and few writers who value clean fingers will be without one.

ARMOUR FOR SHIPS.

AT the twenty-first ordinary meeting of the session of the Institution of Civil Engineers on Tuesday, the 9th of April, the paper read was on "Armour for Ships," by Sir Nathaniel Barnaby, K.C.B.

The author described and illustrated by drawings the applications of armour to ships in the French navy between 1858 and 1888. He directed attention to the increasing thickness of armour to meet the growth in the gun, to the corresponding reduction in the area of surface covered, and to the eventual disuse of side-armour for protecting the batteries. Thereupon the development of quick-firing shell-guns was rapidly extended, and high explosives, such as gun-cotton, melinite, bellite, lyddite, &c., were introduced, and were being perfected as bursting charges for shells. On the assumption that thin armour was, and would remain, effective against such projectiles, armour of 4in. and 5in. in thickness was again being demanded, by sailors, for the defence of the sides of the ship in front of the batteries. Believing that such armour would be costly, ineffective, and even dangerous, and that it would tend more than ever to reduce the number of ships which could be brought into action, the author drew attention at the outset to what he conceived to be a wrong policy for this country. He observed it was certain that, apart altogether from these quick-firing guns, it would only be necessary to put up targets of thin armour, and expose them to the fire of heavy projectiles, in order to show the frightful wreck, behind the target, which occurred years ago, and which led to thicker and ever thicker armour. But there would be this difference in favour of the gun, that the projectiles were heavier and stronger, the velocities higher, and the explosives more powerful. He showed that without going beyond the ships now building, an expenditure of £1,000,000 per ship had been reached. On examining all such large ships, whether British or foreign, it would be discovered that they were most seriously exposed to the attack of the powerful weapons now in rapid course of development. The naval authorities had to decide whether they would concur in still further enlargement in individual ships; or would endeavour rather to meet these weapons by combining the forces of smaller ships. The author considered there was no difficulty in taking the latter course, and that it had many advantages. The principle of subdivision was consistent with perfect seaworthiness, with speed as high as that of the largest ships, with the control of weapons which could be used with fatal effect upon the most powerful ships of the enemy, and with such powers of endurance as would enable the smaller vessels to receive injuries from the largest ships without necessarily fatal results. If it should be said that this dispersion of force entailed a risk of destruction in detail, by encounters with units of greater force in the hands of an enemy, that argument simply went to show that organising skill would be required to insure the presence of the united forces where they were needed. Referring to the concentration of material value in a few ships, thus preventing the construction of many ships, he remarked that in the line-of-battle ship of fifty years ago the value of the material for a single command was about £100,000, and the value per man in the crews of such ships not more than £150. In the ironclad of 12,000 tons of to-day, the value of ten of the former line-of-battle ships was intrusted to each captain, and not less than £2,000 to each man in the crew. In order to put forward, in a concrete form, his view as to the type of fighting ship most suitable for the present needs of the British Navy, he had brought forward a design. It was for a ship of 3,200 tons displacement, costing one-fourth of the so-called first-class battle-ship of to-day. A sufficient number of ships of this type could probably be built and armed in two years. It might be said that nothing could be done upon such dimensions, and at such cost, to entitle the ship to be called a battle-ship. But the seventy-four gun line-of-battle ship of fifty years ago had only a total displacement of 3,000 tons; and the eighty-gun ship of the same period 3,600 tons. The design came between the two, and would only cost as much as three seventy-four gun ships. If the British Government determined to spend money upon invulnerable ships, the difficulty in getting enough ships would be perpetually growing. There was no obstacle, except in finding the money, to making an invulnerable ship. Ships could be built and navigated which no torpedo, or ram, or gun that could be worked from any ship now in existence, could fatally wound. In such a ship every man might be absolutely protected, high explosives notwithstanding. But there would be so few of them that commerce and the Colonies might be lost for want of ships, and there would only be the satisfaction that the sailors had been protected in such ships as existed. The question was, ought England at the present moment to move still farther onward in increasing the size and cost of heavily-armoured ships, requiring four or five years to complete? Or, ought this country rather to endeavour to increase rapidly the number of protected ships capable, by reason of their speed and armament, of taking part in any engagement with an enemy, however powerful? In this exposition of the uses of armour it was apparent that fighting ships must continue to use it. When armour was employed in the form of comparatively thin horizontal plating, experiment seemed to have shown that steel, low in carbon, was the best material. When it was employed in the form of a wall, either upright or inclined, and comparatively thick, the value of a hard face became very marked. The various modes of manufacturing thick armour for upright, or nearly upright, defences were described, and illustrations were given of the comparative resisting power of compound and of forged steel plates; also of two armour plates of great excellence manufactured at Sheffield, one of them compound, having a steel face and an iron back, and the other of forged steel throughout. The superiority of the compound plate was very marked. The author also drew attention to the improvement effected by the use of the hydraulic press in the manufacture of thick armour-plates. To many minds, it seemed that the hope of the future, for peaceful sea-traders, lay rather in abasing than in increasing the individual superiority of the special ship of war. No efforts should be spared to raise the character and strength of the fast mercantile ships. But it must be admitted that there was no prospect of a diminution in the use of armour in regular fighting ships. The evident tendency was towards its introduction into every fighting ship. Referring to the aspect of the question from the side of the attack, the author remarked that when the large unarmoured structures in the French ships were considered, the seriousness of the new attack became evident. And it was the artillerist who must be first impressed. It was of more consequence to be able to inflict damage in action than to be able to avoid it. The best defence was to be found in a vigorous attack. It must be understood that the powerful ships in modern navies were not protected, so far as their batteries were concerned, by the armour which the French thought necessary. They were unarmoured from their lower decks upwards. The author asked: Was full advantage to be taken in the British navy of these high explosives in any war which might break out within the next two or three years? Writing before the Government proposals had become known to him, he would agree cheerfully to any suggestions by the Government as to the size of the new ships, and as to the use of armour for them, if they were laid for approval before some competent technical committee for a month. If the author were responsible for the steps which must be taken by the Administration, he would insist upon having the soundest independent judgment which could be obtained. He felt satisfied that if such a body as the Council of the Institution had been consulted in 1868, 1871, and 1875, when naval ordnance was in a crisis and under serious debate, it would not have happened that the question of breechloading would have been kept closed from 1866 until 1879. He believed that if such a body had been consulted in 1859 it would have appreciated better the significance of the four ironclad ships then building in France, and the Government proposals would have been wisely modified. The attitude of the engineer towards questions of war-material differed from that of a member of a political administration, and from that of naval and military officers. The engineer was mainly interested in the question of the development of the powers of weapons of war, and he was constantly thinking how they might be extended, and how the maximum of power might be got out of a given expenditure. The tendency with the Administration was to estimate the comparative value of available resources of rival Governments, and not to look beyond the immediate future. It might be seen, from the speech of Sir John Pakington, when introducing the Navy Estimates, on the 25th of February, 1859, and when the French ironclad sea-going ships were being built, how easy it was to undervalue new forces. This Administration undertook the building and conversion at that time of sixty-seven wooden line-of-battle ships and frigates; and they were all in the hands of the dockyard authorities, in various stages of production, a few months afterwards. But not one of them was suitable for the circumstances of the time. Many of them were never finished.

SOME RECENT DEVELOPMENTS IN ARTIFICIAL ILLUMINATION.[*]

By Prof. Henry Morton.

On the evening of October 18, 1878, in a lecture delivered before the American Gas Light Association, at the Stevens Institute of Technology, I used the following words:—

"While improvements will, of course, be made in the development of light from electricity, improvements are also being carried out in the production of light by the combustion of gas; and there is no reason in the nature of things why the improvement in the one direction should not keep up with that in the other."

Looked upon as a forecast or prediction, this has not been fulfilled; but I still think it is true that "there is no reason in the nature of things" why the improvements in illumination by gas should not keep pace with those in illumination by electricity. The reason why they have not done so is not in the nature of things, but in the nature of men.

In other words, while for the last ten years we have had most of the brightest minds of the world intent on the development of the electric light, and the means for producing it, very few have given their attention to the improvement of the gas light, or the methods for its production.

The result has been that, while the electric lamp of to-day is between twice and three times as efficient as the electric lamp of 1878, the gas-burner in all but universal use is identical with that in like use ten years ago, and, with one exception, no marked improvement has been reached in any of the proposed new burners which are seeking recognition and use by the public. At the very lecture to which I have above referred I exhibited a Sugg burner with which a consumption of 40c.ft. of ordinary 16-candle gas gave a light of 250 candles, or 6¼ candles per cubic foot. This is an efficiency which, as far as I know, has not been very much surpassed by the Siemens-Lungren or similar burners which are seeking introduction at the present time, unless it may be where very large volumes of gas are consumed in a single burner.

The mere cheapening of gas, I contend, is not the only or the scientific method of correcting the manifest wastefulness of our present method of using it to produce light. It would be equivalent to saying that to secure cheap fuel was the right way to improve the steam-engine. In the case of gas such a policy, if persisted in, can only result in relegating gas to the cellar, the kitchen, and the engine-room, to warm us, to cook our food, and drive our machinery; and in replacing it, as a means of illumination, by electricity, which may, it is true, owe its very existence and life to the enslaved labours of its deposed rival, imprisoned in the furnace of the steam-engine, or labouring blindly in the closed cylinders of the gas-engine.

The problem presented to us when we seek the improvement of the gas-burner is a most encouraging one, because the prospects of a satisfactory solution are so good. Thus, in the first place, there is such an immense margin of profit or possibility of improvement. This I will now endeavour to point out by the following considerations:—In 1865 Prof. Julius Thomsen, of Copenhagen, showed that the mechanical equivalent of light was about 12·28ft.-lb. per minute, or 749ft.-lb. per hour for each candle. (See *Philosophical Magazine*, 1865, Vol. XXX. p. 246.) Mr. Moses G. Farmer, in a paper in the *American Journal of Science and Arts* (1866, Vol. XLI. p. 214) showed as the result of certain experiments made in Boston with an electric light, that the mechanical equivalent of light was about 10·1ft.-lb. per minute for each candle. This would give us an average of 11·29ft.-lb. per candle, or, for the sake of round numbers, say, 12ft.-lb. per candle per minute. If a candle-power per minute represents 12ft.lb., a candle-power for an hour would be equal to 720ft.-lb. in the same time. A cubic foot of our Hoboken gas gives about 640 heat units. That is to say, a cubic foot of it in burning would raise the temperature of 640lb. of water 1° Fahr. This multiplied by Joule's equivalent of 772 gives 493,080ft.-lb.; or, say, for round numbers, 500,000. That means that a cubic foot of this gas, in burning, gives out half a million foot-pounds of energy.

Now let us see how this compares with the amount of energy developed in the form of light by the same cubic foot of gas. This same Hoboken gas, burning in a standard Sugg burner so as to make it give 16 candles, will burn just exactly 4c.ft. per hour. That gives an efficiency of 4 candles per cubic foot. Each cubic foot will therefore give us 4c.p. for an hour. Therefore each cubic foot so burned would, in an hour, give out light equal to 12 (the energy of one candle light) multiplied by 4 (because there would be 4 candles) multiplied by 60 (the number of minutes), which is equal to 2,880ft.-lb., and this is the total energy of the light developed. While it is doing this, or was giving out the 2,880ft.-lb. of light energy, it was at the same time giving out the half-million foot-pounds as the total energy of combustion. The percentage of light energy to total energy would then be 0·586 per cent., or, in round numbers, 0·6 per cent. So we may say that with the ordinary Sugg burner, giving 16 candles while burning 4c.ft. per hour, we are getting a light efficiency of 0·6 of 1 per cent. of the energy present in the gas burned.

This shows us that in this Sugg burner we are turning the available total energy into a particular kind of energy by a method which is enormously wasteful; and that, therefore, there is every probability that some change in the method, or some new invention, will improve this conversion to an equally great degree. And if it only economises a little, if it gives us even but one per cent., instead of 0·6 of one per cent., it will be giving us an enormous advantage at once.

But, even with this terrible waste, when we are only getting 0·6 of one per cent. of energy as light, throwing almost all of the energy of the gas away, and only saving this fraction of a per-cent., we still stand pretty well in the long-run in comparison with electricity, as I shall show you presently when we come down to the final figures.

In the case of the incandescent electric light we find the following figures. Assume that practically you can get ten lamps of 16 candles each for each horse-power expended. (Some people will say that that is too much, and some will say that it is not quite good enough; but that it is not very far out of the way I think most people will admit.) This figure will make, for each horse-power, 160 candles. Now at 12ft.-lb. of energy per candle per minute, in the form of light, this would give us 1,920ft.-lb. of energy per minute, in the form of light, from these incandescent lamps. A horse-power expresses 33,000ft.-lb. per minute. Comparing these numbers, we get 5·812 per cent. of the total energy, developed as light, instead of 0·576 per cent. in the case of the gas-burner. In other words, in the electric lamp we have about 10 times as much of the total energy usefully converted into light as in the gas-burner.

If, however, we go back to the coal as the source of the energy, then we are confronted at once with this other condition. In the steam-engines used for running electric light plants (and this is the result, not of mere guess, but of a number of measurements which have been made here by various members of our faculty, on electric-light plants) we utilise only about 5 per cent. of the energy of the coal used to produce the power applied to develop the electric current. It is true that there are engines that give 10 per cent., and perhaps there are some that give a little more—I think that 10 per cent. is very high, and is not practically reached at all in any such conditions as exist in engines running electric-light plants, and I think that 5 per cent. is about as much as we can depend upon. On the other hand, in gas-making I think you will allow that there is not any greater waste in the production of gas from coal than 50 per cent., and, therefore, you get into the gas 50 per cent. of the energy of the coal.

From this you see that there is here the same ratio (one to ten) between gas and electricity, only it is turned the other way. In order to turn the coal energy into motion (as in using the steam-engine to drive an electric-light plant), we throw away 95 per cent., and only utilise five per cent.; in order to turn coal into gas we throw away 50 per cent. and utilise the other 50 per cent. So that, getting five per cent. in the one case and 50 in the other, the proportion is as one to ten; and that brings the two systems to an equality again; for, starting with the coal, about as much of the total energy of the fuel is developed by the gas-burner as by the electric lamp. Thus, starting with the coal pile, and considering merely the question of the conversion of coal into light, one process is about as wasteful as the other at present. I think this is a very encouraging thing to the gas-makers. It shows us that, notwithstanding all the advantages that electricity has had by reason of its attracting the attention of the most ingenious minds of the world, and with all the ingenuity, thought, and effort which have been devoted to it, the conditions are still nearly equal in respect to developing energy from its crude source—the coal. I think it shows that if even a moderate amount of the same genius and effort was turned in the direction of developing light from gas, and in improving the agencies which effect this conversion, we might hope for something very good indeed.

I am aware that some who are connected with the electric lighting interest say that they do much better than what I have stated; but I have taken the trouble to inquire what any company believes any other company can do, and I find that they would all much rather guarantee an efficiency of four watts per candle than anything better—if they knew that the guarantee was going to be enforced. In another comparison which I have made I have, therefore, taken four watts per candle, because I find that to be the result of many tests. The Franklin Institute tests, made a few years ago, showed nearer five than four watts for Mr. Edison's lamps. Suppose that we take four watts as being not an unfair estimate of the practical efficiency of incandescent electric lamps on the average. There being 746 watts to the electric horse-power, this gives 186 candles to the horse-power; and each candle representing 12ft.-lb., we have 186 × 12 = 2,232ft.-lb. of light energy to the horse-power; and 2,232 ÷ 33,000 gives us 6·7 per cent. as the efficiency of the electric lamp on this basis—which is not far from the 6·0 per cent. which we have already calculated from other data.

Another obstacle in the way of introducing the electric light existed in the fact that until some satisfactory method of measuring the electric current was discovered, there would be serious difficulty in making its use a commercial success. We all know what difficulty there was in introducing gas before the companies got to measuring it, when gas was sold at so much per light, and the consumers knew that they might burn an excessive amount without having to pay extra for it. The same difficulty has existed with regard to the electric light. The lamps have been put in and a contract price agreed upon, upon the assumption that they were to be used only a certain number of hours per day; and then they have been used two or three times as long. It has been a very difficult matter to control. It is only very recently that this requirement has been, as it seems to me, very satisfactorily met.

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[*] Extracted from a lecture before the Society of Gas-Lighting, delivered in Stevens Institute, Hoboken, N.J., January 17, 1889.

In the first place I will show you the Westinghouse meter which I have here on the wall. It consists of certain coils through which the alternating current passes. By adjusting the angle between the coils the amount of motion obtained can be regulated and arranged. These vanes encounter resistance from the air. If they move more rapidly, they experience greater resistance. Therefore, by adjusting the size of the vanes and the position of the coil, it is possible to regulate the motion of the registering parts of the device so as to correspond with the flow of the current. If the vanes move slowly, they record a small flow of electricity; if very fast, they record a rapid flow. That is, the rapidity of the motion is in proportion to the flow of the current. It is only necessary to connect the vanes with a train of wheel work, moving little hands on dials, and you have a meter as accurate as any ordinary gas meter. There is a little glass, in an opening in the case, through which you can see the vanes going around, and so, in a general way, judge whether it is running fast or slow. Then, through this other little window you can see the hands on the dial plate, and may in that way follow it from hour to hour, or day to day, and see just what the consumption is. The consumption of current may be indicated on the dial in whatever way is thought best. It may indicate lamp hours, or the equivalent of cubic feet of gas, or ampères, or anything else. For all practical purposes, it seems to me that this instrument measures electricity exactly as the gas-meter measures gas. Experiments have shown that this meter can be kept right within two per cent. This meter will measure 40 lights. I am not able to state its cost, but there is no reason why it should be more costly than a gas meter, as there is nothing about it to make it expensive. The train of wheels, if made in quantity, would cost very little. In addition to that, there are this little metallic disc and the spindle. There is no machinery to move it, and no rubbing surfaces to make a connection. That is the very extraordinary part of it. It is a revelation in electrical machinery.

This meter is constructed on the principle of the motor which will very soon appear in the market—a motor to be run with alternating currents, and in which there are some remarkable peculiarities. There is an armature with its current closed on itself—that is, the wires of the armature come around so that the two ends meet, and there is no connection outside. Then there are coils outside of the armature through which the alternating current passes, and when the alternating current passes through this exterior circuit, the armature rotates.

(Query: "Does it take any pressure from the current to drive it?) It takes a minute quantity, of course, to do anything; but as a meter it is a very economical machine. As a motor it has an efficiency of 85 per cent. or thereabout. In practice this machine takes no more from the current than a gas-meter takes from the pressure of the gas.

(Query: "Suppose you drive that by a 40-light current, would not the resistance of the air make considerable difference?") It would make a difference, of course; but the adjustment is so made that it will give a correct proportionate measurement. It is intended that there should be a little more resistance in the air at the time, and that helps to make the indications accurate. It takes a little more energy out of it when measuring a large current than for a small current; but that is proportioned all the way through, so that the registration keeps within 2 per cent. I am purposing to make a series of tests, so as to be able to see for myself just what it does; but I fully believe that what is told me about it is reliable, and that it really operates with that degree of accuracy.

In addition to that, I call your attention to another form of meter, which has been developed in this Institute, and which I think is very ingenious, and may meet another want in that direction. It has not the attractive characteristic of looking so much like a gas-meter, and so it does not quite come home to our hearts as the other does; but still there may be cases where that fact would not be considered a great disadvantage.

The foundation principle of this meter is shown by the small object which I have in my hand. It consists of two pieces of German silver—a German silver wire and a strip of German silver. In the first place, this strip of German silver is, by a simple mechanical treatment, punched and cut in such a way that there are a vast number of equally-placed little cuts right through the strip; and then the piece between two cuts is pushed one way, and the piece between the next two cuts is pushed the other way; and so the pieces are pushed alternately backward and forward, so that a wire can be run right through, like the warp and weft in weaving. You have often seen a ribbon laced into a piece of trimming in this way, and just so is this small wire laced in and out. Here is a piece of insulated German silver wire that may be thus run through the sort of open tube which is made by cutting the strip, and pushing the parts alternately backward and forward, and if when it is so inserted pressure is brought upon the threaded strip, the whole is made tight and solid. That being done, one end of the wire is soldered to the strip at one of its ends. Then a current is passed up through the wire and down through the strip.

The heating effect of the current is next to nothing upon the broad strip, but is relatively great in the wire. The result is that the wire expanding, but being held piece by piece all the way along by this strip which does not expand, causes it to curve or bend over, and so bend or curve a great way. Now, any change of surrounding temperature (I mean any change of the temperature of the room) will have no effect upon this compound wire and strip, because it will affect both parts (wire and strip) equally. It may be exposed to a freezing mixture or to boiling water, yet remain perfectly straight; but if you pass a current through it, it will bend in proportion to the force of the current. It bends so much that, if you fasten one end, you will see the other end swing through a long arc.

We fasten the strip at one end, while the other end carries a little pencil or marking point. Beneath the point a disc of card or paper is rotated by clockwork. It may occupy a month, a week, or a day in rotating. As it rotates, of course, if the point stood still it would draw a circle upon the disc, and the diameter of the circle would depend upon the amount of current passing. If no current were passing, it would draw this inner circle; if a great current were passing, it would draw a circle far out here. According to the amount of current passing, it will draw circles at different distances. The result of this would be that when, from time to time, you looked at this rotating disc, you would find marks which would indicate just what strength of current was passing at any one time; but when the whole thing was done it would require a little calculation, or the use of some instrument, to read from the card what it represented, and get the summation of the amount of current passing during any given period. Sometimes a great deal of current would be used, say, for one hour, and very little for another hour; and therefore it would require some work to integrate and determine what the aggregate amount was. It would not be a thing that you could read off at the mere inspection, as you can with the other meter; but there are many ways of making it quite easy to read it. In fact, there is now a plan under way by which the apparatus can be made self-integrating.

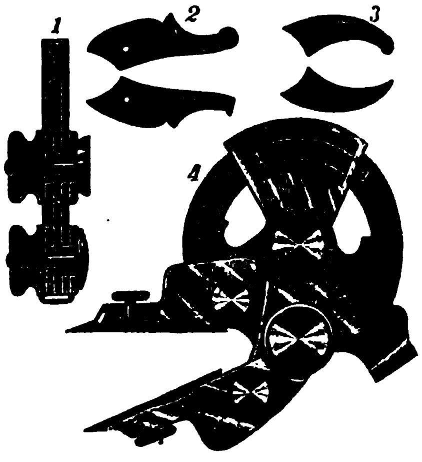
(Query: "I understand that the main advantage claimed for the alternating current is the saving of expense; but do you not have to use one of the converters for every customer?") Not for every customer. For example: An enormous plant is being put up near London at the present time. They have selected ground about seven miles out of London, where they can get the coal shovelled right out of the vessels into their yard, and so run their boilers in the most economical way. Now for the number of lights which they expect to run (something like half a million or more), it would require a year's product of the world in copper to furnish conductors on the direct system. There would have to be cables as large as a barrel. But they propose to generate the current at an enormous potential, and use an electromotive force of 10,000 volts. They will run it in that condition on a comparatively small wire—no larger than the ordinary arc light wire. Of course, that will have to be very carefully insulated and inclosed.

This current will be carried down to a central point in London, and there be converted by one set of converters down to 1,000 volts. This will be carried as a 1,000 volt current to the different houses or groups of buildings, and there a converter such as *this* will bring the current down to 50 or 100 volts, as may be desirable. Of course, as the report with which you gentlemen are so familiar and the rest of the world so ignorant, has shown you, there are many cases in which the distribution of electricity by this system is not advantageous. If the people using it are not within a moderate radius around the central station, there would be no object in using it. Its true efficiency will come in best where you can have the direct system for the immediate neighbourhood, and then at a distance use the other system to overcome the loss and expense of conductors.—*American Gas Light Journal.*

A bed of salt has been found in Kansas, 400ft. thick. It is said to extend for 300 miles, and to be 25 miles wide.

IMPROVED CALIPERS AND DIVIDERS.

THE illustration represents an improved measuring and drawing instrument specially adapted for mechanics, to be used as inside and outside calipers, dividers, &c. It has been patented by Mr. Thomas Green, East Davenport, Iowa. Fig. 4 is a face view and Fig. 1 a transverse section of the instrument. The central plate has a hub, on which is mounted to turn the indicator, fitting over the sides of the plate and on to the hub on each side of the plate, the indicator being held in place by a bolt passing through the centre of the hub. A nut screws on the bolt against the other arm of the indicator, and by adjusting the nut the indicator is permitted to turn freely on the hub, or is fastened in any desired position. The indicator has slots on both sides, near its outer edge, arranged segmentally and directly over the outer edge of a segmental part of the central plate, and both the inner and outer edges of these slots, on both sides of the indicator, are formed with graduations, indicating over graduations formed on the inner and outer edges of the segmental part of the central plate. The graduations may be of two systems, on each face, one system indicating by the English and the other by the metric system, making a combination of readings on both sides of the instrument. Around its axis the indicator has gear teeth, which mesh into a segmental gear wheel turning on a bolt secured in the plate, this segmental gear wheel having an arm adapted to carry a pointer arm, as shown in Fig. 4, or one of the inside or outside caliper arms shown respectively in Figs. 2 and 3. The other arm of the dividers and calipers is adapted to be secured to the fixed plate by a bolt, and in order to hold the arm in place there is a notch in the plate, into which fits a corresponding lug formed on the arm. The dividers and inside and outside calipers are adapted to be adjustably fitted into the arms, respectively, according to the use to be made of the instrument, one of the inside and one of the outside caliper arms being provided with a friction-wheel at its point. To open or close the divider or caliper points, the operator takes hold of the central plate and moves the indicator, whereby the points are moved toward or from each other, the graduations on the scales indicating the exact measurement in inches or centimetres, &c.



THE MILLING MACHINE AND ITS OPERATIONS.*

THE universal milling machine dividing-head, as used on nearly all machines of that type, would seem to present little room for improvement. It does when we want to use it only in the ordinary manner, as its construction admits of the most accurate dividing, provided its original conditions are maintained. But there are very often operations of milling that the dividing-head as applied will not admit of doing, and consequently its does not bear out its name, "Universal."

I have frequently had jobs of work to do in which it was necessary to have the chuck face the spindle of the machine, and have it geared to the screw, as in the case of cutting spirals, for instance, or a scroll gear either flat on face, or conical. It will be seen that the dividing-head as now used on nearly all Universal milling machines is not adapted for this kind of work.

I improvised a plan for cutting a scroll which cost very little to make, and is shown in Fig. 1. I made a stand A, and bolted it to the end of the platen, where the dividing-head is usually used, and bolted the head on its side on the centre of the platen, upon parallel pieces (not shown in drawing), for the purpose of the bolt-head escaping the platen.

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* By A. B. Landis, in the *American Ma*

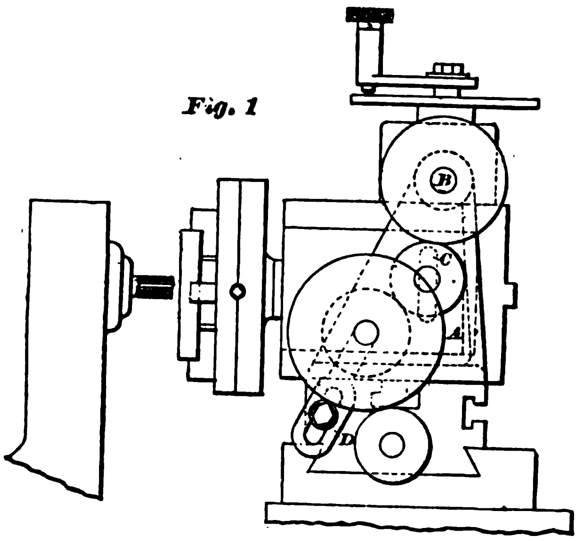


Fig. 1

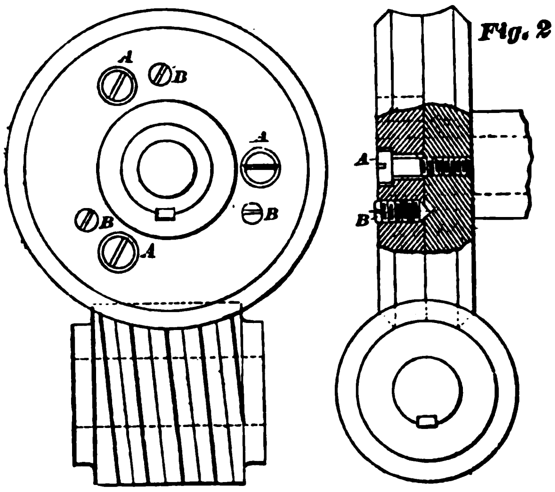


Fig. 2

A shaft B connected with the shaft in head, with its other end supported in a bearing on the upper end of the stand A. A slot, C, receives a stud upon which is mounted an intermediate gear, the ordinary bracket stud (as used on the Brown and Sharpe machine) D being fastened at its usual place on the end of the platen, by which means the usual compounding of the gears can be made, the intermediate stud in slot C being only used to make the connection to the top. It will now be seen that a scroll on the face of a plate can be readily cut of any pitch and at any angle desired by swinging the head round to any degree, by the same means it is swung up and down when in its regular position. To make a more complete job of this, a neat base could be made to fasten the head to, instead of the parallel pieces, which would only justify the doing n case of considerable work of the kind to be done. This arrangement does not make a neat appearance, ut it answers its purpose well.

With reference to accurate dividing, I have lready said that the construction of most dividing eads admits of it, for the reason that a worm gear is sed and the index is placed upon the worm shaft, thus elieving the index pin of the strains it would get ith the index plate mounted on the spindle, and lso admitting of a greater number of divisions to e made from the same index-plate, and also make ore accurate work, provided an accurate worm-heel has been made. A good dividing head of this ind is the one only which has no lost motion in y of its parts, and to avoid lost motion ample proion for adjustments should be made in all its rts. The worm and worm-wheel is quite sceptible to wear, and hence lost motion, and hen this once occurs no dependence for accurate viding can be placed upon the machine. To overme the trouble, the parts must be brought to iginal conditions. Brown and Sharpe make the orm-wheel in their dividing head in halves, and sten them together with three screws. In their atise on the milling machine they state "making capable of adjustment," but they do not provide e means therewith, nor state how it might be isfactorily accomplished.

I will here give my method of adjusting it (which ly is their plan also). I took the wheel apart, arged the holes in the one half—as well as the nter-sunk portion—to make room for the bolts A. A. Fig. 2. I then put it together again and ted it around as far as the bolt would permit, and fastened them, then I bored holes to receive the screws B through the one half, and counter-sunk the other half to receive the point of the screw. Now, by loosening the screws A and having the worm and worm-wheel in place in the head, with the cap removed, draw up the screws A just sufficient to allow the two halves to slide over each other (not freely), then adjust the three screws B until the worm will engage the worm-wheel without any play. Then securely fasten the screw A, and the adjustment is complete. Now it is in readiness for quick adjustment at any future time, and will allow of many adjustments thereafter, and an accurate dividing head be maintained at all times. Whether all manufacturers of milling machines have made this provision in the worm-wheel as stated, I am not aware; but if not, the remedy is not quite so clear as in this case.

It is obvious that this worm-wheel is now susceptible to more wear than before, since it has only one-half of the bearing surface; but this presents no argument against it.

In cutting gear-wheels this lost motion will be found exceedingly objectionable, owing to irregular spacing.

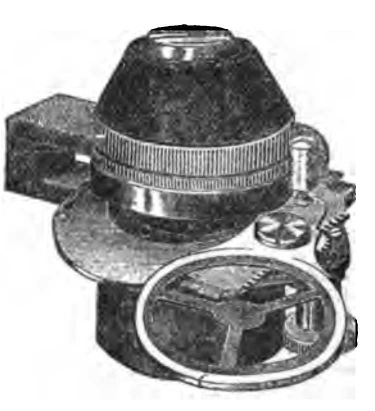
Before adopting the method here described, I helped the case by using a face-plate, screwed on the spindle of the head, and applied a strap over its edge, fastening it with a screw, and suspending it over the sides of the platen, and applied a weight, and thus kept the lash all in the same direction. But in the case of cutting steel or wrought gearing (or any other similar work) it failed to produce good work—chiefly for the reason that the gear-cutting miller has so little side clearance that cuttings, lodging on either side of the miller when coming in contact with the side of the gear-tooth, will thrust it from one side to the other, and make very rough work. This is also true, however, to an extent, with a closely-adjusted dividing head, since the arbor holding the blank to be cut will spring.

To make smooth work in cutting wrought-iron or steel gearing, when the entire cut is made at once, and oil is used, some means for brushing or washing the cutter should be employed, else smooth work cannot be the result. To cut them dry is very hard on the milling cutter, especially so since the side clearance is so little. The best results, no doubt, are obtained by roughing out first, and finishing with a very light cut without oil.

NOTES ON THE SUBSTAGE CONDENSER, WITH SPECIAL REFERENCE TO THAT OF PROF. ABBE.*

THIS piece of illuminating apparatus is one of the most important and valuable that the microscopist can possess. It may be used to increase the illumination until the eye refuses to endure it, or the light, by its means, may be reduced to the faintest glimmer. With it the whole aperture of the objective may be filled by a solid cone of light, and by the use of the proper diaphragms, or by moving the entire condenser laterally, illumination of the greatest obliquity may be obtained for the resolution of tests, or for the study of obscure structures of a certain character; and with the best of the modern substage condensers, black-ground illumination of the most exquisite beauty may be accomplished. The defining and resolving powers of the objective are improved by its use. Indeed, the best high-power homogeneous immersions will not do themselves entire justice without the use of the wide-angled condensers now so common.

In what is called black-ground illumination the object appears to be self-luminous, gleaming with the vivid radiance of molten silver, seeming to rest softly on a background of the blackest velvet. Living animals appear like moving creatures fashioned from moonbeams; minute particles shimmer and flash like silver stars; a little heap of coloured sand-grains seems a little heap of rubies and diamonds from Sinbad the Sailor's Valley of Gems. And to obtain such exquisite pictures it is only necessary to obstruct the central beams of light by a circular opaque disc, allowing the object to be illuminated by the light that comes to it from the periphery. No rays reach the objective directly. All must first enter the object and there be properly refracted or reflected, or after passing through the object, they must be thrown back on it by reflection from the cover-glass, so that under the beating of those waves of light it shall appear to glow with a soft intensity indescribable. This effect may be obtained, sometimes better and more easily, by substage apparatus especially intended for the purpose, rather than by any substage condenser.



The accessory just mentioned is a collection of two or three lenses forming an instrument somewhat similar to an objective. It is fitted to the substage ring so that it may be accurately centred, which is essential to its best performance, and so that it may be moved upwards to bring the light from the mirror to a focus on the object, or removed from the latter towards the mirror to reduce the intensity of the illumination. Some method, therefore, for changing its position vertically, either by rack and pinion or by direct finger movements, is absolutely essential.

It is always accompanied by diaphragms to reduce the size of the illuminating cone, to obtain light of great obliquity, or black-ground illumination. In the best condensers these are applied below the lenses, while in the cheaper and less desirable forms they are placed above the uppermost lens.

Low-power objectives—those, for instance, up to the ½in. or ⅓in., and those of small angular aperture—do not call for the use of the condenser. Sufficient illumination, generally more than is needed, may be had from the concave mirror alone. For small-angled lenses, if a condenser is desired, the 1in. objective, or an eyepiece of the proper construction, is useful. The objective, when used for this purpose, is screwed into an adapter fitting the substage ring with the front lens upwards, the light being reflected from the plane mirror. If the Acme or other microscopical lamp be used, or if a bull's-eye condensing lens be interposed between the light and the mirror, the objective is then to be raised or lowered until the proper illumination is obtained. With this, however, only central light may be used.

Messrs. J. W. Queen and Co. make a simple and useful form, with an adapter for the substage ring, centring adjustments, and three diaphragms, which are placed above the lenses. The diaphragm with the smallest opening is used here, as elsewhere, for centring the condenser to the objective, the former being moved from side to side and forward or backward, while the eye is at the top of the body tube, the ocular having been removed. This small opening can be easily seen through the objective as a bright spot of light, which must be brought accurately to the centre. For low powers where a larger field is to be illuminated with less intensity than with high powers, the upper lens of this condenser is removed, and the lower one focussed on the object in the usual way after the diaphragm with the largest opening has been applied. This is a commendable, inexpensive condenser for use with small-angled, dry objectives, but for the best wide-angled objectives there are other forms better adapted to the purpose.

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* By The Loiterer in a Microscopist's Laboratory, from the *American Monthly Microscopical Journal*.

Several English and American opticians have produced substage condensers which are praiseworthy in some respects, but it was for Prof. Abbe to devise the best ever offered by any optician. This is the popular Abbe condenser, as supplied by Zeiss, of Jena, and so frequently referred to in microscopical literature.

The condenser as made by Zeiss for his own stands is very large and heavy, and is not intended to be used on those of any other maker. He says that since this is the case "adaptation to stands of other make, therefore, is nearly always impracticable and will not be undertaken." The contrivance is too useful, however, to be abandoned by English and American microscopists, so that the majority of our opticians make modified forms, which preserve the essential features and are adapted to American and English stands. Mr. Zentmayer, Mr. Grunow, Messrs. J. W. Queen and Co., and Messrs. Bausch and Lomb all offer the device with minor points of difference from Prof. Abbe's and from each other's.

The condenser, as made by Mr. Zentmayer, is in two forms, one for use with objectives having a numerical aperture of not more than 1·20, the other for the widest-angled glasses, itself having a numerical aperture of 1·40. The purchaser should, before final selection, consider which form he needs, his objectives deciding the question.

It is not achromatic. As to the desirability of seeking achromatism for it, microscopists differ. Mr. James Swift states that "the superiority of light from an achromatic condenser over that of any non-achromatic arrangement is due to the fact that rays, in their passage through a simple lens or combination of simple lenses, are decomposed into their elementary colours, which seriously impair the beauty of uncoloured objects, such as the *Podura* scale, &c., whereas, in the achromatic condenser this defect is obviated, and all objects are seen with natural colours; moreover, confused pencils of light are produced by the spherical aberration of the single lenses which fogs the image of fine structure, whilst the achromatic condenser, being thoroughly corrected for spherical aberration, provides illumination of the greatest purity, and the most delicate objects are seen with a clearness and sharpness of detail quite unknown to those microscopists whose experience has been confined to the use of non-achromatic condensers." Prof. Abbe, however, says, "the condenser is not made achromatic for the reason that, for the effect contemplated, it would be altogether useless to seek to obtain a sharp image of the cloud or other source of light, as it is in like manner quite immaterial whether the image is formed precisely on a level with the object, or somewhat above or below it." Mr. E. M. Nelson also takes issue with Prof. Abbe's opinion. But no optician in America, so far as I am aware, has offered microscopists an achromatic wide-angled condenser. The only one made, I believe, is the oil-immersion of Messrs. Powell and Lealand, of London.

The modification of the Abbe condenser with 1·20 N.A. has but two component lenses, a large bi-convex posterior one with surfaces of unequal curvature, and an anterior, which is more than a hemisphere in form. The other, with 1·40 numerical aperture, consists of three lenses, the posterior being similar to that of the smaller angled form, while the middle lens is concavo-convex, and the anterior a smaller hemisphere.

When used with wide-angled objectives, to avoid loss of light and to obtain the best results, the space between the lower surface of the slide and the top of the condenser should be filled with water or homogeneous immersion fluid, and in all cases, except when oblique illumination is desired by a lateral movement of the condenser, it must be accurately centred. This is essential to its best performance. For ordinary purposes, however, with dry objectives it may be used dry.

Its focus is only a short distance below the object or the upper surface of the slide. This distance varies with the aperture of the special form used, and is to be ascertained by experiment; but I think the condenser can seldom be employed when accurately focussed, except, perhaps, while studying the striæ of diatoms with high-power objectives and high-power eyepieces. With medium powers the exact focus of the condenser produces a little spot of light of terrible intensity. It is, at least, my own custom with the form having 1·40 N.A., to use it out of focus, except on special occasions; what others may do I have no means of knowing. The thickness of the slide is, however, to be considered, particularly when using it as an immersion with wide-angled glasses.

When employing low powers with central light or black-ground illumination, the concave mirror may be needed to illuminate the entire field; in other cases the plane mirror is always used, especially with the bull's-eye lens.

Several diaphragms, which are used below the posterior lens, for central, oblique, and black-ground illumination, accompany both forms. Those for central light have a central opening, the size of the cone of light and the obliquity of its lateral rays varying with the size of the diaphragm opening employed. For oblique illumination usually two lune-shaped diaphragms are supplied. These are placed in the carrier, one at a time, of course, in any position that may be needed to produce the effects desired. For black-ground illumination those with the central disc supported by radiating arms are used, but to obtain the effect with wide-angled glasses something more is needed than the use of these special discs. A circular diaphragm must also be placed at the back of the objective.

The diaphragm carrier in the American forms of the condenser is usually a sliding plate into whose aperture the various diaphragms are placed, when it is pushed below the lenses until a spring catch indicates that it is properly centred to the condenser, but this has nothing to do with the centring of the condenser to the objective. The spring catch is usually a delicate one and the microscopist is in danger of forcing the carrier beyond the centre.

The light may be readily modified by the use of the circular diaphragms, or, if the change is inconvenient, by lowering or raising the condenser.

For oblique illumination the lunate discs are used, the larger when the greater portion of the cone of light is to be intercepted, the smaller when more of the rays nearer the centre are desired. With either size concavity the condenser will give light of greater obliquity than many objectives will receive. The object, however, may be obliquely illuminated with rays from any direction, either by withdrawing the carrier and inserting the moon-shaped diaphragm in another position, or by rotating the entire condenser, so that the light shall sweep around a circular course. This requires delicate manipulation, an objective of the proper angular aperture to receive light of that obliquity, and very accurate centring of all the parts. It may be done, however, with fine effect in the resolution of lined objects—diatoms, for instance; but if the microscopist owns the condenser of 1·40 numerical aperture, and this form of oblique light is to be employed, the front hemispherical lens of the condenser should be removed and the remainder of the combination focussed on the object without any diaphragm. Then insert the lunate disc, and, if all is well, a glance down the body tube without the ocular will show a small double-convex spot of light near one border of the back lens of the objective, with the diffraction spectra also, if they are specially looked for, particularly if *Pleurosigma angulatum* be the object on the stage. With the condenser of 1·40 N.A., the front lens being removed, and the lunate diaphragm in the carrier, Mr. Gundlach's dry one-fifth inch objective, 135°, resolves balsam mounted *Pleurosigma* into beads, bearing the ¼in. solid eyepiece to perfection, and with this objective, under these conditions the bright spot may be seen, when the eyepiece is removed, to sweep around the edge of the back lens like a drop of fire. To accomplish this with the condenser of 1·40. N. A., it and the objective must be in immersion contact with the slide, while the objective itself should be a wide-angled homogeneous immersion.

If the substage has lateral movements, as it has on some first-class stands, oblique illumination with the circular diaphragm openings may be obtained, but somewhat less effectually, by moving the entire condenser from side to side.

For black-ground illumination, the central disc diaphragm must be used, and with the 1in. objective brilliant effects may be produced under this illumination, with the proper objects. To do this with the 1in. of 33° and the condenser of 1·40 N.A., it is necessary to remove the front lens of the condenser, when the effect will be exceedingly fine. Here again, if the bull's-eye lens is placed between the mirror and the source of light, the plane mirror is to be used; if the light is taken directly from the lamp flame, the concave mirror is the proper one to be employed. Back-ground illumination may be obtained with powers of from five to six hundred diameters, but according to my experience it is not praiseworthy. The field is not brilliant, the object does not glow with that peculiar and attractive silvery fire that seems to come from an internal source, but the picture is foggy with a bluish mist, and the silvery gleams are dull and lifeless.

With his form of the condenser, Dr. Zeiss supplies diaphragms to be applied to the back lens of the wide-angled objectives when black-ground illumination is desired with them. The proper disc-bearing plate is placed in the diaphragm carrier, and immersion contact is made with the lower surface of the slide. The difficulty with any but Zeiss's objectives is to prepare the diaphragms for the back lens. With his they may be made of metal, to properly fit when dropped into the mounting, and the opening will then be central; but if the microscopist must cut them from paper, he need not expect to obtain the best results. The directions are to drop diaphragms into the back of the wide-angled objectives, and then the microscopist is left, by all except Zeiss, to take care of himself. Yet it is, of course, impossible for any one optician to supply these little parts, since no two objectives of even the same magnifying power have the same sized mounting. The microscopist *must* depend upon himself, and he will speedily observe that when the aperture is reduced by a diaphragm at the back lens, the defining and resolving powers of the objective suffer an injurious diminution. The experiment is worth making though no other result than this is obtained.

While black-ground illumination is beautiful, it has little scientific value. I do not know that any discovery, or even any observation of importance, has ever been made by its use. It will at times exhibit certain structural features in a conspicuous way, but only, I think, after they have been previously observed, for in most cases this peculiar lighting appears to make the structure obscure. It may render the contour lines more distinct, and envelop the whole object in a glamour of brilliant beauty; but the microscopist, while he never disdains beauty, never makes it the object of his pursuit.

That the black-ground illumination obtainable by means of the Abbe condenser is not entirely satisfactory with high power, or wide-angled objectives, need give the prospective purchaser no uneasiness. The condenser is the best in existence, except, perhaps, the oil immersion of Messrs. Powell and Lealand, of London. And all of the special adaptations made in this country are equally good. They do not differ in their optical portions, except so far as the aperture is concerned, but in the manner of introducing the diaphragms, which affects only the price of the appliance, and that in all the forms, seems unnecessarily high.

Mr. Zentmayer's modifiation of the Abbe condenser is shown in the accompanying figure.

Simultaneous Thought-Processes.—M. Paulhan, a French psychologist, has performed experiments that he thinks prove that two thought-processes may go on simultaneously. Whether conclusive or not, such experiments corroborate the testimony of introspection that mental processes may take place in addition to the activity that mainly occupies the attention. These ideas in the background of consciousness are allied with the one in the centre or antagonistic to it. While a certain amount of distracting elements may be necessary to preserve the healthy flux of thought, and while in very simple operations two disparate thought-processes may be carried on successfully together, economy demands that, in the main, the ideas in the background of consciousness should be harmonious with the one in the focus of attention. The waste of energy when these ideas are of an unessential or distracting nature is a matter of common observation. A single illustration will suffice. A student is passing an examination. He is ill-prepared and nervous. The question he is answering, or the problem he is solving, occupies the focus of consciousness, but in the background are such distracting ideas as the fear of failure, the thought that there will not be time enough to answer all the questions, the query whether it were not better to omit this particular question, the self-conscious fear lest he is growing nervous, the sound of the proctor's footsteps, the scratching of a neighbour's pen, and the like. Most pupils know the waste caused by such distracting ideas. Even if by an effort of will these inharmonious elements are kept strictly in the background, still there is some loss of energy, and the effort of will demanded to repress them also takes energy.—*Scribner's.*

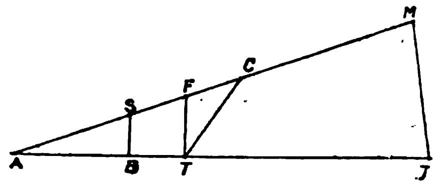
Sugar as an Anti-Incrustator.—Col. Potto, an Italian engineer, has, it is said, recently made some interesting experiments respecting the employment of sugar as an agent to prevent the incrustation of steam boilers. The experiments were made in a boiler of 20-horse power and containing 126 tubes, and the results are stated to have been highly satisfactory. Two kilos. of sugar were introduced into the boiler every week. Formerly the same boiler used to become incrusted in a period of about six weeks, but at the end of a like period after the sugar had been employed it was found to be but slightly coated. After the boiler had been working continually for upwards of four months with sugar introduced into the water, a thin film of incrustation was found to be formed; but this was easily removed by washing.

SCIENTIFIC SOCIETIES.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE seventh meeting of the present session of the above society was held in its room at the Royal Institution, Colquitt-street, Liverpool, on Monday evening, April 8th, Mr. James Gill, F.R.A.S., in the chair.

The business of electing the candidates and proposing the new candidates for membership being over, the chairman called upon the Rev. J. Bone, F.R.A.S., to give his paper "Upon a Proper Determination of the Size of the Plane Mirror in any Reflecting Telescope of the Newtonian Form." After referring to the importance of the subject to amateurs, the reverend gentleman went on to remark that the flat of the telescope is made too small, under the mistaken impression that a waste of mirror surface would be incurred by making it larger. This, though a possible drnger, might yet lead to another danger—the making of the flat so small as not to take in the whole of the rays from the solar or lunar image. Most amateurs might solve the question by drawing a triangle representing the cone of rays from the mirror with its diameter at the base, and the focal length as the axis, the major axis of the flat being equal to a diagonal section of the cone at the position on the axis where the flat is proposed to be placed. Though this method would serve to secure the performance of the telescope on a star, or an object of no apparent diameter, yet it will not fulfil the conditions for the performance of the telescope on the sun or moon, the image of either of these being, not a *point* of light, but a measurable image, the size of which depends on focal length. To find the place of a flat that will take in the whole solar or lunar image it will be necessary to measure a cone of rays longer than to the actual focal point; not that the focus of the sun or moon is longer, but the different angles at which rays from different parts of the sun or moon's surface are approaching the mirror cause the incidence of each ray upon the flat in a different position; the flat must, therefore, be sufficiently large to embrace all the positions. To illustrate by example, take the case of an 8½in. mirror with 76 focus. The focal image of the sun in this case is ·70744, or ·35372 radius. To find the size of flat to be placed at 11in. from focus—



Draw right-angled triangle A M I.
Make M I = 4·25in. (semi-diameter of mirror).
B I = 76in. (focal length)
Then S B = ·35372in. (semidiameter of sun's image).

Put F T, the flat, at 11in. from B, and draw T C at 45° to F T. To find F T, we first find A B = x.

$$x : SB :: AB + BI : MI.$$
$$\text{Or } x : {\cdot}35372 :: x + 76 : 4{\cdot}25.$$
$$\therefore x = 6{\cdot}9{\cdot}$$

And to find F T—

$$x : SB :: BT + x : FT$$
$$\text{or— } {\cdot}6{\cdot}9 : {\cdot}35372 :: 17{\cdot}9 : FT$$
$$\therefore FT = {\cdot}9176.$$

The flat in this case must be scarcely less than 2in., if it is to reflect the *whole* cone of rays. A flat of 1½in. is often thought plenty large enough in the case referred to. To test this, F T = ·75 (half of flat).

$$\text{Then } x : SB :: BT + x : 175,$$
$$\text{or— } x : {\cdot}35372 :: 11 + x : 175;$$
$$\therefore x = 9{\cdot}8186.$$

With this new value for x the new value for M I is found by—

$$x + BT : FT :: BI + x : MI,$$
$$\text{or } 20{\cdot}8186 : {\cdot}75 :: 85{\cdot}8186 : MI;$$
$$\therefore MI = 3{\cdot}0917.$$

The effective aperture of mirror being thus reduced to a little over 6in., the area of an 8½in. mirror is—

$$(8\tfrac{1}{2})^2 \times {\cdot}7854 = 56{\cdot}74\text{sq.in.}$$

The area of effective portion with 1½in. flat is—

$$(6{\cdot}1834)^2 \times {\cdot}7854 = 30{\cdot}029\text{sq.in.}$$

Subtracting from each the area of circular shadow of flat, which in 2in. flat = $(2)^2 \times {\cdot}7854 = 3{\cdot}141$, and in 1½in. flat = 1·767, then the effective area in 8½in. mirror, with 2in. flat, would be 53·60sq.in., and with 1½in. flat 28·26sq.in. The deteriorating effect of this waste of aperture must be the same whatever eyepiece is used; but it would be still more apparent in the use of high magnifying powers.

The remarks which followed the paper were only to bring out the general satisfaction of those present with the reverend gentleman's statements.

Mr. Johnson expressed his indebtedness to the Rev. Mr. Bone, and said that his experience bore out what was expressed in the paper, and referred to the value of a large flat in observing nebulæ.

Messrs. Defieux and Higgs also expressed their thanks for the paper, and remarked on the importance of the matter to amateur observers.

The Secretary read the following papers:—"On the Stars Visible to the Naked Eye," by Mr. T. Backhouse, F.R.A.S.; "On the Relation of the Raised Ring to the Sunk Inclosures in Craters and Walled Plains," by Mr. S. E. Peal; "An Ultra-Neptunian Planet," by Mr. W. H. S. Monck, F.R.A.S.

The meeting closed with a special vote of thanks to the Rev. J. Bone for his kindness in coming to read his paper.

USEFUL AND SCIENTIFIC NOTES.

Henderson Steel.—The experiment of making steel from the pig iron of Alabama at a very reasonable cost has at last been practically solved by the Henderson process. To test the process, during the spring of 1888 a company erected a small furnace, lining it with the best ordinary firebrick. The result of the iron made was, first, that steel of the finest quality, as well as soft steel, could be made; but the test demonstrated also that the firebrick used could not withstand the heat. The company was not discouraged, but doubled its capital. With this it imported magnesia brick from Germany, and made a furnace of about 14 tons capacity a day. This new furnace was put into blast on Nov. 26, 1888, and has since been running continuously, and without any injury to the magnesia brick. The cost of making the finest steel by this process and by this company, limited as its plant is, will not exceed 22dols. per ton. Heretofore steel could no be made out of the low-grade iron of the Birmingham and St. Louis districts by any process known which did not cost too much; but it looks now as if there would be a great revolution in Southern iron, and also in the steel business of Pennsylvania, as its iron will have energetic competition from Alabama. There is ore and coal enough, however, in the latter State to absorb all the Pennsylvania manufactories which desire to change their base of operation.

A Gas Blowpipe.—An American paper says that in a shop where gas is available, a handy blowpipe can be made out of the ordinary gas fixture, a piece of ⅛in. brass pipe, and some rubber tubing. Use an ordinary gas-burner, with the tap in the horizontal pipe, while the burner is fitted from an elbow at right angles with the horizontal pipe. Drill a hole in bottom of tube in which the burner is placed, knock out the lava tip and the wire screen, then insert the ⅛in. brass pipe through hole in elbow, so the pipe will come in centre of upright tube, and end about midway between horizontal pipe and end of burner tube. Solder firmly the brass tube, then put the rubber on protruding end, and fit a mouthpiece so that it may be easily held when blowing through the tube. Light the gas above the burner tube in the ordinary manner. Upon giving a gentle stream of air through the rubber tube, a long blue flame, intensely hot, will be projected above the burner tube, and its size may be regulated by the quantity of gas admitted by the gas-cock. For large work, such as heavy, hard soldering, a ⅛in. air-pipe will prove large enough; while for small, delicate soldering, such as jeweller's work, an ordinary blowpipe nozzle should be attached to the ⅛in. tube. The burner tube may be unscrewed at will, and the nozzle left exposed. By cutting a thread on the blast pipe, different-sized nozzles may be screwed on at will. When at work the burner tube becomes quite hot, heating the gas and air contained within it, thus giving what is known as the "hot blast," so much sought after by blowpipe makers, and sometimes secured by bending the blast-pipe into a coil, and placing the same over the gas-flame, where it will become quite hot.

Heavy Steel Casting for an Engine Shaft Forging.—At the Parkhead Forge and Steel Works, Glasgow, Messrs. Wm. Beardmore and Co. have recently cast a steel ingot weighing 75 tons, which is said to be the heaviest ever cast in Scotland. It is intended for the largest shaft ever produced in any forge. The shaft is one of three under order for the London Electric Supply Corporation (Limited), and is to be 36in. in diameter by 26ft. long. It is to be machined down to 28in. in diameter at the bearings, and a 12in. hole will be bored through the centre. When completed and the hole bored, the shaft will still have a weight of upwards of 23 tons. Delivery is to be given at the Electric Supply Corporation Works at Deptford, where it will be fitted to the largest electric machine in the world. The work of making the casting was carried out with the utmost success, the "chief founder" being Mr. Wm. Muirhead, manager of the Parkhead Steel Works.

SCIENTIFIC NEWS.

THE comet discovered by Mr. E. E. Barnard, of the Lick Observatory, on March 31, as mentioned last week, was observed at Copenhagen on the 4th inst. at 8h. 51m. G.M.T., in R.A. 5h. 17m. 56s., N. Dec. 15° 59′ 5″.

Mr. Sawyer has published in Gould's *Astronomical Journal*, No. 190, the results of observations of variable stars made by him during 1888 or thereabouts for Mira. Ceti was observed at maximum in 1887 (Nov. 10), and W Cygni at minimum on Jan. 1 last.

The white spot on Saturn's ring, first observed by Dr. Terby, of Louvain, was seen six days afterwards by Prof. C. H. Macleod, of McGill College Observatory, Montreal, who says it appeared brightest towards the inner edge.

The next meeting of the Astronomische Gesellschaft will be hold in Brussels from Sept. 10 to 12.

The following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the Society. The ballot will take place on the 6th of June:—Mr. J. Aitken, Dr. E. Ballard, Mr. A. B. Basset, Mr. H. T. Brown, Mr. L. Clark, Prof. D. D. Cunningham, Mr. L. Fletcher, Mr. W. B. Hemsley, Mr. C. T. Hudson, Prof. T. M'K. Hughes, Mr. E. B. Poulton, Prof. W. J. Sollas, Mr. C. Todd, Mr. H. Tomlinson, Prof. G. F. Yeo.

Michel Eugène Chevreul, whose death we announced in this column last week, was born at Angers on August 31, 1786, and having served as assistant to Vauquelin, was appointed in 1813, professor at Lycée Charlemagne. He had already commenced those researches on the Fats which have been so useful to mankind, the name of Chevreul being indissolubly associated with margarine, stearine, and oleine. In 1824 he was appointed director of the carpet factory known as the Gobelins, and in 1830 succeeded his old master Vauquelin, as professor of chemistry at the Museum of Natural History, Paris. Possessed of an ample fortune (for him), Chevreul lived a quiet, uneventful life, and pursued the study of science almost to the last. A man of temperate habits, he had few physical ailments during his long career, and he is probably the only member of the Academy of Sciences who ever reached the age of one hundred years—certainly the only member who passed the century. It is worth noting that longevity was hereditary in his family, his father dying at ninety-one and his mother at ninety-three.

Dr. Joseph Rogers, whose death we announced last week, was a Hampshire man, having been born at Westmeon, August 6, 1820. The *Lancet*, referring to him, says:—"A prince has fallen out of our ranks. Not that to him it was given to scale those mountain heights of fame whose path is strewn with men's bones and watered with widows' tears. Not for him was that glory which is expressed in glittering stars and sonorous titles, nor would we claim such distinctions for such a man. His fame is written in the hearts of ten thousand of his medical brethren, whose position and power for good he raised; and in the homes of the poor, whose miseries he laboured to alleviate." It is stated that a memoir is about to be published by Mr. Fisher Unwin, written by Prof. Thorold Rogers, a brother of the deceased.

Prof. Mendeleéf has accepted the invitation of the Council of the Chemical Society to deliver the Faraday Lecture; he will probably give his mature views on the Periodic Law of the Elements, with which his name is so indissolubly connected. The lecture will be delivered by permission of the managers of the Royal Institution in their theatre, on the evening of June 4. The Fellows of the Society will entertain Prof. Mendeleéf at a dinner at the Holborn Restaurant the next evening; and the President, Dr. W. J. Russell, F.R.S., will hold a reception at the Grosvenor Gallery on June 7.

The following are the lecture arrangements after Easter at the Royal Institution:—Dr. Jean Paul Richter, three lectures on the Italian Renaissance Painters, their education and their employments (with illustrations); Prof. E. Ra Lankester, four lectures on Some Recent Bio gical Discoveries; Prof. Dewar, five experime lectures on Chemical Affinity; Mr. Joseph Bennett, four lectures on the Origin and Development of Opera in England (with musical illustrations); Prof. W. Knight, of St. Andrew's, three lectures on (1) The Classification of the Sciences, Historical and Critical; (2) Idealism and Experience, in Philosophy and Literature; (3) Idealism and Experience, in Art and Life (the Tyndall Lectures). The Friday evening meetings will be resumed on May 3, when Sir H. E. Roscoe is to discourse on "Aluminium," and the following arrangements have been made:—May 10th, Prof. Dewar, "Optical Properties of Oxygen and Ozone;" May 17th, Prof. Silvanus P. Thompson, "Optical Torque;" May 24th, the Rev. S. J. Perry, "The Solar Surface during the Last Ten Years;" May 31st, Prof. Demetri Mendeleéf, "An Attempt to Apply to Chemistry one of Newton's Principles;" June 7th, Mr. Archibald Geikie, "Recent Researches into the Origin and Age of the Highlands of Scotland and the West of Ireland;" June 14th, Mr. C. V. Boys, "Quartz Fibres."

The council of the Royal Geographical Society has resolved to recommend as president Sir Mountstuart Grant Duff, in succession to General R. Strachey, who has held the post for the last two years. The medalists of the society for this year will be Mr. A. D. Carey, of the Indian Civil Service, who will receive the Founders' Medal for his remarkable journey through Central Asia; and Dr. G. Radde, Director of the Natural History Museum, Tiflis, who will receive the Patrons' Medal for a life devoted to the promotion of scientific geography, as traveller, observer, and author. The Murchison Grant is awarded to Mr. F. S. Arnot, to take out in presents to Chitambo, of Ilala, where Livingstone died; the Back Premium to Mr. F. C. Selous, the South African hunter; the Cuthbert Peek Grant to Mr. Arnot for his seven years' work in Central Africa; and the Gill Memorial to Mr. J. Ogle, of the Indian Survey.

The London Geological Field Class, under the direction of Prof. H. G. Seeley, F.R.S., commences the summer excursions this year on May 4, and will continue them on Saturday afternoons thereafter until the end of June. Intending students should apply for tickets to the hon. secretary, Mr. Walter Lewinson, Lundy House, Willoughby-road, Hampstead, N.W.

The meeting of the Institution of Naval Architects was held last week, and after the president, Lord Ravensworth, had made a brief speech, in which he stated that the Institution was in a satisfactory condition, the "great debate" was commenced with the reading of Mr. White's paper, which was practically a defence of the Admiralty and the designs of our first-class battle-ships. After discussion, that was followed by a paper by Sir N. Barnaby on "Buoyancy and Stability in Ships," which led to another discussion; and then a paper on the "Protection of Merchant Steamers in Time of War" was read by Capt. Penrose Fitzgerald, R.N., in which it was suggested that all second and third-class steam-vessels should have a thwart-ship coal-bunker abaft the engines about 15ft. to 20ft. wide and 10ft. thick, extending to about 2ft. above the tops of the cylinders, and the bottom on a level with the screw-shaft. Such a bulwark, he thinks, would be an effective protection against the bow chasers of most cruisers, while the tactics of the merchant vessels would be to run away and keep their stern to the enemy.

Amongst the other papers was one by Mr. Beauchamp Tower, describing his apparatus for providing a steady platform for guns, a telescope, or a search light, on board ship. The apparatus has been tried on the inventor's yacht, and is acknowledged to be an ingenious device; but it may be remembered that Sir H. Bessemer had a similar idea for the purpose of preventing sea-sickness, for which purpose indeed Mr. Tower's apparatus is also available. Admiral Sir J. Hay, however, expressed a doubt, with reason, whether any such means is desirable for working guns, as it is necessary for a gunner to be trained in all the varying conditions of a ship's rolling, and to take aim after making the necessary allowances. Mr. White pointed out that the apparatus would be useful in measuring the rolling of vessels.

Prof. V. B. Lewes read a paper on the important subject of the fouling of steel and iron vessels, in which he said that metallic coatings had proved a failure, and that, so far as it was possible to judge, there was but small likelihood of their ever being made to succeed. He examined the value of all the compositions and coatings, and maintained that tar and tar products and waxes were among the best protectives; but care must be taken to eliminate acid and ammonia salts from those, and the protectives should be applied hot, and then the question of inside protection might be considered to be practically solved. As to the outside, after dealing with the question of fouling by sea animals, he recommended bituminous compositions, or varnishes with substances to give them body, as a means of protecting the metal. To overcome the long-felt evil of destruction of iron in ships through galvanic action in sea-water, he insisted that all copper-coating compounds (many of which were in the market) must be carefully rejected.

Prof. Tyndall's explanation of the blue colour of the sky is well known: it is blue because the particles in the atmosphere are so small that they are able to reflect only rays of short wave-length. Prof. Hartley, however, has been investigating the subject, and gives reasons for thinking that ozone exercises some influence on the rays, as he found that a small quantity of ozone gave a full sky-blue in a tube 2ft. in length. The question, however, then comes in, What is ozone?

What is the cause of fog, and what that of the peculiar black cloud (not fog) which visited London on the 10th inst., say? Fog—the real "pea-soup" fog, as it has been called—exercises a most deleterious effect on plants, often worse than frost, and the Scientific Committee of the Royal Horticultural Society, at the instance of Mr. Dyer, is to have a special report on the subject. There is a difference between the "black clouds" and the fogs which surcharge the air with soot particles, but there can be no doubt that the fogs are more deleterious to plants.

The Board of Trade is willing to receive a deputation of electrical engineers to consider the question of overhead wires.

The Cowles patents for the manufacture of aluminium alloys by electricity have been upheld by the German courts. This decision is the outcome of an action for revocation which was recently brought by Dr. H. Kunheim, of Berlin, who relied on the so-called anticipations of Sir W. Thomson (1879), Benzon (1858), Faure (1882 and 1883), and John Calvert (1856). The Héroult process, which is employed at Oerlikon, is not, it appears, patented in Germany.

At the Central Institution of the City and Guilds of London Institute, Mr. T. Bolas will deliver a course of six lectures on photography, on Wednesday evenings, at 7.30, beginning on May 8. Lectures I. and II. will deal with the use of artificial light in photography; lectures III. and IV. with photo-mechanical printing methods; and lectures V. and VI. with direct contact printing methods.

Hydrogen Fluoride.—At a recent meeting of the Chemical Society a paper was read on "The Vapour Density of Hydrogen Fluoride," by T. E. Thorpe, F.R.S., and F. J. Hambly. The authors have carefully studied the molecular breaking down of the vapour as it is affected by changes of temperature and pressure. It would appear that there is no evidence for the existence of a molecule corresponding to the formula H_2F_2. The density at above 32° corresponds apparently with H_3F_3, but the curve gives no indication of any condition of statical equilibrium in the neighbourhood of this temperature such as would be manifest if such a molecule were capable of independent existence. At temperatures below this point the density gradually increases in a perfectly regular manner until at 26·4°, the lowest temperature observed, the density becomes 1·773, equivalent to a molecular weight of 51·2 ($H_3F_3 = 60$); as it is heated, the vapour behaves like a mixture of a complex molecule H_xF_x, or of H_xF_x and H_yF_y molecules, with a gradually increasing number of molecules of HF, the process of dissociation being perfectly continuous until the temperature increases to about 60°, when the density becomes approximately normal—i.e., corresponds to a vapour consisting wholly of HF molecules. Their values for the density at 32°, under ordinary atmospheric pressure, agree almost exactly with those obtained by Mallett.

It is estimated that the increase of population in the United States is 100,000 per month, exclusive of immigration, which last year was 518,000. The present population is estimated to be 64,000,000, and the next census, to be taken in July, 1890, will probably give 67,000,000.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE REPORT OF THE PARIS OBSERVATORY — A "SECOND ROTATION OF THE EARTH" (!) — LOCKYER'S "ASTRONOMY" AND "F.R.A.S." — REFLECTING TELESCOPE — "TOO MUCH OF WATER HAST THOU, POOR" "E. L. G."—VENUS—TRANSIT TABLES — PHRENOLOGY — ACHROMATIC OBJECT-GLASS.

[29833.]—The Annual Report of the Paris Observatory for 1888, by Admiral Mouchez, its director, contains a good deal that will be found interesting by astronomers generally. Prominence is naturally given to the researches of M. Loewy, the first assistant, on refraction and aberration, by the aid of his singularly simple and ingenious contrivance applied to his equatorial coudé. The results of these investigations will be looked forward to anxiously as possessing a practical interest of the highest order; for, to take a single illustration, there can be no doubt that if the constant of aberration is determined with great precision, its combination with the velocity of light, as found by Newcomb and Michelson, will furnish us with a value of the solar parallax more trustworthy than that derived from all the Transit of Venus observations put together. Another point dealt with in the Report is the very curious one of a possible change of latitude—a change alleged, by certain theorists, to have its origin in an actual shifting of the earth's axis, which is supposed to have a slight movement of rotation about its mean place. The balance of probability is in favour of the idea that this seeming shifting arises from a very slight variation in refraction incident on change of temperature at different seasons; but, as Admiral Mouchez points out, this may be set at rest by careful observations made simultaneously in Europe and at the Cape, while a further check may be found in the determination of latitude by Talcott's method with the zenith sector. Of the ordinary routine work of the observatory it is needless to speak here. A statue of Le Verrier is to be placed in the courtyard facing the north front of the observatory, and one of Arago at the cross-road formed by the Boulevard Arago, the Place, and the Rue St. Jacques.

I have seen General Drayson's "Thirty Thousand Years of the Earth's Past History," to which "W. J. S." refers in letter 29786 on page 109, but I have not read it. Oh! dear, no. "Timeo Danaos et dona ferentes." That gallant officer is a crack shot at big game, wrote a capital little book on "Military Surveying and Sketching," and is no mean authority on whist; but as an astronomer he is—to put it as mildly as possible—not much deferred to at Burlington House. "W. J. S." is quite right in his assumption as to the real motion of the earth's axis. If we accept the annual amount of precession as 50·2", and divide the number of seconds in 360° (1,296,000) by that number, we shall get 25,816·7, say 25,817 years, as the period occupied by the pole of the earth in making one complete revolution round the pole of the Ecliptic. That General Drayson was a Professor at the Royal Military Academy affords no guarantee for his competence to theorise on such a subject as this. He did not teach astronomy at "the shop."

Letter 29792, p. 110, renders it necessary that I should speak very plainly indeed. There is a certain class of people of whom Pope said that they "rush in where angels fear to tread," and if Mr Arman will impute motives, he must take the consequences. Now either my "identity is masked by" (what Mr. Arman, with his obviously intimate classical knowledge calls) my "pseudomyn" (?)—or it is not. If it is, he merely talks ignorantly in attributing my strictures in these columns to absence of love for Mr. Lockyer. If, on the other hand, he does know who it is who writes these lines, he is saying what is false, *and he knows it*, in putting my attacks down to personal dislike of, or enmity to the gentleman whom he champions. I do not dislike Mr. Lockyer in any personal sense whatever. I never had a cross word with him in my life. What I not only dislike, though, but hate and detest, is advertising and puffing. Mr. Lockyer is a very able spectroscopic observer, and were he content to accumulate material for other men to explain, would earn the imperishable gratitude of his fellow-countrymen. But his mathematics are—well, I would really rather not say what. It is not so very long since I was looking through a little work called "Outlines of Physiography: the Movements of the Earth," by him, in company with a leading official English astronomer and head of a great observatory, and I declare solemnly that we both roared with laughter over the book. As for the "Elementary Lessons in Astronomy," it is a South Kensington textbook, and hence that it is "now in its thirty-fifth thousand" only shows how many people avail themselves of what passes for instruction there. Would Mr. Arman be surprised to hear that "awful examples" have been selected from that very book in an examination at Trinity College, Cambridge? Finally, as happily my "reputation" is scarcely dependent on my demolition of the meteoritic theory, and I am, I gravely fear, terribly indifferent to Mr. Arman's "respect," I would refer that gentleman to a paper by Mr. W. H. Monck in the number of the *Journal* of the Liverpool Astronomical Society for June, 1888, the perusal of which may conceivably prompt him to transfer such respect to its able and gifted author, whose "reputation," though, by the way, is already made. [Since this paragraph was written, I have seen letters 29813, 29814, and 29815 on p. 131. In thanking my unknown friend, "A Sympathiser with 'F.R.A.S.,'" I would simply observe that he has exposed, in a perfectly calm and dispassionate manner, a few of the blunders made by Mr. Lockyer during his career as a public instructor (?). As regards "Autolycus," if I have never seen the "Primer of Astronomy," I have read the review of it by a man to whose astronomical knowledge Mr. Lockyer can scarcely pretend to lay claim. I mean the late R. A. Proctor; while, as regards the "Elementary Lessons in Astronomy," I *have* seen that; but, as a matter of fact, possessing every single book from which it was compiled in my own library, I cannot see that my "astronomical enthusiasm" can be justly assailed, because I care less than nothing for paste-and-scissors work.]

If "A. S. L." (letter 29793, p. 110) can obtain access to Vol. I. (the "Prolegomena") of the original edition of Smyth's "Celestial Cycle," he will find his device explained and illustrated on p. 403, under the name of a Chamber Transit. Smyth speaks well of it, but (possibly I think from certain difficulties in connection with instrumental corrections) it has never come into general use.

It would be as idle to attempt to reason with the author of letter 29796, on p. 111, as it would be to argue with any gentleman in Colney Hatch who regarded himself as Sir Francis Drake or the Podasokus. There is not the very slightest proof that such a thing as a watery comet ever has existed, does exist, or ever can or will exist. Every comet that has appeared since the application of the spectroscope to the telescope has been spectroscopically examined, and no vestige or trace of aqueous vapour has ever been found in one of them. That a body of water should exhibit the phenomena presented by any single comet of which the apparition has been recorded, is, as every physicist well knows, absolutely impossible; but (as I have before said in these columns) "E. L. G." has gone on talking about his Cometary Flood and reiterating his ridiculous assertion until he really believes it himself! Halley was a great astronomer, but his knowledge of celestial chemistry might be algebraically described as a − quantity.

I wish that Mr. Baird Gemmill (letter 29797, p. 111) would try the experiment of hiding the crescent of Venus entirely, and seeing whether the phosphorescence of the dark limb still persists. I heartily echo his hope that observers will continue to direct their attention to this lovely planet, and trust that they will watch her right into Inferior Conjunction.

I am sorry to be obliged to reply to "Observer" (query 68313, p. 122) that Clark's "Transit Tables" are discontinued. As used in conjunction with his very effective little transit instrument they were of real service to many whose knowledge of astronomy was limited. Nothing of the sort is to be seen anywhere, save the short tables of star transits, with which you conclude your monthly "Astronomical Notes," which I fancy must have first suggested to Mr. Latimer Clark his own more extensive list of the Mean Times of Star Transits.

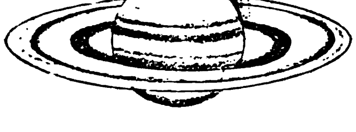
Would Mr. Mark Moores (letter 29822, p. 133) mind giving me the number of the *Graphic* containing the "engraving of Pigott taken from a photograph after death"? I ask because I see the *Graphic* every week of my life, and do not remember this particular one. I would furthermore ask if *it is in profile?* Because, if not, what becomes of Mr. Bridges' phreno-physiometrical angle, and how on earth can this be measured from a full or three-quarter face portrait? As for "the worthlessness of Dr. Bastian's remarks about phrenology," as they are founded on the experiments and observations of such men as Ferrier, &c., I do not think I need occupy two lines of your space in pointing out the impertinence of this description of the work of such a man.

If "Copernicus" (query 68351, p. 141) will take my advice, he will have an entirely new object-glass altogether. The difficulty of fitting a fresh flint lens of the required dispersive power and of the proper curvature to an already wrought crown one would be so great as practically to raise the cost of the objective to that of a new one. I am assuming, of course, that my querist wishes for an aplanatic object-glass. He might get a new flint lens partially to correct it at less cost. Wray would be as good a man as any to go to. I can say nothing about prices, which "Copernicus" must get from an optician.

A Fellow of the Royal Astronomical Society.

SATURN.

[29834.]—J'applaudis à l'idée de vos correspondants qui vous envoient des dessins de planètes et, pour les imiter, comme les années précédentes, je vous communique mon dessin de Saturne du 6 Mars, à 9h. 12m., contenant la tache blanche *a*, sur l'anneau. J'ai appris avec plaisir que cette observation a été confirmée déjà par M. McLeod, de Montréal (Canada), et par M. Brooks, de Geneva (E.U.), depuis le 12 Mars je n'ai plus rien vu de *comparable* à cette tache, de sorte que je suis d'accord avec les célèbres astronomes qui, depuis cette date, ont essayé de vérifier cette observation, sans y réussir. J'appelle spécialement l'attention de vos correspondants sur l'ombre *partielle* qui couvre le bord nord de la planète, découvert maintenant, sur la bande de Struve, sur celle d'Encke, et sur la bande fine, grise, qui longe la projection de l'anneau obscur sur la planète en restant bien séparée de cette projection. J'oubliais de rappeler que ces observations ont été faites à l'aide de mon 8 pouces de Grubb et d'un grossissement de 280 fois.



Louvain. **Dr. F. Terby.**

SATURN—HIGH POWERS.

[29835.]—The several sketches and remarks on Saturn, especially with reference to Encke's division, which have recently appeared in the "E. M.," have caused me no little surprise. I have been unable to detect this division this year using an excellent 13in. mirror by With (the Madeira speculum), although I saw it well in '88 and '87 with an 8¼in. Calver. It was not visible in the excellent 12¾in. refractor at Dunsink Observatory on an exceptionally good night in January. Mr. Hallowes and Mr. Kempthorne, however, state they have frequently seen it lately; and Mr. Southgate, even with a 6½in., which is very surprising, considering the present opening of the rings.

I have never been able to use so high a power as 425 on Saturn, as Mr. Kempthorne does, with my 8½in. Calver mirror *with any advantage*. I rarely use powers exceeding 300 on the planets, even with the 13in. mirror of 10ft. focus, and I am surprised so much could be seen with so high a power as 425 on 8½. The best drawings of the planets by our most experienced observers are made with powers rarely exceeding 250. Mr. Denning generally uses 250 with his 10¼in.; and the recent excellent drawings of Mars and Jupiter by Dr. Boeddicker in the *Transactions* of the Royal Dublin Society have been made with a power of 144, and occasionally 216 on the fine 36in. mirror belonging to the Earl of Rosse at Birr Castle Observatory.

Dublin, April 12. **H. Watson.**

COPERNICUS.

[29836.]—Looking at my sketch of this crater, observers familiar with lunar objects will at once perceive that the ring is represented much too dark. This may be due to my hurriedly-executed copy of the drawing, and must not be regarded as actually observed in the first instance. The narrow white streaks in the *middle* of the shadow in the ring are entirely without foundation, and only a defect in the engraving.

April 13. **A. Southgate.**

U (NOVA) ORIONIS.

[29837.]—I send all the observations of this interesting variable which I have been able to secure this year. They are in continuation of those on p. 438, Vol. XLVIII. of the "E.M." They were made principally with a binocular magnifying five times; but when the star got too faint, a 2¾in. refractor, power 28, was used.

1889.		m.	
Jan.	22	6·26	2 steps < K; 4 steps < E.
	26	6·42	¼ mag. < K; 3 > D.
	27	6·17	3 < K; 6 > D.
	29	6·37	4 < K; 3 > D.
Feb.	1	6·52	6 < K; 2 > D.
	3	6·76	6 < K; 2 > D. Est. 7m.
	4	6·42	5 < K; 3 > D. Brighter; very ruddy.
	8	6·57	about = D (moonlight).
	20	7·18	est. 7·3. ¼m. < D.
	21	7·44	est. 7·5. ¼m. < D. in 2¾in. 4 or 5 steps > A.
	22	7·5	est. 7·6; more than ½ mag. < D.
	26	7·8	est. 7·8; far below D.
	27	8	estimated. Just held steadily.
March	2	8	estimated.
	4	8·0	estimated. Seen quite steadily in binocular. Later on, with 2¾in., it was 2 or 3 steps brighter than A; whitish orange.
	8	< 8	Just glimpsed in moonlight.
	19	8-9	Just caught in binocular.
	22	8·8	2¾in.; slightly < B.
	28	8·9	2¾in.; less than B.

I am doubtful as to observation of 26th Jan.; but on Feb. 4 it seemed that the star was a little brighter than on the previous day. Can other observers corroborate these apparent irregularities in the diminution of the star's light?

Comparison stars:—

A =	D.M. + 20°	1171	8·2		
B =	+ 20	1168	8·6		
D =	+ 20	1156	6·57	Harvard.	
E =	+ 19	1126	5·85	,,	
K =	+ 19	1110	6·08	,,	

E. E. M.

LOCKYER'S "ASTRONOMY" AND "F.R.A.S."

[29838.]—I have been much interested in the discussion concerning the plate of Copernicus in Lockyer's "Primer." I am, compared with "F.R.A.S.," only a beginner, and have a limited astronomical library; but I have Lockyer's book and "Hours with a 3in. Telescope," by Captain Noble. The latter has, on p. 37, a picture of Copernicus, said to be drawn at the telescope. Now, Sir, during the last few days I have carefully observed Copernicus with my 8in. reflector, and I, in my opinion, have no hesitation in saying that at the telescope Lockyer's picture is much more after the true appearance of Copernicus than Noble's. I don't know if "F.R.A.S." has ever seen Noble's book, as he seems to scoff at elementary works such as this is; but if he has not, I should suggest he borrowed one, and also Lockyer's book, as these are two such well-known elementary books, and let us know which plate he considers the best when compared at the telescope. It would really be useful to know what elementary book contains a good drawing of this, the grandest of all craters, as it would enable beginners like myself to see more detail when we have something to show us what to look for. I inclose my card.

Veretatem Teneo.

MR. ESPIN—A PERSONAL EXPLANATION.

[29839.]—Will you kindly allow me to correct a mistake in Mr. Isaacs' letter (29819, p. 132)? Mr. Isaacs states that my name was "inadvertently omitted," whereas the secretary, Mr. Rowlands, informed me that the list of members of the L.A.S. had been revised, and my name purposely struck out. Finding this had been done against the wishes of the council, Mr. Elger compelled the editor to reinsert my name.

T. E. Espin,

Wolsingham Observatory, April 13.

ORGAN MATTERS—TO MR. AUDSLEY.

[29840.]—I must heartily thank Mr. Audsley for his suggestions (I can't call them criticisms) for the improvement of the specification of the organ I gave a fortnight ago (p. 114). I can assure him that I do not consider his remarks in any way hypercritical or captious, since I am only too glad to have any suggestions made about it. After Mr. Audsley's "Notes on the Concert-Room Organ" came out, I had thought of having a department somewhere in which string-toned stops were to have predominance, but I did not quite see my way to so enlarging the second organ—first, on account of its low w.p. (only 2⅜in., on which I question if stops of the imitative viol class would be satisfactory); secondly, on account of the enforced introduction of a fourth expression lever and chamber. Finally, I abandoned the scheme as impracticable, without undue enlargement of the organ, since I suppose it would involve the introduction of at least half a dozen more stops, including another full mixture. Afterwards I inserted two stops of a very pronounced "viol" type in the third organ (which has a w.p. of 3in.). If the second organ has its string-toned division, where is the accompaniment for the above string-toned stop when used for solo purposes to come from? In the original scheme (where there was one w.p. of 2⅝in. throughout), the vox humana was placed in the third organ; but afterwards I thought a higher w.p. for the third and part of the pedal organ would be effective, and that the vox humana would be more satisfactory on the lower 1⅜in. w.p. Therefore, I moved it into the second organ; but when I did so I must confess that I never gave its accompaniment a thought. However, if it would be perfectly satisfactory on a 3in. w.p., it had better be placed in the third organ. My reasons for omitting nearly all 16ft. on the manuals were—first, because I was not guided so much by the "Notes on the Concert-Room Organ" as the "Notes on the Chamber Organ" (where I think no mention is made of a 16ft. manual stop); secondly, I thought that if so much 16ft. was introduced on the manuals, a 32ft. stop would be required on the pedal; thirdly, I thought that with a soft 16ft. on the second organ, and the second to first sub-octave coupler, there would be sufficient weight. Nevertheless, I shall add a soft open sub-octave 16ft. to the first organ (of course, I suppose it must be uninclosed), and change the double dulciana treble and lieblich bass of the second organ to lieblich gedact 16ft. throughout (with split knob). In that case, I suppose the sub-coupler will be almost useless, and may be dispensed with. I also don't like the word "gamba," as I think it is unmeaning; but as Mr. Audsley permits it in his stop nomenclature, I used it to represent a set of reedy-toned flue stops not so imitative as the "viols" (as he himself somewhere says). I get the idea of inserting a violin 4ft. and 'cello 8ft. in the third organ from his suggestions for the solo department of a concert-room instrument. I purposely omitted to say whether of wood or metal, as I am ignorant which produces the most imitative tones. My reason for inserting No. 24 was partly for its special effect and partly to form a very soft accompaniment for such delicate stops as 13, 14, and even 5 and 12, when used for very soft solos. I am in doubt whether the system of borrowing in the pedal organ would answer, or whether Mr. Casson's system would not be better. I am afraid Mr. Audsley will think I have been taking leaves out of his book (his own chamber organ on which this organ is based) and using them for my specification—such, for instance, as Nos. 2 and 38, and "dodging" the lower pipes of No. 31, &c. I must, therefore, apologise and beg his forgiveness. Would it be too much to ask him to re-specify this organ (increasing the number of speaking stops to about 50) and to publish it so that we might have an idea what a perfect chamber (or concert-room) instrument of 50 speaking stops is? In the mean time I will try to scheme a chamber organ of, say, 25 or 30 stops, in as near agreement with the "Notes on the Chamber Organ" as possible, as I fear the other specification has grown quite out of "chamber" limits. Mr. Audsley has rightly added, in speaking of this organ, "if artistically carried out"; but, alas! how many English builders could be relied on to make, say, Nos. 2, 9, 19, 20, 21, 23, 26, 38, 39, &c., so as to be satisfactory in all respects? **G. Dixon.**

Sea View, St. Bee's, Cumberland, April 13.

ORGAN MATTERS—GENERAL DESIGN IN CONNECTION WITH TONAL COLOURING.

[29841.]—If simplicity of form be really compatible with variety of effect, as I have in a former letter on the subject of tonal colouring maintained to the readers of the "E. M." that it is, then I have good ground to disagree with the means employed by Mr. Audsley, and now followed in some degree by Mr. Dixon, to this end.

My contention is that if with 50 stops the utmost variety in tonal colouring is possible, that you are heavily handicapping the player, complicating your organ, and wasting money, if you add materially to that number.

We do not come within the range of tonal colouring till we first recognise some guidance for general design—for anyone can draw up a long list of stops who is at all conversant with the organ; but the artistic condensation of such designs into a form which will embrace all the varied requirements which a player can possibly need, requires not only an intimate knowledge and appreciation of the various colours at disposal, but a practical knowledge of all the conditions under which a skilled player may require their use.

Mr. Audsley's concert organ design is an imitation of the organs of Roosevelt, of New York, by whom he swears. It is an immense thing, with a most laudable aim at his back, with which I most heartily sympathise; but it fails, in my opinion, at the outset to fulfil the first conditions of artistic organ design—simplicity of form,—and on this point the whole question turns.

We cannot approach the consideration of tone colouring till we recognise this first principle. Having done so, we then have to acquaint ourselves with the colours at disposal. On these two points our friend, Mr. Dixon, appears to be entirely ignorant.

For example—In the Great Organ we look for the embodiment of the true organ tone, the foundation, in fact, of the superstructure. In his design we find one diapason only, the tone of which would be cut to pieces by his gamba (No. 4) if it were not already smothered by his two flutes (2 and 3), which, by the way, are two similar colours. The salicional belongs to the same family as the gamba, and beside another like colour would be worse than useless. There is no double, and the super. work is all out of balance.

In the Choir Organ there is still further absence of balance, with the terrible example of two opposite colours combined in one stop, the dulciana 16ft. to mid C breaking into a lieblich or stopped wood, and that exactly in the middle of the keyboard—nothing worse could be conceived. Then the dulciana 8ft. and echo gamba would kill one another. Lastly, with a mixture 15, 19, 22, he has no 4ft. metal, so there would be a great gap between his feeble 8ft. foundation and this mixture!

Then we come to his third or Solo Organ—a curious organ; for, in the very middle of it, we find a vox angelica on a special wind of 1¾in.—the only stop in the organ: meaning, of course, that this poor little misery would be furnished with a special wind reservoir to itself—a most extravagant outlay when it is considered that placed, as here proposed, probably no one would be the least the wiser whether the stop be drawn or not.

Then, in this organ we see the necessity for at least three wind reservoirs—a thing quite to be advocated, but not at the expense of gaining nothing, as would here be the case.

Certainly Mr. Dixon would not get anything approaching an orchestral trumpet from a 3in. wind (does he know, I venture to wonder, the pressure which a trumpet player brings to bear to produce his tone?) and certainly he would gain nothing in delicacy from his special 1¾ wind.

Of the Pedal Organ, I can only say that it would overtop the whole organ. Mr. Dixon here avails himself of the method employed by Mr. Thomas Casson, but with none of the advantages of that gentleman's masterly and splendid system.

As the organ at St. Barnabas Church, Pimlico, has been more than once quoted, I may say that in the entire reconstruction of the instrument now in hand many faults before insurmountable will be remedied, and a fair opportunity given for the criticism of a piece of tone colouring.

I am, however, with those who consider it unfair to ignore the really artistic work of Henry Willis. It is by comparison that we correct our judgment. Taking, therefore, the broad lines which I indicate, I would bid all those who are really interested in this subject to try to master it. Do not be guided by the prejudice or the advice or the mere opinion of one person who may have his own interest to serve, but compare for yourselves, and then give honour where honour is due. In this special branch of art there are, I fear, but few real artists; we cannot, therefore, afford to ignore one of them, however much it may affect our personal interests.

Shepherd's Bush. **Carlton C. Michell.**

PITOT TUBES.

[29842.]—These tubes are now very generally used for measuring air velocities in air channels or mine drifts; but I am unable to understand how the calculation from the data obtained is effected. The tubes, as used, are of brass of about ¼in. internal diameter, and their ends are exteriorly coned and ground to knife sharpness, so as to present no surface resistance to the air current. The other ends are connected by indiarubber tubing to their respective water gauges. There are always two tubes used simultaneously, or together—the one, which we may call A, being straight, with its end parallel to the air current, and the other (B) bent at right angles with its inlet facing the air currrent. A is coupled to an ordinary siphon-like water gauge, and shows the *ramification* due to the velocity of the pressing current, whilst B, into the open end of which the air impinges, evidently produces *pressure*, and acts upon a glass tube containing water placed in an inclined position at *a known gradient* varying from 1 in 10 to 1 in 50, as the case may require.

From the *difference* of the two readings—depression or pressure—the velocity of the passing air current is in some way obtained.

This method is said to be much more reliable than anemometers, and I should be much obliged if some of our mining friends, or others, would kindly explain the method of calculation employed. I may add that the ends of the tubes are in the same (cross-sectional) plane of the air drift, and placed in the fillet of assumed *mean* velocity, or at 0·7 of radius from the centre of gravity of the air tube or drift.

Taking an actual case, and referring to some tests with an exhaust fan, the metric scale of measures being employed, I find the pressure *difference* in the two pitot-tubes started at 14·60.

The air velocity is estimated from this by the formula: $c = 4{\cdot}25 \sqrt{\frac{h_1}{g}}$ in which c = air velocity per second in mètres (3·2809ft.); h_1 = pressure difference in the two pitot-tubes (but I don't know in what terms—perhaps millimètres—remarking, however, that the *depression* in tube A was 47·1 millimètres [2·8in.] of water); g = weight of a cubic mètre of the passing air, equal in this case to 1·21klgr. (0·07556lb. per cubic feet). The resulting velocity is 14·763 mètres per second (48·436ft.); but I do not know how the difference (14·60) in the two pitot-tubes is found.

The tube A would of course show a rarification of the air as stated, *a*, represented in this instance by 47·1 millimètres of water, whilst the air impinging in the tube B would act by pressure or impulse upon the water contained in the inclined tube, driving it to a corresponding elevation, which could then be read off. The two columns will be of different height, and the difference, as stated, is 14·60. Which will show the highest w.g. at the given velocity—the depression or the pressure-tube? How does the *difference* between these show the velocity? **M.**

THE RECENT BRAKE TRIALS AT CARLSRUHE.

[29843.]—Your readers will remember that between the 13th October and 14th December, 1887, a series of experiments was made in America to test the new quick-acting Westinghouse brake upon a very long train, consisting of 50 cars. The authorities of the Baden State Railways recently decided to repeat the American experiments; they therefore fitted three trains. The first was composed of 18 carriages, and provided both with the ordinary and the quick-acting systems complete. The second train consisted of 30, and the third of 50 carriages, and were both fitted with the quick-acting brake. The trials were made at Carlsruhe, on the Baden State Railway, 19th and 20th March, with the following results:—

Carlsruhe Brake Trials.

Results obtained 19th March, 1889.

Number.	Nature of Experiment.	Speed of train miles per hour.	Distance of Stop in Feet.	Time of Stop in Seconds.	Details of Trains and Brakes.
1	Ordinary stat'n stop	44·7	1,174	30	Ordinary Westinghouse brake, 18 carriages, 1in. train pipe.
2	Emergncy. stop	39·7	567	16	
3	Emergency	43·5	659	17·4	
4	Ordinary ..	43·5	1,292	31	Quick-acting Westinghouse brake, with 1in. train pipe, 18 carriages.
5	Emergency	39·1	515	15·75	
6	Emergency	43·5	613	17	
7	Ordinary ..	44·1	994	25	Quick-acting W'house b'ke. with large 1¼in. train pipe, 18 carriages.
8	Emergency	38·5	506	15·6	
9	Emergency	44·7	640	18·5	
10	Emergency	48·5	794	21·25	

Results—20th March.

Number.	Nature of Experiment.	Speed of train miles per hour.	Distance of Stop in Feet.	Time of Stop in Seconds.	Details of Trains and Brakes.
11	Ordinary ..	44·1	1,516	34	Quick-acting Westinghouse brakes, large train pipes, 30 carriages.
12	Emergency	34·8	420	14·25	
13	Emergency	40·4	564	16·7	
14	Emergency	42·2	600	17·5	
15	Ordinary ..	34·8	1,538	40·5	Quick-acting Westinghouse brakes, large train pipes, 50 carriages.
16	Emergency	28·6	302	12·5	
17	Emergency	34·8	443	14·8	
18	Emergency	36·0	462	15·5	

With reference to the working of the brake upon the long 50-carriage train, it should be mentioned that the brake blocks upon the rear pair of wheels, 1,500ft. from the engine, were brought to their wheels in less than one and three-quarter second.

The new ingenious apparatus of Mr. A. Kapteyn, C.E., was employed to ascertain the time, pressure, speed, and distance, consequently the results were exactly recorded upon diagrams.

Experiments were also made upon a long incline of 7½ miles of 1 in 80, to test the regulation of the brake, which was found highly satisfactory.

Clement E. Stretton,
Consulting Engineer, Asso. Soc. of Engineers and Firemen.

Leicester, April 15th.

THE HARECASTLE ACCIDENT.

[29844.]—It will be remembered that on the 28th February as the mid-day express from Manchester, composed of London and North-Western carriages, and drawn by a North Stafford engine, No. 55, was approaching Harecastle, the engine left the rails at the V-point of the crossing, and, with the tender, ran 183 yards, the whole of the carriages also left the line and ran 172 yards. The accident was due to the breaking of the left-hand crank-pin on the driving-wheel; the train ran forward in safety for a distance of 516 yards, when the side rod threw the engine and train off the line.

The engine had a steam-brake, the tender and train had the Webb simple vacuum with the automatic arrangement in the vans. These brakes were applied for a distance of 356 yards; but only reduced the speed of between 45 and 50 miles an hour to 15 miles an hour, when the engine ran off the line. The breaking of the coupling at the rear of the tender rendered the Webb brake on the carriages useless, and it at once came off, and as the driver accidentally shut the steam-brake valve by being thrown about, the train ran forward for 183 and 172 yards.

There can be no question that if the train had been provided with a proper automatic continuous brake it could have been stopped in the distance of 356 yards and therefore have not left the rails, and in any case the breaking of the couplings would have caused an automatic brake to remain "on," and not release itself just at the moment when it was most of all required. The railway company may consider itself extremely fortunate that the accident was not of a much more serious character.

Clement E. Stretton.

LOCOMOTIVE CABS.

[29845.]—Your correspondent "I. A.," p. 135, directs attention to the fact that the cabs in use upon American locomotives are much more commodious than those used in this country. I fully agree with him that engines are running upon many railways in the United Kingdom which afford little or no protetion from the weather; on the other hand, I consider the cabs he illustrates, which completely inclose the driver and fireman in a box, would not be satisfactory in practice.

In designing a cab, several points must be taken into account. For instance, a cab which may be very well in winter, will in summer be found so extremely hot that the men can hardly live upon the foot-plate.

It must also be remembered that during fogs and snowstorms drivers have to run many miles together looking over the side of the cab as the windows or glasses are completely obscured. In case of anything going wrong with the engine, it is important that the driver can instantly look over the side of the cab without the delay of opening a door.

The American form of cab tried by Mr. Bromley on the Great Eastern Railway, and by Mr. Worsdell upon the North Eastern, is much liked by engine-drivers. Those persons who ride upon locomotives know well the cold wind and snow which blows in between the engine and tender. Some form of door or protection, about 3ft. high, placed between engine and tender, and in the doorways of tank engines, would be a great benefit to enginemen and firemen in winter time.

Clement E. Stretton, C.E.,
40, Saxe Coburg-street, Leicester, 13 April.

[29846.]—"I. A." (letter 29826, p. 135) is justified in saying that loco. cabs are not what they might be; but it must be remembered that cabs are the present result of the gradual development of the locomotive, and are a feature which did not appear at all till about 1860, and then only as a low wind-guard with two windows. American cabs are more comfortable, because the question of the exposure of the engineman to the weather on mountain lines quickly becomes a serious one.

A door such as suggested by "I. A." would have advantages, and the need for it is shown by the common spectacle of a sheet-iron or canvas shelter rigged on to engine cabs; but it appears to me that a folding iron shutter on either side, and stowing in the roof of the cab, would be more convenient and more capable of partial use than the suggested door. Many old four-coupled engines on the S.E. are provided with a tender wind-guard—evidence of evil habits of tender-first running—but no roof.

The American cab is either a little glazed house built on top of the fire-box, with doors in front and behind, and seats on either side, or else (as in most passenger engines) is like a roomy English cab, but with front and back doors, so that one is quite shut off from the tender. This cab affords great protection from the weather, but my own feeling while inside one was a sort of "boxedupness" and want of freedom in the case of anything happening, a feeling not shared by the enginemen. The cabs of new G.N. bogie tanks afford almost entire protection; but the foot-plates of G.N. engines are by no means spacious, and the cab generally seems to have ceased progressing, though minor improvements, such as the row of ventilating holes in top of L.N.W. cabs, are made from time to time.

Uttoxeter. **N. S. R.**

RATTLESNAKES, AND STINGS OF BEES.

[29847.]—"There is no known case of change in form, habit, or instinct developed for the use of another species rather than for the species which develops it. It was always for its own benefit." (From the report of a lecture given in the *St. James's Gazette*).

There seems to be some ambiguity in the above sentence, but it probably means as follows:—"Whenever a species has grown up to be what it is, it has always been—(1) for its own good; and (2) it has always been *more* for its own good than for that of any other species."

With regard to the first part of the proposition, the case of a rattlesnake has often been cited as an example of the contrary. The rattle has been said to be a warning to other things, but to be of no use to the snake. But it may not be so: the sound which it makes attracts attention, and it may have an effect upon some things which hear it, much akin to that which a noise has upon human beings, who are often attracted to the spot to see what the row is about. Sound may attract some things, as light does moths, sparrows, &c., though to their own destruction. It may thus attract its prey to the snake.

A more difficult case is that of the sting of a bee, which is *barbed*, and so cannot be withdrawn from the wound, causing, as is generally supposed, the death of the bee. What advantage to the bee is it to have a barbed sting, rather than one like that of a wasp? It will hardly be said that it is for the good of the individual bee, but if it is said that it is for the good of the *species*, it will at best be only one instance out of a multitude of others in which a thing may in one sense be an advantage, and in another the reverse; so that a philosopher in deciding whether it is for its good or not, will have to strike the balance according to his own notions, and whether he decides this way or that will always have something to say for himself, though it will generally be only a half-truth.

As instances, we might mention the horse, which is said to have been developed from an animal about the size of a fox. Its development to its present size has of course, been an advantage; but, on the other hand, it has caused it to exchange liberty for slavery.

Double flowers, again, are sterile; and when they have become so, the propagation of the species has become more precarious.

Lions and tigers, too, have outgrown their humbler feline relations, and, therefore, have things more their own way, so that the species may have benefited for the time, but not permanently. Most likely pussy will outlive them all. The same kind of thing may be said of any species which has become, or is tending to become, extinct.

The habits developed by a species may be likened to those developed by the body politic. Its division into Whigs and Tories, for instance, is an obstacle to united action, and, so far, is a disadvantage; but the two parties serve as a check upon each other's misdeeds, and, so far, the Whig and Tory system is good. Well would it be for the "lords of creation" if *all* the habits they develop tended to any good at all.

We may now look upon the matter from another point of view. The statement in the beginning of this letter takes no account of *consciousness*. But when we are making a comparison of benefits done, how can we do so without reckoning it in? For example: wheat is one of the family of grasses. What can be the meaning of saying that it has been developed into a cereal for its own good, when it is not even conscious of its own existence, *rather than* for the good of the men to whom it has become the "staff of life"? How can we make any comparison between the two? They have no common denominator.

The mere fact of being *conscious* that a benefit is done us is itself a benefit, just as when you are not conscious of a loss the loss becomes a less evil than it would be otherwise. And in this respect, as also in other things, man is vastly more capable of being benefited than anything else can be; he can *think* of the benefit, be pleased with it, forecast consequences, and shape his actions for his own benefit accordingly.

The view held by the great majority of mankind, which, though we may call it teleology, or any other hard name, will continue to be held for many a year is—*That every species is developed into the form which makes it best fitted to perform a given part in the world.* But this must mean something quite different from saying that a species derives more benefit itself from its developments than any other does—a statement which it is hard to understand even the meaning of, as in the case given above. And what about the *habits* developed—some of our own, for instance? Many people have been sceptical as to whether they have always been for our advantage.

W. G. P.

THE "E. M." AS A WORK OF REFERENCE—HAYDON'S CUTTER-BAR.

[29848.]—Being the fortunate possessor of twenty-odd volumes of the "E. M.," I have just been going through them, making notes of all matters bearing on lathes, turning, and workshop hints; and it has struck me that the value of back volumes as books of reference would be greatly increased if the titles to articles and letters indicated rather more clearly what were their subjects, and that writers might greatly help in this matter:—e.g., "J. L." has given us some very useful papers under the title of "Inferior Expedients," but that does not give one any clue to their contents; and under the head of "Lathe Matters" will be found a great deal of most valuable information; but one has to look all through each letter before one can find out what it contains.

Haydon's Cutter-Bar.—I made one of these bars from "J. L.'s" instructions, and must say I altogether disagree with "F. C." as to its usefulness. My slide-rest is a very common one, and my 3in. lathe one of the cheapest made, and I do all my turning sitting down; yet I have, with Haydon's cutter-bar, just finished the outside and faces of a wrought-iron ring, over 3in. in diameter, and have turned up a 4in. face-plate, both without back gear.

I entirely agree with "Mechanic" (letter 29801), in his opinion of both the Haydon Bar and your correspondent "F. C.," and if the latter will do as I have been doing, and go through the last twenty-five volumes of the "E. M." he will find ample ground for both these opinions, which, I feel sure, are shared by the great majority of your readers.

A. H. S.

PHRENOLOGY.

[29849.]—When I wrote my last letter I did not intend to trouble you again; but on reading the letter of "A Continental Anti-Phrenologist," which attacks myself as much as phrenology, it is but fair that I should say a few things in reply. Who the writer is I know not, and value his letter very little, for if he did call on me and get such a description, he never had the manliness to speak out his mind and point out my mistake (which I, like every one, am liable to make at times). Wrong conclusions or blunders are constantly being made by chemists, doctors, and mathematicians, whose sciences, nevertheless, remain unaffected by their blunders.

As to my place at Morecambe, any of your readers may call and see for themselves. I can show them there two as neat, clean, and light rooms as any possessed by any mechanical engineer in the kingdom, and they will find a number of casts of heads, several skulls cut open, some of the finest illustrations of the brain which one of the very best medical publishers can sell, a great number of large photographs of statesmen, actors, artists, men of science, authors, &c., by one of the best photographers in the kingdom. As to the dingy appearance of the place, they shall be the judges.

I do lecture at Morecambe, when fine, on the beach; but the description given of my audiences is ridicule, and not truth, and from what he says, many of your readers might think my phrenological life is a dirty, mole-like existence; but allow me to tell him and those who do not know (though I am known to a great many of your readers to be otherwise), when he wrote his letter I was giving a course of two weeks' lectures in the largest hall in Lancaster (the Palatine), and that I am at present giving two weeks' lectures in the Town-hall, Barrow-in-Furness, the largest and best hall in the town; and when he reads this letter I shall have commenced five weeks' lectures in the Exchange Hall, New-street, Birmingham. I have given courses of three and four weeks' lectures in the large halls of Preston, Wigan, Oldham, Huddersfield, Sheffield, Nottingham, Newcastle, Leicester, Manchester, Blackburn, Bolton, Gloucester, Leamington, Cheltenham, and throughout the whole of the Northern and Midland Counties, and in every place bring to bear on my subjects as fine a collection of sketches, paintings, lime-light pictures, and models of the human frame as any other lecturer upon any other subject in England can upon their subject, and I am lecturing in the different parts of the country from September to Whitsuntide every year without any interval whatever. My existence as a phrenologist is not a very indolent one, I can assure you.

What "Anti-Phrenologist" says about doctors and their belief in phrenology is not worth much. I dare say I have met more of them than he has, only to find out that they have not studied phrenology, and, like all human beings, they sometimes venture an opinion about something they do not understand.

Mark Moores.
Town Hall, Barrow-in-Furness.

HAYDON CUTTER BAR.

[29850.]—Allow me to suggest that the Rev. Fred. Carre has hardly given the Haydon bar a fair trial. I purchased one some time ago, and at first condemned it, as it dug in with a very small depth of cut—viz., $\frac{1}{32}$, and sometimes even less than that;

but as I read so many accounts of its good work in "Ours," it seemed to me that there was some fault in the bar, and I found that the sling where it gripped the cutter was not flat; being slightly convex, it allowed the cutter to give so that a dig-in was almost inevitable; on truing this it worked admirably, and since that time I have hardly ever used a solid tool.

But perhaps, Mr. Editor, you will allow me to quote the words of one of our most reliable authorities on lathe matters—viz., "J. K. P.," in the number for April 24th, 1885, in answer to query No. 59391; these are his words:—

"I use this bar constantly for the heaviest cuts, both in the lathe and in the planing machine, and would not be without it on any account. It is, in my opinion, the best cutter-bar that I ever saw, and I have seen most, and have made many varieties. The whole thing lies—that is to say if you have a real Haydon bar (and there have been many spurious ones of improper angle and unsuitable height) in the means applied for grinding. I was the first to suggest this to "D. H. G.," and he condemned my plan utterly at first, but subsequently wrote to say that my method was the only thing wanting to make his arrangement of stock and cutter a complete success. There is nothing like it that I have ever met with, and with my method of grinding you can go to work in the dark. I explained the grinding years ago, Vol. XIV. p. 434."

I think, after this quotation, Fred. Carre will see that the bar is not quite so bad as he would make out.

Dunelm.

LATHE CRITICISM.

[29851.]—The Rev. Fred. Carre pretends to know who I am, and states that I am one of A. Hines' workmen. This is quite like F. C.—he is all assumption. Let us hope he teaches gentlemanly and Christian behaviour in his pulpit—he certainly does not set the example in these pages, to my knowledge. His letters have deterred better men from contributing to the pages of the Mechanic.

Mechanic.

A NEW APOCHROMATIC TEST.

[29852.]—The new test just discovered is the butterfly *Colias Cæsonia* (foreign). Those scales distinguished by fine ribs widely separated are remarkable for closely-packed molecules, lying in curvilinear rouleaux generally about 1-120000th of an inch, and with the best glasses throw up brilliant focal discs.

G. W. Royston-Pigott.

CURIOUS EFFECT OF LIGHTNING.

[29853.]—A curious effect of a flash of lightning was exhibited in this neighbourhood on Friday afternoon last, April 12th. A man was cutting some hay from a rick: he wore a cap on his head, and over his cap he placed his handkerchief to prevent the dust of the hay going down his back. The piece of hay cut out is called in local dialect a "slap." He had cut this, and had descended the ladder with the slap on his head, and was standing on the ground at the foot of the ladder. A flash of lightning which then occurred broke off the top of a tree near the rick, splintered the ladder, knocked the slap of hay off the man's head, and turned it upside down on the ground. His cap was thrown about five yards in one direction and his handkerchief about the same distance in another, and he himself was cast on his back on the ground. He received no injury, but he described to me how he felt an overpowering weight on his head which he was unable to resist.

Sidmouth, Devonshire. **J. K. W.**

AN AMUSING ELECTRICAL EXPERIMENT.

[29854.]—Fold a piece of thick, rough, brown paper in two, heat it all over before the fire till it "smokes," lay it on the floor and rub it briskly in one direction with any suitable rubber—I prefer a velvet pad, such as is used for brushing hats, or the velvet back of a hat-brush; but a piece of flannel or the sleeve of one's coat (*pace paterfamilias*) will do nearly as well—then raise it and open it out flat. In this condition it is very highly charged, and will give sparks, make the hair stand on end, &c.; but these are old experiments, whereas the one I am about to describe is, I believe, new.

Make a ball (about $\frac{5}{16}$in. to $\frac{3}{8}$in. diameter) of pith, or, if that cannot be had, of cork, and place it on the paper. So long as the paper is on the ground the effects will be feeble, but let two people hold the paper by two opposite edges in a horizontal position in the air, and the ball will seem endowed with life, and will dart away in the most amusing way on the approach of a finger to touch it. The effect is best if you try to touch the side, not the top of the ball.

If cork is used, perfect roundness and smoothness of the ball is more essential than with pith. Cut it roughly to shape with a knife, burn off in a candle-flame any projecting angularities, and smooth with glass-paper.

Pith balls may be made from alder pith without any tool but a piece of glass-paper.

The pad used for rubbing the paper should be warmed to insure dryness.

Glatton.

OPTICAL ILLUSION.

[29855.]—Bright red figures on a bright blue ground, or vice versâ, have a curious appearance of sliding about if the paper or other object is moved from side to side in your shadow by gas or candle-light, but not by daylight. Why is this? It may be seen on Japanese fans and many other objects, but best of all on an advertisement for some soap (Crosfield's) prepared for the purpose. I can see no good reason for the very remarkable effect.

Glatton.

BETTER METRIC SYSTEMS.

[29856.]—In my letter p. 135, the line in middle of second paragraph that ends with "260," has this a misprint for 360; and in next line, "minions" should be minims. It might be worth while to restate, for "Old Hand" or other reformers, the first 35 of this little-appreciated series of the best metric numbers:—

4	240	10080	110880
6	360	15120	166320
12	720	20160	221760
24	840	25200	277200
36	1260	27720	332640
48	1680	45360	498960
60	2520	50400	665280
120	5040	55440	720720
180	7560	83160	

They will see, on examination, that each of these (after the first column) has more divisors than the powers of either 12 or 60 considerably over it. Such are the multiples of its minims that a good metric table rightly aimed at making its larger units contain.

E. L. G.

PORTABLE AND STANDARD CELLS.

[29857.]—No doubt a great many readers besides myself perused F. W. Mason's letter (No. 29828, p. 135) with interest. He says truly, many amateurs are in need of a portable cell; but surely he does not term such a sloppy concern—described in above letter—portable. His definition of portable is incomplete, and especially as applied to a battery. Such an article should not only occupy a small space, but also be to all intents and purposes unbreakable, and not liable to be upset and spill their contents. In fact, an ideal portable battery would be one possessing a high E.M.F., made up of dry materials, of small size and weight, not liable to breakage, and easily recharged when required, which should be seldom. There is not one at present which fulfils all these requirements.

Let us compare Mr. Mason's cell with this ideal. 1. The E.M.F. is very low; Mr. Mason says ·34 volt. 2. It is not by any means dry, being, in fact, sloppy. 3. It possesses the advantage of small size and weight. 4. The cells being made of glass, are very liable to breakage. 5. The process of recharging, if carried out on Mr. Mason's lines, must prove rather messy—that is, I mean if one has to dissolve the metallic silver in nitric acid and then add common salt to obtain precipitate of silver chloride. If, however, this is bought already prepared it would prove rather expensive. In my opinion, the Leclanché cell made up in a special form cannot be beaten by any in the market for its portability. This Leclanché has an outer case which will stand rough usage, and it will supply current for small shocking coils for periods of about half an hour. Depolarisation takes place quickly when the circuit is broken. The E.M.F. of this cell is equal to four of the aforesaid chloride of silver cells, while its cost comparing cell with cell is much less. It is of great value for testing purposes.

Now, as regards Mr. Mason's cell being used as a standard. As I take it, the surface of the negative element is made up of the surface of the chloride of silver + the surface of platinum wire which passes through solution. This of course is the case when the cell is first set up. When circuit is made and current passes, what becomes of the hydrogen which finds its way to the platinum wire? Surely this portion of negative element becomes polarised, and the E.M.F. is lowered, which is not a desirable state of affairs in a "standard cell." If I am wrong in this my opinion, I trust Mr. Mason will kindly set me right. For my own part I should use a "Latimer-Clark" cell for a standard, as one cell costing about 5s. could take the place of three of these chloride of silver cells costing 14s. 6d. I trust some of "ours" will let us have their opinion on the subject.

Bristol. **W. R.**

THE WILD BUFFALO.

[29858.]—The late fatal accident to the Hon. Guy Dawnay in Masailand, E. Africa (where he was on a hunting expedition), by the charge of a wounded buffalo, bids me relate my own hair-breadth escape in 1844. The Asiatic quadruped, *Bos arnus*, is a much larger species than the African, but they are both equal in strength and ferocity. My adventure took place in the Terai, that great tract of swampy plains and forests separating the Nepalese territory from British possessions. This vast area, covered with tall grasses, being burnt annually by wandering herdsmen to scare away tigers, and at the same time produce a rich crop of succulent pasturage, I availed myself of the open green level country to enjoy the very exciting changes of shooting on horseback. My steed was a vicious Indian pony, of 13 hands high, wonderfully fast and enduring, but in terror of wild beasts, never having previously seen one, hence his repeated misbehaviour at close quarters with the genus Bos. However, I managed to slay several grand specimens, with more than one close shave of our being tossed into the air. I "bagged" two out of three good fighters I had engaged in one day. My light 15 double smoothbore was too small a piece for killing dead; but I had cast some balls of 2oz. or 3oz. weight for a final *coup*. One fine sunny morning at an early hour I was in the saddle, and bounding across the verdant prairie, full of eager expectation to win another huge pair of horns. Within half an hour I caught sight of my black quarry, and rapidly dismounting, gave him two sphericals, and galloping off with the foe in full pursuit, rather tired him, when I found leisure to re-load. This cautious game of attack and defence was only varied by the buffalo occasionally plunging into one of the many small rivers with precipitous banks, when I availed myself of his position to gallop up to the brink and bestow my lead on his back. Refreshed by his bath, the tough brute cantered with angry snort across the further plain towards a dark line of low forest on the far horizon, two or three miles distant. Before we reached this convenient shelter there were many gunshots and many wild charges, the bull and the horse both greatly done and tamed by the hot wind and blazing sun of an Indian spring. The pony was white with sweat; Bos had a protruding tongue from which bloody foam fell in scattered patches. Before gaining the woodland he vented all his wrath on a herd of domestic cattle, which flew like timid doves before his strides. I nearly fell from my saddle with laughter at this funny attack; they were too fresh and too fleet to suffer any injury. Then a cur dog, addicted to the chase, which had followed me from my camp, barked and bothered his heels, favouring my aim. The woods are reached, and my enemy disappears in the thick bushes. I think it is better and safer to find him afoot if I can, and throwing the reins over a branch, I softly advance on a reconnaisance. I have hardly cocked my gun when a rumbling snort and a crashing charge through the brushwood announce the arrival of danger. I spring on one side as he nearly touches my body. Gun to shoulder as he wheels round in disappointed rage, I shoot him through the forehead; my finger touches the other trigger, and at that instant the motion of his head turns the bullet's course through one of his horns. As a desperate dodge I lay hold of these and grip them tightly, till tossed, knelt upon, knuckled with his knees, and dragged about, I become stunned and motionless. Bos snorts, and groans, and staggers, soaking me with his life-blood, and dropping dead nearly a-top of me. Then I sit up and begin to realise that I am terribly hurt. I faint away whenever I raise my head, from concussion of the spine; I roll over when I attempt to stand from dislocation of the right hip; my urine is bloody. I have some internal damages, bones of the pelvis fractured; my clothes are torn to rags by the kneading and horning treatment; my hat hangs on the high branch of a tree; my gun is broken in two pieces, one hammer gone; my powder-flask has been smashed into bits of copper in my pocket. As I lie in a puddle of gore I dread the visits of carnivorous animals, without firearms to repel them, for the sun is getting lower, and not much chance of being found by my servants, miles away in camp, for at least 24 hours. That intelligent little cur dog, however, sticks to me; I dip a piece of my rags in the pool of blood, and tie it on the canine follower's neck. I have just strength to dye my handkerchief till it is red, and work it out with a foot to an exposed spot. I can do no more. The sun has just set, when human voices are audible. I cannot call to them—the power of doing so is gone; but the little cur is barking without intermission, attracting the men and their dogs, a party of Nepalese hunters, who come and have a look at me and take their departure, excusing themselves from assistance by the lateness of the hour! Subsequently some Good Samaritans, in the shape of wandering herdsmen, attend to the dog's unexpected bark, and follow it into my presence. My horse and shattered paraphernalia being collected, they carry me to one of their temporary huts on a great plain, where I enjoy many draughts of cold, clear water, taken in such excess that I feel a bursting sensation. However, I manage to get some sleep. In the meantime some half-savage woodsmen have been summoned to make a rough litter of branches and grass, on which I am carried to my camp by midnight, after much shaking and stumbling in the darkness. A palanquin is sent for me by a friendly rajah, and so I travel on human shoulders to civilisation and surgical help, 100 miles distant. I arrive, black and blue in every part of my body, get a dangerous fever, am twice bled, till I faint, and then improve. Three months in bed and two on crutches, followed by a long sojourn in the dry, healthy climate of the Punjaub, complete my cure, and I am as tight in the saddle again with queer-tempered horses as before the mishap. I have killed many score of savage buffaloes in later years, on foot and from elephant-back, the country not being smooth enough for riding, and have had some exciting encounters, but shooting with such heavy metal as No. 5 and No. 7 bores, I generally won an easy victory.

In the *Bengal Sporting Magazine* of 1845-6, the above perilous escape is described.

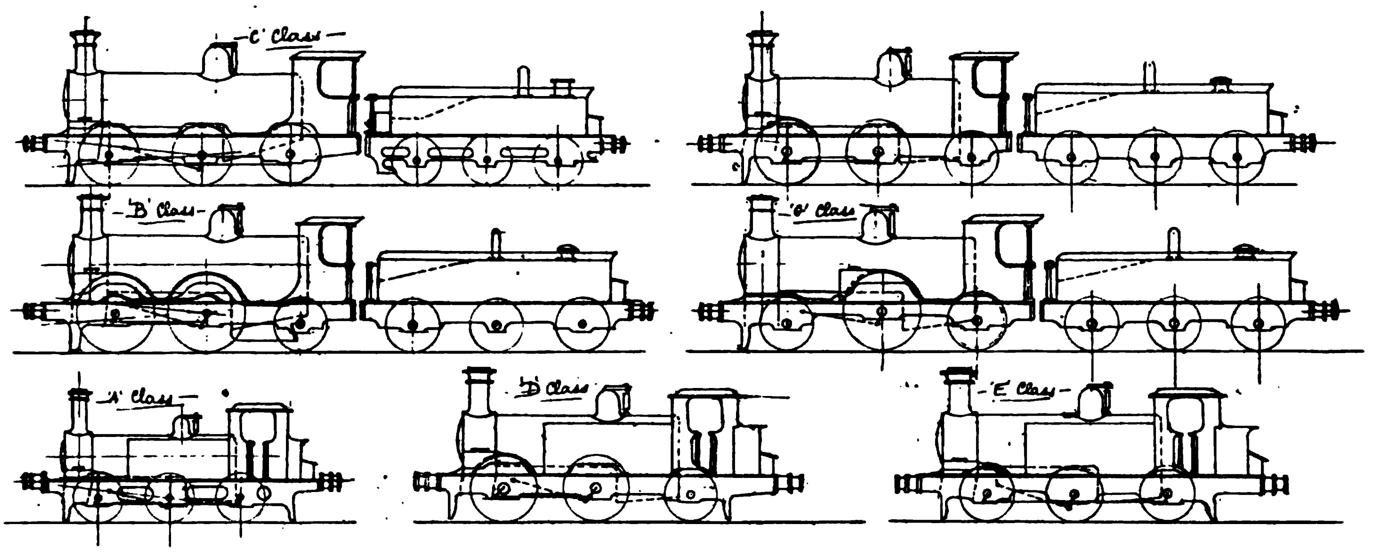
Note.—The tail of the dead buffalo was eaten away to the rump when found. **Eos.**

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67600.]—**S.S. "Brodick Castle" (U.Q.)**—If "V. J. B." will write to either Captain Elward or Captain Perrin, s.s. *Brodick Castle*, Poole, inclosing stamped envelope, I have no doubt he will obtain all information about engines. Vooght.

[67640.]—**L.B.S.C. Locos. (U.Q.)**—I send herewith a sheet of outlines of above locos., which I trust will answer the query. The following are the chief dimensions:—



Class.	Cylinder.	Driving wheels.	Wheel base.	Heating surface.	Grate area.	Weight full.	Coal tons.	Water gallons.	Coal per mile.
	in. in.	ft. in.	ft. in.			tons cwt			Maximum.
C	18½ × 26	5 0	15 3	1413	20·95	40 7	2½	2550	53·24
				(same as G class)					(40 waggons)
D²	17 × 24	5 6	15 0	1184·31	17·04	—	2	2250	—
B	18½ × 26	6 6	15 7	1492·1	20·65	38 14	2	2250	26·55—25 on
B²	17½ × 26	6 6	15 7	—	—	—	2	2250	—
G	17 × 24	6 6	15 11	1184·31	17·04	33 8	2	2250	24·20—14 on
Grosvenor	17 × 24	6 9	15 9	1132	19·30	—	2	2250	—
A	13 × 20	4 0	12 0	506·16	10·00	24 7	1	500	—
D	17 × 24	5 6	15 0	1035·91	15·30	38 10	1¼	860	17·28—13 on
E	17 × 24	4 6	15 3	1031·93	15·30	39 10	1¼	900	—
	18½ × 26	4 6	15 3	1413·00	20·95	—	1¼	900	—
	17½ × 26	5 0	15 3	1413·00	20·95	38 12	2½	2550	—

J. R. Murray.

[67862.]—**Distribution of Load.**—To "T. C., Bristol."—Whilst thanking "T. C., Bristol," for coming to my rescue, his solution still leaves me in this dilemma—viz., that if we make A W a radius, and load the resulting circle plane equally on the present lines of support, W will not be the centre of weight—i.e., no solution will hold unless the angles round W be taken into consideration. I cannot find a solution in Hahn, or Dr. Jamieson's treatise on "Centre of Gravity." The question seems to be hinted at, but evaded.

Liverpool. W. S.

[67894.]—**Compound Engine on the G.E.R.**—I cannot refer to this query, as my volume is at the binders; but I may inform "Stratford" that the sketch he refers to is intended to represent an engine, certainly unique in its way, being the only compound goods loco. running south of Doncaster. Full details of its work would certainly be interesting, and I had hoped someone would supply them; but as they did not, I sent all I knew, and if "Stratford" can tell us more, I hope he will not fail to do so. I may add that the engine is fitted with Mr. Worsdell's patent starting valve, and is, I believe, the only compound locomotive in this country fitted with link motion with only two cylinders. East Anglian.

[67904.]—**Round-Faced Hammer.**—What I "seem to know," or what "Carpenter" "knows," is neither here nor there. I tried the experiment he mentions more than a quarter of a century ago, and I am quite sure that a flat-faced hammer is the best kind for me to use in driving a nail. A carpenter has other uses for a hammer than driving nails, and he might (I do not say he would) choose one with a rounding face; but I would point out that there is some difference between a round-faced hammer and one having merely a rounding face. What I mean is exactly seen in what is known as an "engineer's" hammer, where one of the "panes" is quite rounding, and the other is practically flat. I dispute the dictum that a round-faced hammer is the best for driving nails. See the articles on hammers in Vol. XXII., and sundry other notices of the subject in back volumes. Should be glad to hear opinions of experts on this matter, for certainly I find the flat-faced hammer the best for driving nails.

Ohmi.

[67934.]—**Wire Ropes and Cables.**—I notice that "J. T.," in your last issue, rather "begs the questions" than replies to the querist, when he states that tables for calculating the breaking strains of wire exist, but does not mention any. Further, the inquirer is told to read patent specifications for trade practices—i.e., the proportions of "lays," or how to properly form "compound strands," &c. I would mention that Rickards and Co., of Birmingham, has published such a table for calculating the tensile strengths of various wires, and that Bucknall-Smith's manual on "Wire Ropes and Traction" gives much useful information on the subject, and, further, the same author has just treated the industry and trade practices more exhaustively in a series in the *Engineer*, entitled "Wire and Wire Ropes: their Manufacture and Uses." If the inquirer will examine these publications, he may find what he wants; but trade practices are seldom to be found in a useful form in patent specifications. J. P.

[67935.]—**Flues.**—Is there not an error in this reply by "Sweep"? Two or even three square inches would be an amazingly small top for a chimney, and would quickly choke up. By the formula given $\frac{15 \times 15}{4{\cdot}5} = 50$ approximate square inches, instead of two or three. Kanet.

[67995.]—**Ivory.**—If "Pommes de Terre" will turn up the indices of the back volumes, he will be able to find many recipes for making artificial ivory, but scarcely one for making it from potatoes treated with nitric acid. The best imitation or substitute is celluloid, but that has not the grain of ivory; and after that, there are various other preparations which may be useful to the querist. He will find, however, that the basis of all is a treatment of cellulose with sulphuric and nitric acids. He could obtain much information by searching at the Patent Office Library. Nun. Dor.

[68000.]—**Parchment Paper.**—The method of making parchment paper or vegetable parchment has been frequently given in these columns, and if "G. F. T." has failed to make it, he has only his own want of skill to blame. It can be bought cheaper than it can be made; but all that is necessary is to dip unsized paper in a dilute solution (half and half) of strong sulphuric acid for a few seconds, wash in water, and then soak in a dilute solution of ammonia. Wash in water again, and make it flat when nearly dry by passing over it a warm flat iron. In manufacture it is, of course, passed between heated rollers. It puzzles me why people should take so much trouble to make things they can buy so much cheaper than they can make them. Nun. Dor.

[68004.]—**Batteries for Small Installations.**—This question has been answered almost weekly for several years. The most convenient battery for the average householder to use is the chromic-acid arrangement with carbon and zinc, but the cheapest and most effective is the well-known Bunsen. The fumes of the latter are its great drawback. Why does not the querist look up his back numbers?

Nun. Dor.

[68008.]—**Boring Holes in Beechwood.**—Why not use a taper borer of the size required? As the querist has a "number of holes" to bore, it would surely pay to have the tool made.

T. J.

[68011.]—**Medical Battery.**—If this querist will say what his battery is built up of, he may obtain some useful information; but it is useless guessing as to its elements. Surely the querist can give some idea of whether the plates are carbon and zinc, or what? He says, "At present it is dry neutral," and it seems likely to remain so if he cannot take the trouble to put a definite question to those who, I am sure, would be quite willing to help him. Nun. Dor.

[68013.]—**Camera.**—"P. A." will find all necessary instructions in back volumes; but why does he want a "conical"-shaped camera?

Nun. Dor.

[68018.]—**Trough.**—"Steam" can make his trough of guttapercha, which is easily moulded when softened by heat. S. P.

[68020.]—**Reversed Brass Letters.**—These are no doubt used for putting into moulds in which clay, &c., is cast. If used for the purpose suggested by "Jack of All Trades," p. 59, the letters would be reversed on the castings. Reversed letters make letters in the proper position in a mould, and a cast from that would also have them reversed. The subject is easily understood by trying—with a bit of putty, say. Nun. Dor.

[68042.]—**Slide-Rest.**—What sort of a compound slide-rest does "P. S." want to make, that none of those already given will suit? I presume he is aware that patterns, &c., have been given before?

X.

[68054.]—**Diamond Cutting.**—If steel laps are used, they must be of soft metal; but why steel?

S.

[68061.] — **Square-Inch Pressure.** — This querist can easily ascertain the square-inch pressure by measuring his rubber rings when under pressure.

T. M.

[68126.]—**Paris Exhibition.**—Neither Phipps nor Jael have answered "Tourist's" query. A few days since the *Daily News* had a column on the subject, which would be very useful to tourists. Of course, for those who are absolutely ignorant of the French language, the best plan is to put themselves in the hands of Cook or Gaze, or any other firm who have a good reputation to maintain, who will find tourists board and lodging, and run them round to see the sights. But for those who have even a small knowledge of French, the case is quite different. The best way then is to go to an hôtel meublée, prowl about where you like, have your meals when you like and where you like; you will not be bound to return at a fixed hour to your dinner, perhaps a bad one, as at a pension, and pay for it if you do not return to it. It is better even to pay a proportionately higher price for a bed-room at an hôtel meublée; for how can you say where you will be at 6 or 7 p.m.; perhaps miles away, or in the Exhibition, wishing to stay there all the evening. In effect, the *Daily News* says this:—"On arrival in Paris (most people will arrive early in the morning), clear your luggage at the Customs, and leave it at the left luggage office (à la consigné), have a wash and a brush up, and take your breakfast at a café, and ask for the Bottin (the Paris Directory), making sure first that they have one of this year's before ordering anything, and you will find a list of the proprietors of hôtels meublées; select the addresses of those you think likely, and have a look at them and ask prices. Avoid houses where the lattice shutters are closed at 10 or 11 a.m., or which have the number of the house larger than usual (les gros numéros). Spend all the time possible in the Exhibition, leaving Paris for a future visit free from the turmoil of the Exhibition. Take a light meal in the middle of the day (there will be a 1 franc déjeuner in the Exhibition), and the principal meal at 6 or 7, after your day's tramping about. Do not drink much Paris water, or alcoholic liquors; if you are thirsty, trust to fruit as far as possible.—Pékin." P.S.—Can Dr. Allinson tell me where to get good wholemeal bread in Paris?

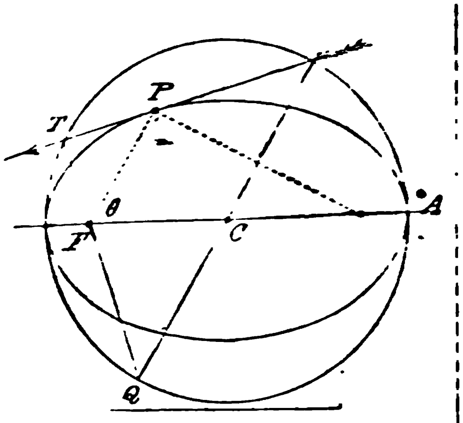
CHARLES BUSBY.

437, Caledonian-road, Holloway, N.

[68183.]—**Compressed Air.**—The replies given to this query by R. H. Craven and "Acier" seem to require a few words of comment. There is no such connection as they assert between the changes in the volume of a mass of air and the variations of temperature it may show. So long ago as 1845 it was experimentally proved that the expansion of air to many times its original volume is not necessarily attended by any fall whatever in its temperature. The mechanical theory of heat, which is one of the fundamental principles of modern engineering, affords a complete and satisfactory explanation of all the heat phenomena connected with the compression and expansion of air, by showing that the disappearance of heat is exactly in proportion to the amount of work done by the expanding air, and that where work is done by compressing the air, the rise of temperature is also in proportion to the work done upon it. A clear and simple summary of this subject may be found in Tyndall's "Heat, a Mode of Motion," which may be recommended to the study of those who have not yet grasped its principles.

F. E. C.

[68188.] — **Kepler's Second Law.** — Your esteemed correspondent, "M.I.C.E., Bath," though not an astronomer, seems to have all an astronomer's love for the above law, and his contributions and explanations do him credit. Perhaps he is not aware that in the article "Mechanics," *Ency. Brit.*, the whole subject is handled afresh by Prof. Tait, and illustrated with a hodograph. Under "Astronomy," by the late R. A. Proctor, the subject is also discussed in his most lucid manner. Under "Hodograph" it is again noticed; but to my mind the most masterly and interesting treatment of the matter is by Sir R. Ball, under "Gravitation." The concluding paragraph, with diagram, I beg to append for those who may not have the opportunity of consulting this work:—"Let F be the focus of the ellipse, in which, according to Kepler's I. law, the planet is moving, then, from a well-known property of the ellipse, the foot of the perpendicular FT let fall from F on the tangent drawn to the ellipse at the point P, lies on the circle of which the diameter is the axis major of the ellipse. The line FT cuts the circle again at Q, and as FT × FQ is constant, the radius-vector FQ must be constantly proportional to the velocity, and therefore the hodograph will be the circle TAQ turned round through 90°; but we have shown the tangent to the hodograph is parallel to the force: the line CQ must therefore be parallel to FP. If θ be the angle PFC, then, in consequence of the law of equal description of areas in equal times, $FP^2 \times d\theta / dt$ must be constant, therefore $d\theta / dt$ must vary inversely as FP^2, but the velocity of Q will be proportional to $d\theta / dt$; hence the velocity of Q, and therefore the force will be inversely proportional to FP^2. In this way it is shown that the planets are attracted by the sun with a force which varies inversely as the square of the distance."



Liverpool. W. S.

[68216.] — **Harmonium.** — The querist is evidently desirous of having a two-manual and pedal harmonium, but the way he suggests is too ambitious and rather impracticable. The bellows of his 1½-row harmonium is not large enough to supply sufficient wind required for an extra manual and pedals. He can certainly arrange a pedal action to bring down the lower octave or 1½ octave of keys, and he can also have a pipe top without detriment to the wind supply. There may not be sufficient room in the case to admit of a second row of keys or additional number of reeds. My advice to Mr. W. A. Parry is this:—Sell the 1½-row harmonium for as much as he can get for it, and buy the necessary fittings for such an instrument as he requires, and, if he cares to advertise his address in the "E.M.," I will send him a drawing of a two-manual harmonium free of charge, providing he cannot refer to the back volumes, in which a large amount of practical information on the subject appears.

Swansea. G. FRYER.

[68221.]—**Rusty Water.**—Thanks to "Fuzz," I can limewash boiler and hot cistern, but hardly know how to apply it to pipes. How would it do to hang a lump of lime in a bag in cistern for a month or so? If "Fuzz" could suggest any better way I should be glad to adopt it.

H. SPINK.

[68226.]—**Preventing Horses Slipping.**—The cheapest, safest, and best means "Tramcar Driver" can adopt to prevent his horses from slipping is to allow the frog of the foot to grow naturally, and pin or screw a light steel rim round the edge of the hoof to save it splintering. By this means the horses will be able to work comfortably and well both on greasy and frosty roads, and will rarely require the steel rim (one can hardly call it a shoe) to be renewed. Horsekeepers and grooms, of course, strongly object to this system of treating horses, as it materially lessens the amount of commission which they receive each time they take the cattle to be "shod"—a matter of frequent occurrence with our present barbarous form of "shoeing."

HERBERT WILKINS.

[68235.] — **Engine Query.** — The insurance company get the quantity of water used per h.p. from the quantity of steam shown in the l.p. cylinder immediately after expansion, all of which is exhausted except the small amount cushioned, and which may be neglected to allow for other losses not shown on diagrams. The quantity of steam in pounds pressure must be reckoned from an absolute and hence impossible vacuum—not that shown on the diagram. The l.p. diagram shows this to be about 15lb. (but you had better take that from diagrams). The capacity of l.p. cylinder is 380sq.in. (= 2·64sq.ft.) × 3 = 7·9c.ft., consequently it will use 7·9 × 60 × 2 × 60 = 56,880c.ft. per hour at that pressure. Steam at 15lb. occupies 1,610 times the space it did as water, so divide by 1,610 and you get the cubic feet of water used. Multiply this by 62·5, and divide by the H.P., thus—$\frac{56,880 \times 62\cdot5}{1,610 \times 106}$ = 21, to which you may add 10 p.c. for condensation and losses in cylinder. I only give the method, not the actual figures. As a heat engine, 106 H.P. represents 3,500,000 per minute, divide by 772, and you have about 4,530lb. of water raised 1°, but as you have used 22lb. with a total heat of, say, 1,100° added heat = 24,200lb. raised 1°, you will see the efficiency is about 0·18.

Bristol. T. C.

[68235.]—**Engine Query.**—Measure the pressure off H.P. card from zero at $\frac{1}{16}$ of stroke; this = 48lb.; the specific volume of steam of 48lb. pressure = 535; then the area of H.P. cylinder in square feet × $\frac{1}{16}$ of stroke in feet × twice revolutions and ÷ specific volume = cubic feet of water used per minute; this × 62·5 = pounds of water or steam used per minute; and this × 60 ÷ I.H.P. = pounds of water or steam used per 1 H.P. per hour. This does not allow for clearance, which may be taken at 8 per cent., or for waste, which may = 10 to 15 per cent. The l.p. cylinder is not taken into account. In your engine the steam used is as follows:—

$$\frac{\cdot924 \times 3 \times 8 \times 120 \times 60 \times 62\cdot5}{535 \times 10 \times 100 \text{ I.H.P.}} = 18\cdot67.$$

Then 18·67 = pounds of steam as shown by card + 8 per cent. of this for clearance

$$= 1\cdot5 = \begin{array}{r} 18\cdot67 \\ 1\cdot5 \\ \hline 20\cdot17 \end{array}$$

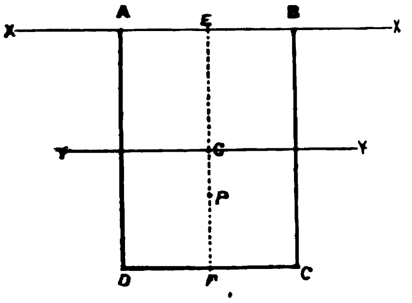
$$10 \text{ per cent. waste} = \begin{array}{r} 2 \\ \hline 22\cdot17 \end{array}$$

22·17 = either weight of water or steam used per I.H.P. per hour in pounds.

McGILL.

[68268.]—**Centre of Pressure.**—Let ABCD, Fig. 1, be the rectangle, with one edge, AB, in the surface of the fluid. Let AB = 2a; BC = 2b. From symmetry, the centre of pressure must be on EF, which bisects the rectangle. Let C be centre of gravity of rectangle, P the centre of pressure. It may be proved that depth of centre of gravity × depth of centre of pressure = square of radius of gyration of rectangle about surface. If K = radius of gyration about the axis YY through centroid. $K^2 = \frac{b^2}{3}$

FIG. 1.



$$\therefore \text{(rad. of gyration)}^2 \text{ about XX} = \frac{b^2}{3} + b^2 = \frac{4b^2}{3}$$

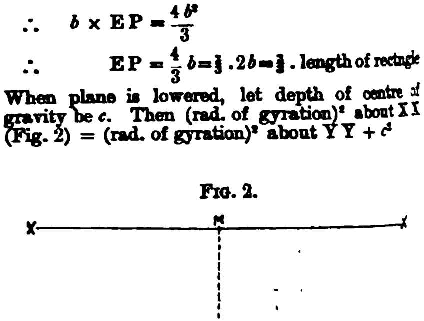
$$\therefore EC \times EP = \frac{4b^2}{3}$$

$$\therefore \quad b \times EP = \frac{4b^2}{3}$$

$$\therefore \quad EP = \frac{4}{3}b = \tfrac{2}{3}.2b = \tfrac{2}{3}\text{. length of rectangle}$$

When plane is lowered, let depth of centre of gravity be c. Then (rad. of gyration)² about XX (Fig. 2) = (rad. of gyration)² about YY + c^2

FIG. 2.



$$\therefore MC \times MP = \frac{b^2}{3} + c^2$$

$$\therefore \quad c \times MP = \frac{b^2}{3} + c^2$$

$$\therefore \quad MP = \frac{b^2 + 3c^2}{3c} = c + \tfrac{1}{3}\frac{b^2}{c}$$

$$\therefore \quad CP = \tfrac{1}{3}\frac{b^2}{c}$$

J. F. COOTE.

[68247.] — **Optical.** — The effect is probably caused by the spectacles being badly fitted. Either the frame is not of the right width, so that the centres of the lenses are not exactly in front of the centres of the eyes, or the lenses are badly mounted in the frame, so that their optical centres—i.e., the thickest parts of the lenses, do not come exactly in the centres of the eye-holes of the frame. Consult a trustworthy optician. F. E. C.

[68278.]—**Faulty Watch.**—" F. W." will find that altering the banking, so as to prevent the balance from swinging so far as to allow the faulty 'scape tooth to get fast, is the simplest way to cure the fault of which he complains. The tooth has got a little bent, I expect, and it would be dangerous for him to attempt to straighten it. If he has not found it catch often in a day, altering the banking will not affect the going much, as the balance will only strike it when it would otherwise catch.

H. Wake.

[68288.]—**Legal.**—B buys from A a piece of property on the condition that he must not build a slaughter-house upon it. This is a bargain between A and B, therefore, B must adhere to it. If B sells this property back to A, or his heirs, he may stipulate that A, or his heirs, must not build a slaughter-house; but if he does not do so, then the property is sold without this condition, and A, or his heirs, may do as they please. Econal.

[68282.]—**Wall Sundial.**—If care is taken to fix the index exactly parallel to the earth's axis it is easy to mark the hours correctly on the dial by experiment, using a good clock and making the proper allowances for the longitude and for the equation of time. Any good local map will give the longitude, and four minutes of time must be allowed for every degree. This must, of course, be added to Greenwich Time if the longitude is east, and subtracted if it is west. The construction of sundials which do not face the south involves some interesting practical geometry, and therefore with the kind permission of the Editor to occupy the needful space, I give the following method:—We first proceed to find the position of the index and its inclination to the plane of the dial. Draw the horizontal line *a b* (Fig. 1) and a perpendicular, *c d*, cutting it in *c*. Then draw *c e*, making an angle with *c a* equal to the latitude of the place (here taken as 55°). Take the point *e* at any convenient distance from *c*, and from it draw *e f* perpendicular to *c d*. Next find exactly how many degrees the dial is to be turned eastward of south, and draw *f g*, making an angle *d f g* equal to this (here assumed as 20°). Make *f g* equal to *f e*, and draw *g h* perpendicular to *e f*, then draw *c h*. This line gives the position in which the index must be fixed on the dial; its slanting direction is owing to the dial not facing due south. Next draw *h k* at right angles to *h c*, and make *h k* equal to *h g*, then join *c k*. This gives the angle *k c h* for the index, which may be of any convenient length, but must be fixed on the dial along *c h*, so as to be truly vertical to its plane. Its upper edge must make an angle with the plane of the dial equal to *k c h*, and must have its upper point exactly on C. If the graduation of the dial is to be done geometrically, we continue as follows:—From *f* draw *f l* parallel to *h k*, and from *l* draw *l m* perpendicular to *c k*; then make *l n* equal to *l m*. It will now be better to transfer the needful points and lines carefully to a fresh diagram to avoid confusion. In Fig. 2 the lines *a b*, *c f*, and *f l* are reproduced, also the point *n*. Produce *f l* both ways to *p* and *r*, then draw *n f*, and from *n*, as a centre, draw lines 15° apart, beginning from *n f*, and proceeding both ways as far as there is any need. These lines will cut *p r* in *p*, *v*, *x*, *y*, &c. If this has been accurately done, the hour lines are now obtained by drawing lines from *c* through these points of intersection, and producing them to any desired length, according to the size and shape of the dial (which is quite immaterial). The vertical line *c f* is the line of noon, and care must be taken, in fixing the dial, to set this line exactly vertical. The drawing is done with greater ease and accuracy when the scale is taken as large as possible. F. E. C.

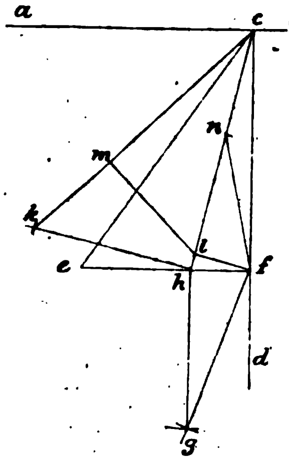


Fig. 1

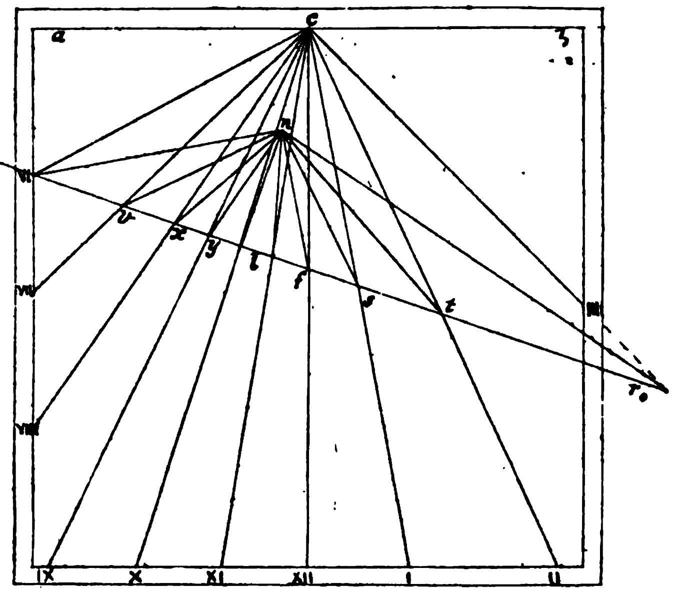


Fig 2.

[68293.]—**Arithmometer Calculating Machine.**—In reply to " W. H.'s " query, I have had several machines of M. Thomas de Colmar in almost daily use for some years. About two years ago, however, one of Tate's machines (worked in a precisely similar manner, and on the same principle) was purchased, and, owing to its never getting out of order (with proper oiling and care), I have almost entirely ceased to use the French machines. The machine of M. Thomas de Colmar is, I have been told, exactly on the same principle as one brought out in England more than a century ago. It is made in several different sizes, one of which is called a six-figure machine (giving products to 12 places), another an eight-figure machine (giving products to 16 figures), and, I think, a ten-figure machine (which I have not seen), and which would give products to 20 places. For most practical purposes an eight-figure machine is what would be required. With such a machine, products can be obtained to any number of places by splitting up the factors—e.g., required (by an eight-figure machine) the product of the two following factors:

$$\underbrace{2{,}359{,}437{,}654{,}354{,}061}_{\text{1st factor.}} \times \underbrace{2{,}432{,}109{,}836{,}564{,}531}_{\text{2nd factor.}}$$

Let 2359437600000000 $= a$.
Let 54354061 $= b$.

Then 2359437654354061 $= (a + b) =$ 1st factor.

and let 2432109800000000 $= c$.
and let 36564531 $= d$.

and then 2432109836564531 $= (c + d) =$ 2nd factor.

Now we know that $(a+b)(c+d) = ac + ad + bc + bd$. Therefore—

$$\begin{array}{lr} ac = & 57384113094484800000000000000000 \\ ad = & 0862717292677656000000000 \\ bc = & 1321950444278978000000000 \\ bd = & 1987430748410391 \end{array}$$

And 57384115279152556830941484 10391

$$= ac + ad + bc + bd,$$

which result has been brought out by a machine with a capacity of dealing with only eight figures at a time. It will thus be seen that there is no limit to the capacity of the machine in this regard. The machine is constructed to perform the four simple rules of arithmetic—addition, subtraction, multiplication, and division. With regard to the first, if only a single column of figures is required to be summed, the operation would be performed much more quickly by "totting" than by the machine, and even with eight-figure columns there would be very little, if any, saving of time by using the machine. It is only with regard to another form of addition—viz., multiplication—that any appreciable saving of time is effected, and the same may be also said with regard to division, which is, of course, only another form of subtraction, in which the advantages to be gained by using the machine are about the same as in addition. There is another point, however, which should not be neglected in considering the utility of the machine as compared with brain labour, and that is correctness of result. A good machine will never go wrong. It may happen, however, that the machine has had considerable wear, or that it requires adjustment; but even then, if it go wrong, it will give such an absurd result that the error is at once patent. On the other hand, the operator may err in setting the figures upon the machine, or in turning the handle the required number of times; but if he be so careless, it would seem also that results brought out by him without the machine could not be depended upon. The correctness of the results brought out by the machine can be easily verified by testing, say, the first and last of a series, by another method; and, if these be found correct, it is highly improbable that the machine can have given wrong results between the two points. The remedy for the errors of the operator is to perform the operation in duplicate, if possible by two different persons. I have found that with hard wear the French machine soon gets out of order, owing, no doubt, to the parts being made of soft yellow brass and not being cut out of the solid. Further particulars of this machine can be obtained from Messrs. G. F. Redfern and Co., 4, South-street, Finsbury, who are " sole agents for the arithmometer for England, America, and the Colonies." With regard to its usefulness, the following papers will give further details:—*Journals* of the Institute of Actuaries, April, 1865, April, 1869, July, 1871, and a book by Peter Gray, F.R.A.S., F.R.M.S. (price 3s. 6d.), all of which may be had from Messrs. C. and E. Layton, 56, Farringdon-street, London, E.C. I think the *Journal* of the Institute of Actuaries for July, 1871 (price 2s. 6d.), would be the most useful. It contains a paper by the late ~~Major~~ Genl. Hannyngton, F.I.A., F.S.S., "On the use of M. Thomas de Colmar's Arithmometer in Actuarial and other Computations," one by Edward Sang, F.R.S.E., "On Mechanical Aids to Calculations," and a note by W. J. Hancock, "On the use of the Arithmometer." As the arithmometer of Tate is so much like that of M. de Colmar, and as I have an illustration of it which, if reproduced would render the subject clear, I will endeavour, next week, to describe in detail the mechanism of Tate's machine. Frank West.

[68294.]—**Small Electro-Motor.**—To "Phos." —The above is required to wind up a small spring at intervals of about one hour, which spring acts as the motive force for driving a train of wheels used as a mechanical display for a window or similar purpose. The motor would be geared down to gain mechanical advantage. Any information as to suitable motor would oblige. M. F.

[68299.]—**Printing on Silk.**—After tracing your outline on the silk or satin, secure it by going over it with China white. Mix together about equal parts of honey and gum-water in strength such as is sold in bottles in druggists' shops, but made of white gum. Paint over what you intend to colour with this and let it dry; then use your colours, either oils or water-colours. If the latter, they must be mixed with China white, and varnished when the painting is finished. If the mixture of honey and gum-water does not dry readily, use more gum-water; if it rubs off or is inclined to crack, more honey. E. G.

[68300.]—**Mercurial Pressure Gauge.**—My experience in a precisely similar case may be worth insertion. The pipe from the overhead tank terminated in such a U as "T. C." describes, and so confident was I of its success that I had a dial made to register inches, the motion being derived from a float on the top of the mercury. It was very sensitive and accurate: the slightest motion on the water showed on the dial. But it was a mean failure with all these fine points, for the water leaked steadily past the mercury, and, of course, spoiled the whole thing—so don't try an iron or steel tube; and, indeed, there is some reason to discard such an appliance altogether, and depend on purely mechanical transmission. Is there no means whereby a current and small wire would be available?

Dublin. W. M. I.

[68307.]—**Watch Repairs.**—To fit new feet to a dial, take an old broken dial, and crack the enamel off; then cut out the feet, leaving about $\frac{1}{16}$in. all round, like a small tack. Now clear away the enamel on the dial, where you intend to fix the feet, and solder them on, using ordinary tin and lead solder, with chloride of zinc as a flux. This makes a good job, if nicely done; but I generally prefer to drill two holes at the 3 and 9, and fix with two small screws going through into the plate. This is the way many of the best Geneve watches are done when new. H. Wake.

[68308.]—**Cement for Pushes.**—A first-class cement is made of 1fl.oz. silicate of soda, ½fl.oz. carbonate of magnesia (heavy), ½fl.oz. best plaster of Paris, 1dr. (powdered) alum. Mix the powders all at first, then add silicate, and, if necessary to make it more fluid, add water; but it is better without. This cement in our place works splendidly and is in constant use. Dealers in recipes, please don't copy. Workshop.

[68314.]—**Wire on Coils.**—I beg to thank both gentlemen who replied to my query as above, and to ask Mr. Bottone if he will kindly give the other method he mentioned (with the Editor's kind permission), as this would likely prove of assistance to other of our readers who would not be able to get at the bottom of the formulæ given? I tried every dodge short of unwinding, previous to getting the replies kindly given. Formula.

[68318.] — **Waterproofing Silk Fishing Lines.**—Would not passing the lines through melted paraffin wax answer the purpose of the querist, who must understand that this would make them smell rather, and be unpleasant, because greasy to the fingers? Dubbin might answer the purpose. Vir Sapientiœ.

[68318.] — **Waterproof Fishing Lines.**—I know of no better way than tanning them. Steep the lines in rain-water for a few hours; then wind them tight on a piece of slate, stretching them well to remove kinks. Put them in a tanpit, or, if not convenient, boil 5lb. of broken oak bark in a large enamelled pot, free from grease, with a gallon of water, till reduced to a quart. Pour into a jar, and let it cool. Place your lines in this liquor for a few days. When brown, remove them; rinse in several waters; unwind, and dry them in the air by rolling them loosely on a board. When you fish, rub the parts in use with a piece of beeswax.

Eos.

[68319.]—**Battery for Medical Coil.**—I have found bichromates very good for medical-coil work. Have your cells square if you can, with two carbons and one zinc to each cell, exposing as much carbon surface as possible. If you use 4oz. bichromate and 1oz. sulphuric acid to each pint of water, you will get plenty of power and hardly any smell.

Forest Hill. J. Minuto, Electrician.

[68319.]—**Battery for Medical Coil.**—If you make up a carbon zinc battery with plates 3½in. by 7in., one zinc between two carbons, and charge with chromic acid 3 parts, water 20 parts, sulphuric acid three parts, you will have a powerful battery, one cell of which will be equal in current to two or three Bunsens, and will last three hours at a stretch. If you want a longer run, then use Bunsen cells; but instead of using nitric acid in the porous cell, use a mixture of chromic acid 2 parts, water 3 parts, sulphuric acid 1 part.

S. Bottone.

[68319.] — **Battery for Medical Coil.** — The querist would probably find that the bottle form of bichromate battery (which has the zinc lifting arrangement which is most convenient), charged with either the chromic acid or bichromate of potash solutions as commonly used, would be the most convenient in the place of the Bunsen's cells for the purpose named. The three bichromates would, to all intents and purposes, about equal the three Bunsens. If this form with lifting arrangement be thought too expensive in first cost, batteries without the lifting arrangement would be cheaper, but not nearly so convenient. If bichromate solution be used, a good form of this is the Trouvée solution, which lasts longer than the ordinary bichromate solution. Vir Sapientiæ.

[68321.]—**Electric Bells.**—To Mr. Bottone.—If the small difference of expense is a consideration, you may use galvanised iron wires instead of copper; but the iron wire must be much stouter than the copper to carry the same amount of current. Where the wire touches trees, posts, &c., insulators should be used. The return wire may be dispensed with, and an earth return used instead, provided you can carry your earth plate good moist earth. See my book on "Electric Bells" for details as to making a good "earth." I should think you would require at least three cells to work a bell through 200 yards of No. 20 copper, or its equivalent No. 16 iron. S. Bottone.

[68323.]—**Electromotor.**—To Mr. Bottone.—Armature 2¼in. diameter, 4in long, wound with ¼lb. No. 20 d.c.c field magnets 4in. wide, ½in. thick, 5in. long, wound with 5lb. No. 16, coupled in series with the brushes. This will need six bichromate cells with double carbons 7in. by 3in. to give desired effects. This means 12 volts and about 24 ampères. If driven as a series dynamo, this motor should give, at 3,000 revs., about 5 ampères at 50 volts pressure.

S. Bottone.

[68326.]—**Stove Pipe Difficulty.**—I don't think the right angle has anything to do with it. It is generally necessary in a case like yours to have to fire the chimney where the flue pipe ends, to get a proper up-draught, and draw the cold air out of the pipe; also your stove will have to be fired sufficient to keep it so. And this brings us to the conclusion that you will not be able to work your stove on the slow-combustion principle. The T-piece is not necessary—a straight entry is all that is wanted.

Gas Engineer.

[68327.]—**English Lever Watch.**—Most likely there is something wrong with the escapement, which causes the balance not to vibrate so far when the watch is perpendicular as when it is horizontal. Perhaps the ruby pin slightly touches the bottom of the lever notch, or it might be the safety-pin too close to the edge of roller, or half a dozen other causes — it is impossible to tell what without seeing it; but if "Bolton" will put it in the hands of some really competent watch examiner, he will make it go correctly. But he must not expect it done for nothing, as it might be some trouble; but the seller ought to have made it right before he put it in his window for sale. W. L. Matthews.

[68329.]—**Cupola.**—The cupola is altogether badly designed. It is too small—15in. or 16in. is the very least diameter permissible for a cupola. It is not tall enough; charging hole 15in. above tuyeres is not nearly high enough to give room for perfect combustion; 3in. from hearth to tuyeres gives no room whatever for bed charge. You ought to have room below the tuyeres for a bed charge equal in weight to eight or ten times that of subsequent charges; then that would last through a blowing of several hours and keep the metal hot. I think it impossible under any circumstances to melt and tap out hot metal from such a cupola. But by melting the metal in a crucible above the tuyeres, you might still utilise it. The melting might be long about, but the metal would keep hot in the crucible. For a small cupola, take the following rough dimensions, slightly modified from one in occasional use:—Get a piece of old wrought-iron pipe, or make a wrought-iron shell about 21in. in diameter and 9ft. or 10ft. long, support it on brickwork, and line with one course of bricks, making inside diameter 15in. or 16in.; leave the top open, and make the platform level therewith, and charge down from the open top. Make a single 3in. tuyere hole 9in. or 10in. up from bottom; tap from the bottom. This will melt a half-ton of iron per hour. J. H.

[68330.]—**Dynamo.**—To Mr. Bottone.—To calculate the speed at which the armature of a dynamo is rotating, the diameter of its pulley, that of the driving-wheel, and the number of revolutions the latter makes per minute being known, all you have to do is to see how many times the diameter of the dynamo's pulley is contained in the diameter of the engine's driving-wheel. Multiplying this by the revolutions of the engine's driving-wheel gives the revolution of the armature. For example—say the engine's driving-wheel be 15in. in diameter, the pulley on the dynamo 1in. in diameter, then 1)15(15. Now, suppose the revolutions of the engine's driving-wheel be 120 per minute, 15 × 120 = 1,800, the number of revs. of the armature per minute. A 45 volt 20c.p. lamp is a lamp that requires a pressure of 45 volts to cause sufficient current to pass through it to give 20c.p. light. No man could drive a 120c.p. Gramme by hand; it requires a ½H.P. engine. S. Bottone.

[68331.]—**Coppering Carbons.**—Use one large Daniel cell in conjunction with a saturated solution of copper sulphate, rendered slightly acid with sulphuric acid. Wash well when coppered; but you can cast a ring of copper round the top ends of the carbons, and this is even better than the copper.

S. Bottone.

[68332.]—**Bichrome Battery.**—The explanation of the heating of "W. G.'s" battery cells is that, there not being enough resistance in the outer circuit to absorb the energy being generated in the battery by the chemical action of the solution on the zinc, the extra energy is converted into heat in the liquid itself. The remedy would be either to withdraw a cell, or use a thinner wire in the outer circuit. B. Harcourt, Solicitor.

118, Palmerston-buildings, E.C.

[68332.]—**Bichrome Battery.**—Perhaps the querist has put more than the usual and proper quantity of acid to the bichromate solution, so that the local action of the battery is very great. The zincs may need re-amalgamation. The points being seen to, the battery may work as it should.

Vir Sapientiœ.

[68332.]—**Bichromate Battery.**—The probable causes of the heating in your battery are:—1st. Mixture used while still warm. 2nd. Clamp touches zinc as well as carbons. 3rd. Zinc touches carbons below. 4th. The battery is working against a very low outer resistance. Vulcanite is not a good thing to work a bichromate or chromic acid solution in.

S. Bottone.

[68334.]—**Chemical.**—Have you not made a mistake in your query? Should it no be—an alc. sol. of ethylene bromide is heated with pot. cyanide? This would result in the formation of ethylene cyanide, thus:—

$$C_2H_4Br_2 + 2KCy = C_2H_4Cy_2 + 2KBr.$$

If the ethylene cyanide be heated with alc. potash, it forms potassium succinate.

$$C_2H_4Cy_2 + 2KOH + 2OH_2 = C_4H_4K_2O_4 + 2NH_3.$$

Sm.

[68336.] — **Pocket Accumulator.** — To Mr. Bottone.—A week is a long time for such a small accumulator to stand charged. It has simply leaked off. I do not think you will get it to hold its charge for more than 24 hours.

S. Bottone.

[68337.]—**Lathe Query.**—If you send your lathe head to Britannia Co., you can have hard mandrel and collars fitted at a small cost.

B. C.

[68337.]—**Lathe Query.**—Can you not try the mandrel round by hand, and see if it is really there? Hardening the collar and mandrel would make but little difference in the running. Probably you are making the mistake of having the band too tight. Use pure sperm oil.

Bristol. T. C.

[68338.]—**Savery's Engine**—Consists of, first, a boiler; second, a vessel fitted with pipes having a valve in each—one inlet and one outlet. Steam is admitted to the vessel; the steam condensed by injection of water to create a vacuum. The water from mine, if not more than, say, 26ft., enters the vessel in consequence of the vacuum. Steam is admitted on top of the water, which is forced out through outlet valve to a height corresponding to practically 2ft. for each pound of pressure used, and consequently 15lb. is required to force it 30ft. high.

Bristol. T. C.

[68341.]—**Incandescent Electric Lighting.**—Perhaps the wires leading to the fourth lamp have less resistance than any of the others; if so, the current flowing through that lamp would be stronger than that through either of the others, and, consequently, the lamp would glow more brightly. When lamps are arranged in parallel, the first one does not short circuit the dynamo, because each lamp and its leads are of practically equal resistance. This being so, the current splits up into equal portions, one portion flowing through each lamp.

Dnalwor.

[68342.]—**To Mr. Bottone.**—Yes, to all your queries under this number. S. Bottone.

[68344.]—**How to Bore a Lathe-Head.**—Write to the Editor for the number containing full description of how to do this in the articles on "Lathe-Making," by "J. H.," a couple of years or so back; it is exactly what you want. You can run mandrel in the cast-iron without bushing.

Bristol. T. C.

[68346.]—**Chemical.**—The following analysis is for a solution containing the substances enumerated. Neutralise it and all $CaCl_2$, and allow to stand for fifteen minutes; filter. Residue contains oxalic and tartaric acids; wash; add cold strong KHO in excess; filter. Residue is the oxalic acid; filtrate is the tartaric acid re-pptd. by boiling. Filtrate is citric, hydrocyanic, acetic, salicylic acids, &c.; boil for some time; filter. Residue is the citrate sol. in HCl re-pptd. by NH_4HO, and boiling. Filtrate contains the other substances; add $AgNO_3$; filter. Residue is HCy and $HC_2H_3O_2$; boil; filter: the residue is HCy; filtrate is the $HC_2H_3O_2$. Filtrate is salicylic acid, &c.; add bromine water; filter. Residue is the salicylic acid. Filtrate is grape sugar, starch, morphine, and urea; add Fehling's solution; filter. Residue is the grape sugar. Filtrate is other substances; add $Hg(NO_3)_2$; filter. Residue is the urea. Add KHO (not in excess); filter. Residue is the morphine sol. in excess of KHO; filtrate is the starch; add iodine solut. blue, colour of starch iodide.

Derby. F. E. Holl[illegible]shead.

[68346.]—**Chemical.**—It is very difficult to devise any scheme for the separation of all the substances mentioned; but the following plan would serve for the first six (HCN, $(CO\,OH)_2$, $CH_3CO\,OH$, $(CH\,OH\,CO\,OH)_2$, $C_2H_4OH\,(CO\,OH)_3$ and $C_6H_4OH\,CO\,OH$), and the rest could be tested for specially. To the neutral solution add $CaCl_2$, and allow to stand. The ppt. contains calcic oxalate and tartrate; call this A. Add to filtrate two or three times its volume of strong spirit, the ppt. is calcic succinate and citrate; call this B. Add to the filtrate just a trace of NH_4OH, and boil down to expel most of the alcohol, and then add Fe_2Cl_6 (neutral)—a blue-violet colour indicates salicylic acid. If it have also a red tint there may be present acetic and formic acids—it should then be boiled, when the basic salts will be pptd. Call this ppt. C. We will now consider the treatment of the precipitates. (A). Warm with a little $CH_3CO\,OH$ and filter. The portion undissolved is calcic oxalate. Wash thoroughly, dissolve in the smallest possible quantity of HCl, add dilute NH_4OH until a few more drops would gave a ppt., and then a good quantity of sodic acetate sol. Any precipitate is calcic oxalate. Reprecipitate the calcic tartrate from the acetic acid soln., add a crystal of $AgNO_3$, and warm gently to about 65° C. for 15 minutes—a silver mirror shows the presence of tartaric acid. Ppt. (B). Wash, dissolve in least possible quantity HCl, add NH_4OH till just neutral, then excess $Ca(OH)_2$ solution and boil. The white ppt. is calcic citrate. Succinic acid can be tested for in the filtrate by Fe_2Cl_6. Ppt. (C). Transfer to small test-tube fitted with cork and distilling-tube, add H_2SO_4, dilute (1 : 3), and distil. Neutralise (exactly) the distillate with Na_2CO_3, add $HgCl_2$ (if immediate ppt. in the cold this indicates that excess of Na_2CO_3 is present), and heat to about 70° C. The white ppt. is Hg_2Cl_2. Test for acetic acid by H_2SO_4 and alcohol. Now it only remains to test specially for grape-sugar, starch, morphine, and urea. For these, separate portions of the original solution should be taken and tested with (1) Fehling's copper solution, (2) iodine, (3) Fe_2Cl_6 (after precipitating the morphine with Na_2CO_3 and redissolving the precipitate), or H_2SO_4 and HNO_3, and (4), a solution of four parts NaOH, twenty parts OH_2, and three parts Br (all by weight), when nitrogen will be evolved. I fear that my desire to be clear has made this rather long; but as I am myself going in for the same examination as the querist, I am naturally rather interested in it. If he will advertise his address in the proper column, I will see if I can help him by correspondence, packets of substances to test, &c.

Richmond. YOUNG ANALYST.

[68348.]—**Air Vessel.**—This is a rather "big order." If you only run the engine 100 revolutions a minute for two hours, you would use 300c.ft. of air at whatever pressure; and as you could not use more than half in the vessel without reducing the pressure more than half, the vessel would require to be twice this size for every 100 revolutions per minute! For striking gear, you could have a long cylinder fitted with a piston and spring, which, when forced to any height fixed upon, would work the lever of clutch and throw mill in or out of gear as pressure was increased or reduced.

Bristol. T. C.

[68349.]—**Balloon.**—You would require a balloon of oiled paper or silk 7ft. to 8ft. diameter and 170c.ft. to 250c.ft. in capacity, with a square net of meshes 4in. in size, the net to be 14ft. square; 60lb. to 70lb. iron turnings, and about the same weight of sulphuric acid, with 36 gallons water and two large wine-casks to generate the gas will be required. It is a pretty big job to get everything complete, as you will find if you try.

J. SUTCLIFFE.

[68357.]—**Gramme Dynamo.**—Even supposing you have insulation and connection quite perfect, yet the amounts of wire on F.M. and A. are so disproportionate that you cannot get good effects. Supposing you decide to couple your machine in shunt for incandescent lighting, then 5lb. No. 18 equals 3 ohms; ½ of this is the running resistance of the armature, say 1½ ohm. Now the F.M. must have a resistance of at least 300 times this, namely, 450 ohms, so that you would want nearly 80lb. No. 22 to balance it. I can only advise you to get on as much No. 22 as your field magnets will hold. You will then probably get sufficient ampère turns to magnetise your fields fairly well.

S. BOTTONE.

[68361.]—**Chromic Acid.**—The chromic acid, whether obtained by the old process described by Fownes, or the newer process patented by Sullivan, is essentially the same body. You will find a full description in the specification of the patent. "Chromic salts" differ according to makers. With some bichromate of soda is meant; with others chromic acid; with others, again, a mixture of bichromate of potash or soda with nitrate of ammonia or potash. S. BOTTONE.

[68363.]—**Scientific Amusements.**—A medical coil is an indispensable article, and if an "electric lady" is introduced, it will no doubt create much amusement and draw plenty of coin. Microscopes are also attractive. SM.

[68363.]—**Scientific Amusements.**—The following are a few novelties for a bazaar:—The electric lady, the "Thauma" illusion, the new mystery of "She," the new Egyptian mystery, divining cards, the "Stella" illusion, the Nautch girl's dream, the living head in a glass bottle, "Galatea" illusion, Mahomet's coffin, magic oracle, the great shadow ghost illusion, fire-eating, blood-writing on arm, chameleon sand trick, magic picture appears and disappears, sham spiritualism, slate writing, &c. I shall be pleased to give "Hopeful" information. W. H. M.

"Alma," Boscombe, Bournemouth.

USEFUL AND SCIENTIFIC NOTES.

The Dreams of a Hasheesh Smoker.—*Science* describes the experiences of a gentleman who placed himself under the influence of a hasheesh. He smoked it until he felt a profound sense of a well-being, and then put the pipe aside. After a few minutes he seemed to become two persons; he was conscious of his real self reclining on a lounge, and of why he was there; his double was in a vast building of gold and marble, splendidly brilliant, and beautiful beyond all description. He felt an extreme gratification, and believed himself in heaven. This double personality suddenly vanished, but reappeared in a few minutes. His real self was undergoing rhythmical spasms throughout his body; the double was a marvellous instrument, producing sounds of exquisite sweetness and perfect rhythm. Then sleep ensued, and all ended. Upon another occasion sleep and waking came and went so rapidly that they seemed to be confused. His double seemed to be the sea, bright and tossing as the wind blew; then a continent. Again, he smoked a double dose, and sat at his table pencil in hand, to record the effects. He lost all conception of time. He rose to open a door, and it seemed to take a million years. He went to pacify an angry dog, and endless ages seemed to have passed when he returned. Conceptions of space retained their normal character. He felt an unusual fulness of mental impressions—enough to fill volumes. He understood clairvoyance, hypnotism, and all else. He was not one man or two, but several men living at the same time in different places with different occupations. He could not write one word without hurrying to the next, his thoughts flowing with enormous rapidity. The few words he did write meant nothing.

Coal Production in the United States.—Coal production in the United States in 1888, as compared with 1887, is estimated by the Statistical Bureau of the Geological Survey as follows, in tons of 2,000lb.:—Anthracite (1888), 43,578,000, (1887) 39,506,255; bituminous, 94,937,700, 84,509,000; or totals respectively of 138,515,700 and 124,015,255. Pennsylvania was the largest bituminous producer, with 32,500,000 tons. Ohio reported last year 11,950,000 tons, Illinois 11,855,200, and West Virginia 5,498,800 tons; no other State produced over 5,000,000 tons. Coal was mined in 30 States and Territories. The above estimate does not include coal consumed at mines, which is estimated at 6,848,000 tons, making a total of 145,363,000 tons taken out last year.

A PAPER was read at a recent meeting of the Paris Academy of Sciences on the "Compressibility of Mercury and the Elasticity of Glass," by M. E. H. Amagat. In his communication of October 15, 1888, the author gave the results of his studies on the elasticity of the crystal in the cylindrical piezometers of this substance charged with mercury. By simultaneous inward and outward pressure of these cylinders, he obtains the coefficient of apparent compressibility, and ultimately that of the absolute compressibility of the liquid metal. The whole series of experiments are now repeated, and the results here tabulated, showing for mercury a mean general coefficient of 0·000003918 under pressures not exceeding 50 atmospheres.

THE California Electric Light Company, of San Francisco, has erected at the Chollar Mine the largest electric-power plant in the world. It comprises six 120 horse-power Brush dynamos, each driven by a Pelton water-wheel with water under a head of 1,630ft. The water is conveyed through two pipes of 8in. and 10in. in diameter respectively. The station is situated in the shaft of the mine, and the exhaust water is carried off by a tunnel to the Caron River. The current is led to the mill, where it drives six Brush motors of 125 horse-power each.

SPONGES are found chiefly in the Mediterranean and Red Seas, around the Carribean Islands and the Bahamas, and off the west and south-west coasts of Florida. A new kind has recently been found in Australian waters, and another on the Atlantic coast of Brazil, but these are of a coarser kind, and of less commercial value.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

67729. Transparent Show Bills, p. 489.
67744. Ferry, 489.
67755. Electric Bells, 489.
67758. Quill Floats, 489.
67761. Gas-engine, 489.
67766. Jewelry, 489.
67769. Cryolite or Sodium Aluminate Fluoride, 489.

67996. Engine, p. 38.
67998. Closing Steel Rivets, 38.
68007. Electro-Motors, 38.
68019. Camera Obscura, 38.
68021. Chemical Reaction, 38.
68031. Skeleton Leaves, 39.
68034. Electrical Gas-lighter, 39.
68035. Battery Transformers, 39.
68038. Chuck, 39.
68039. Indicator for Medical Coil, 39.
68040. To "Prismatique," 39.
68041. Terschuk, 39.
68056. Drums, 39.

QUERIES.

[68364.] — **Compound Condensing Engine Cylinders.**—Would some of your readers inform me how to find the proper proportion for the diameters of the cylinders of compound non-condensing and compound condensing engines with two and three cylinders, or give the respective diameters from 4in. up to 36in. as the high-pressure cylinders?—EXPANSION.

[68365.]—**Prices of Ironwork.**—I understand that there is an almost standard price per ton with boiler-makers for the cost of manufacture to allow themselves a reasonable profit, and also with bridge-builders, &c., for girders, roofs, tanks, &c. Is there any book to assist in this, or can any of "ours" favour with particulars?—GIRDER.

[68366.]—**Paint.**—Will some correspondent please give me a recipe for non-poisonous paint for inside of water-tank?—BOSH.

[68367.]—**Renovating Band Uniforms.**—I am a performer in, and secretary to, a band in the Midlands, and our uniform tunics are the same as worn years ago in the Royal Marines—viz., bright red serge with blue facings, some of which are stained down the breasts and others at the sides, the former possibly from various articles spilled down them, and the latter from the brass off the instruments, it being usual to carry them at the side when not in use. Our funds will not stand a new suit at present, neither are the tunics near worn out, and as we should like to turn out this season as smart as possible, I should be glad to know of anything that would remove the stains without taking out the proper bright colour. If a dye is necessary, I could get the tunics made up again, but would much rather hear of something that would save this trouble.—BARITONE.

[68368.]—**Drums of Threshing Machines.** — Could any of our readers give me an accurate means of balancing the above? I have tried them between lathe centres, but found that method too dead.—JIM.

[68369.]—**Lawn Mowers.**—Wanted the best method for resharpening cylindrical knives without taking them from their place. I have tried revolving them in lathe against emery brick, but find it injurious to lathe bed.—JIM.

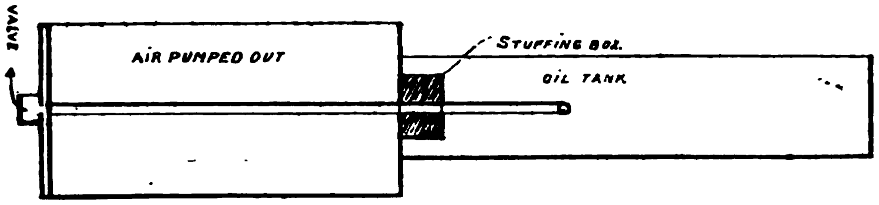
[68370.]—**Calculating R.A. of the Moon.** — Some time ago, in answer to a query regarding the moon's position, "F.R.A.S." said that the R.A. of the moon was not measured off on the terrestrial Equator. I do not think, however, judging by the results I have obtained in defining the shadow of eclipses and tested by the graphic delineation in the *N.A.*, that there can be much error between reckoning on the Equator and in the orthodox manner. Will "F.R.A.S." be good enough to tell me what amount of error exists between the two modes of calculation? I am not anxious for absolute accuracy, but wish to fix the position of the moon, at the periods new and full, relatively to the earth, with as great accuracy as possible.—RURIC.

[68371.]—**The Constellations.**—Can any of your readers inform me of any good commentary on the Shield of Hercules and the Shield of Achilles, and which translation of these poems is best from an astronomical point of view, and how the following works can be procured, and at what cost, and any particulars as to publishers and editions, &c.? Lamb's translation of "Arators"; Sir W. Drummond's "Essay on the Science of the Egyptians and Chaldæans" and in what volume and parts of *Knowledge* the late Mr. Proctor's last articles on the "Origin of the Constellations" appeared; and whether Kurtz's work on "Bibel und Astronomie" has been translated into English, and, if so from what German edition, and by whom published?—J. M.

[68372.]—**Induction Coil.**—Could any reader kindly inform me how to construct a machine for turning coil, so as to wind the wire on, as I find it impossible to do so without the aid of some instrument for turning same. Please insert sketch, if possible.—D. W. H.

[68373.]—**Surgeon.** — Will "Eos" or any reader kindly inform me what is the course of instruction necessary for a youth to become a naval surgeon and probable expense?—IGNORAMUS.

[68374.]—**Organ.**—Should be obliged for information respecting the most simple way to derive stops of different pitch from the same rank of pipes (in a small chamber organ), adding additional pipes for the extreme notes, but without using octave couplers or more than one pallet to a key.—G. H. C.



[68375].—**Atmospheric Pressure.**—I have a piston and cylinder made after my own design, perfectly air-tight; and when I open the bottom valve to get the piston down and pump air away from front part of cylinder, the piston rod at the same time projects into an oil tank and not into the atmosphere. Can any one tell me how it is that there is still as much pressure on the piston as if the end of cylinder was open. I understand the pressure of air and liquids, but somehow I seem lost here?—One in a fix.

[68376.]—**Voltmeter and Ammeter.**—Will Mr. Bottone or some other efficient correspondent give me instructions whereby an amateur can construct the two instruments mentioned above, so that they will register for an arc installation of 2,000 volts of 10 ampères? Also for an incandescent plant of 300 lamps of 16c.p. I have Mr. Bottone's three books on electricity, but cannot find sufficient information to suit this particular case.—R. T. Braddock, Phila., U.S.A.

[68377.]—**L. and S.W. Bogie Engines.**—Can B. Field or any reader give plan, section, of underneath view, looking upwards, of the L. and S.W.Ry. bogie engine, No. 348, as illustrated and described in the "E. M." of Nov. 30th, 1888? One about the same size as illustrated would greatly oblige.—J. G. R.

[68378.]—**Manchester Dynamo.**—Would any of "ours" give dimensions of a dynamo of Manchester type suitable for two arc lights of 1,000 c.p. each, and also say what would be a suitable lamp for factory use?—Vortex.

[68379.]—**Furnace Lining.**—Would any kind reader inform me the best firebricks for lining my furnace with for melting iron, and what would be best to use to set them with and fill up the spaces between, as they are set round, and what thickness of road sand and clay to go next fire? Also what is best thing to put into the furnace to make the slag work well?—Beginner.

[68380.]—**Circular Holes in Marble Slabs.**—Could any reader inform me how the circular holes are cut in marble slabs for wash-basins?—if there is a machine for doing it, or give a simple and quick method.—Tyro.

[68381.]—**Fire-Extinguishing.**—Can anyone tell me anything about a new system of fire-extinguishing apparatus used at the South Kensington Museum? I believe there is air-pressure used on the water-mains in some way.—C. W. P. G.

[68382.]—**Banjo.**—Will some of "ours" inform me how to cover a banjo, and what kind of skin to use? Also how to prepare a skin for this purpose, size 14sq.in. I find that a banjo skin costs about 6s., but I should like to do it cheaper, as I have one that I wish to re-cover.—Ne Plus Ultra.

[68383.]—**Telephone.**—Will some one tell me how to make a cheap mechanical telephone for use between two offices not more than 50yds. distance? A sketch would oblige.—An Old Subscriber.

[68384.]—**Mean and Apparent Time.**—In *Knowledge*, Vol. VII. No. 169, p. 68, is an article by W. F. Allen on "Time." On p. 70, 1st column, 6th line, he says:—"It is hardly necessary to state that the principal cause of the variation between mean and apparent time is the obliquity of the ecliptic to the equinoctial." Whereas I always thought it was owing to the ellipticity of the earth's orbit, causing her (the earth) to travel faster at one time than another, according to Kepler's law of equal areas in equal times. Will "F.R.A.S." or some other reader of *Knowledge* explain?—W. H. H.

[68385.]—**Coil.**—To F. W. Mason.—I am making a shocking coil, and I want to know what size and quantity of wire I must wind bobbin with. Size of bobbin is, length 6½in., paper-tube 1¼in. dia., 1½in. thick. 4in. square-wood ends. Also what battery power I shall want?—H. J. H.

[68386.]—**Slow Motion by Band.**—In driving a large pulley (30in.) from a very small one (2½in.) by band, it might give a better hold to pass the cord twice round the small pulley. And to make the grip better still, a spiral of two threads on the edge of this small pulley might be useful, and would also keep the band from fraying by contact. But on trying this, I find the band unscrews itself from the small pulley, though it would be expected that a fresh supply of band would arrive from the large pulley to replace that which is being delivered at its other edge by the small pulley; instead of which, the band soon escapes altogether from the small pulley. Will the pitch of the spiral have anything to do with this? I make it about four turns to the inch, to suit the diameter of the catgut band.—Antares.

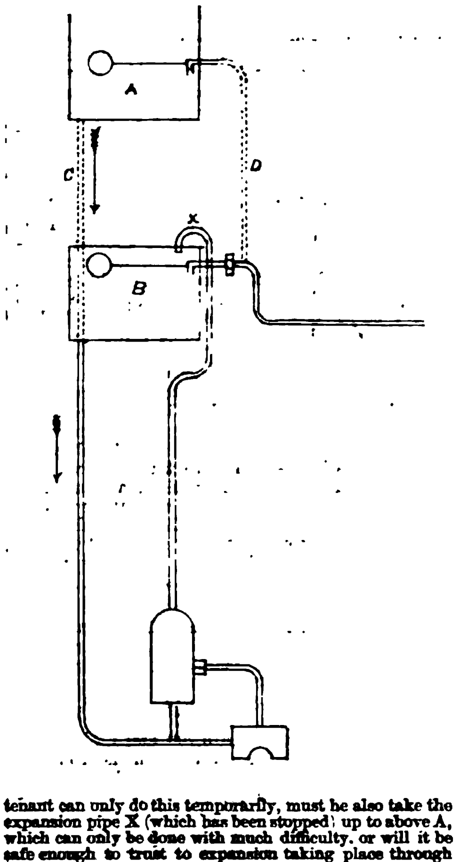
[68387.]—**Black Pepper.**—What process do the black peppercorns go through after coming into the market to remove the outer husk from the corn and afterwards dressing the kernel to produce the white pea for sale. I have a large and increasing sale for white peppers and am making a few inquiries about the machinery employed for above purpose, but would like a few hints on above process previous to buying?—Kasak.

[68388.]—**Best Quality Crucible Making.**—I wish to improve the quality of my crucibles; for first class articles I find a market only. A few practical hints on mixing and selecting raw materials, preparing and finishing, would greatly oblige. Which would be the best way to purchase graphite and best clay? I have fairly good machinery for crushing, and would not mind to add anything necessary in machinery to assure really good work. The finish should be of high class. Could I get a book to assist me?—Keen Competition.

[68389.]—**Cavalry Regiments.**—My son, at present a clerk and strong youth of 17 years, height about 5ft. 6in., has a special desire to enter a cavalry regiment. Would some army man kindly give his opinion as to what line of service would be to his advantage, and is it very irksome for first part in going through riding school, &c., having no knowledge of horses?—Like to be a Soldier.

[68390.]—**Hagioscope.**—Frequently met with in churches in Cornwall, particularly in the Lizard district. What is it?—Question.

[68391.]—**Hot Water Circulation.**—A supply of hot water to a higher level is required in a house, and a small new cistern, A, is put in the attic, and used instead of the old cistern B, which is in the bath-room. The connections are by new pipes C and D. As the present tenant can only do this temporarily, must he also take the expansion pipe X (which has been stopped) up to above A, which can only be done with much difficulty, or will it be safe enough to trust to expansion taking place through pipe C. Also the new supply pipe D is ¾ compo. gas-pipe. Is this safe to bear a pressure of 65lb., which it is now doing.—Nemo.



[68392.]—**Four-Pole Dynamo.**—To Mr. Bottone and "Engineer, Govan."—In the Victoria dynamo the armature sections are cross connected, so as to use only one set of brushes. Does this lower the resistance of the armature to ¼ that of the ordinary Gramme? For point, say an ordinary Gramme armature, wound with No. 12 wire, for 100 volts 30 amperes. If this was put into a machine with four poles and the sections cross connected, would there be any alteration in the output and resistance of the armature?—Formula.

[68393.]—**Dynamo.**—I am making a dynamo, and I should be greatly indebted to Mr. Bottone or some other of our electrical friends for their opinion on it. The armature is of the drum type, and is 3in. diam., made of punchings of sheet iron, with eight grooves for the wire. It is 4in. long, and wound with 18 d.c.c., six layers deep in each groove, and nine wires in each layer. The field-magnets are flat Siemens with four coils each, with wire space, 1¼in. by 3½in. by 2½in., wound with about six layers 20 c.c. Will you please say what voltage it will give, at what speed it should run, and how many lamps it will light? Have I got wire of the right size? The field-magnets are of cast iron to be coupled as shunt. Also kindly tell me what power it will take to drive it.—Electric Amateur.

[68394.]—**Whip Joint.**—Will any reader kindly give me instructions for making a whip joint, such as water tap to lead pipe, and what are the mixtures, and should the solder be a certain heat when poured on? Also for making soft and hard solder. Is there anything besides the lead and tin? I have taken in the "E. M." since 1887, but do not see anything that will help.—H. E. H.

[68395.]—**Electro-Magnet.**—To Mr. Bottone.—I am about to make a magnet, the cores of which are 1½ diam., The bobbins are made of ⅛ sheet brass, 8in. long, 4½ diam. These I have thought of winding with a flat wire. ⅛in. by ¼in., 50yds. on each bobbin. The R. of the two in series is ·13 of an ohm. I cannot say how many turns the wire will make around each core, but it is for a current of 15 ampères 4 volts. Now, I have thought since if it coul not be wound with a finer wire so as to get the sa effect with a current of, say, ·5 ampères at 50 volts. W you please set me right in this matter? Please say h to wind a bobbin to get a certain effect with a current certain force.—Electro-Magnet.

[68396.]—**Dynamo and Transformer.**—To M Bottone.—I am making a small dynamo for plat armature, six pole, 4in. diam., 4½ long. Field-magn are of the Weston type. Wire space on field-magnets oval in section, 3½ by 5½ long. Will you please say w size wire to wind the field-magnets and armature with get as much current as possible, at about 10 volts and more than 2,000 revs. per min.? May I trouble you full particulars or instructions to make a transformer transform a current of say, ¼ ampère at 50 volts down one of about 10 ampères at 6 volts. I understand the work, but know nothing of the wire part of the affair. there any simple rule by which I could find out the qu tity of wire for different currents and instruments?— Transformer.

[68397.]—**Shellac Solution.**—This solution in m spirit is turbid and will not clear by settling, wh a solution of any coloured sealing-wax in same m struum, on settling leaves a clear liquor. Can anyone form me how the pure lac solution can be cleared filtered, so as to be as bright as sherry?—F. G. Ll.

[68398.]—**Oil Lamp for Optical Lantern.** want information from anyone who has experim with different styles of burners, as to the best styl lamp to use under the following circumstances. I w to be able to set the wicks at the beginning of a lect so that they require no further attention until the A sciopticon (two wick) lamp I used to use fulfilled condition, but a four-wick lamp I now use, which g more light (and heat), requires constant attention. there any circular wick lamp of the requisite intensity, would a three-wick be better?—A. W.

[68399.]—**Ventilator.**—I want to clear the steam of a shop in a currier's yard in which two large copp are boiling. It has at present two 10in. pipes from t roof, and I should be glad to know the most effect form of ventilator to place on the top.—W. Noble.

[68400.]—**Leaden Caps on Carbon Plates.**—W some one kindly give directions for making a mould casting a leaden cap on the carbon plate Lecla battery? Also how to keep the carbon plate and sc of the terminal in position while the lead is cooli C. A. A.

[68401.]—**Black Varnish for Boiler.**—I hav greenhouse boiler which is composed partly of sheet and is exposed to the rain, and therefore constantly getting rusty. Will some reader kindly give the r the "E. M." for the black varnish commonly used boiler makers which will stand heat (without burning like japan) and prevent rust suitable for this purpose Vir Sapientiæ.

[68402.]—**Incandescent Lamp Stands.**—W some of our correspondents oblige with particulars stand suitable for five or six small 10c.p. lamps? I ha plenty of strong battery power at my disposal, but can get a suitable stand for the lamps. The holders sold electrical instrument dealers are far too cumbersom want something light and portable, yet making good tact, suitable for a lecture table. I have been using drawn brass wire loops and hooks to slide over the co leads, but they break the platinum wires out that ar in the glass of the lamps.—F.R.Met.Soc.

[68403.]—**Chromic Acid Batteries.**—I have be informed by several that the Bunsen battery far ex the single fluid battery for lighting purposes. I ha tried several times to make a single cell of the Bun type with porous pot charged with bichromate of pot and sulphuric acid and water in the outer, and sulph acid and water in the porous pot, but am sorry to say I cannot get half the power as I can from my sin fluid batteries. I should like to hear from som reader how it is. I purchased a small porous pot ju try, 3in. long by 1½in. Will it be the fault of the por pot, do you think? I am most anxious to make a g battery for a small carbon in a vessel which will last a hours, and so was thinking of trying the porous pot ty and so shall be pleased for a little assistance.—A N Subscriber.

[68404.]—**Wheel Cutting.**—Would some rea kindly inform me of a practical method of making t teeth of small brass wheels the correct shape, usin circular cutter of not more than ⅜in. diam.? The wh are drivers and engage with lantern pinions, are fr 1½ to 6in. diameter, divided into 60 to 120 teeth. difficulty is this:—I understand the shape is obtained a point on the circumference of a circle, tracing a cu when rolled upon the pitch circle of the wheel; this to be the shape of that part of the tooth outside the p circle, if I am correct. How is this applied in prac upon such small work as I am engaged upon? Als planting the pins in the pinions. Should this be done the pitch circle? As this would give half the pin outs would this be sufficient to insure a safe depth, and w is the correct way to arrive at the size of the pin to I believe they ought to be kept as small as consistent strength. Is this so?—L. J. R.

[68405.]—**To Mr. S. R. Bottone.**—Will you kind enough to give me the size of castings for a dynamo, and the probable weight of same. Also the and weight of wire for F.M's and armature, and si accumulators required to run a 10c.p. lamp for about hour. Also would you be kind enough to say whethe motor of the following dimensions would be power enough to run a model tram, 2ft. in length, armat 8in. by 1in., the field magnets are to be arranged on side of the pole-pieces in a horseshoe form? If this do, will you please give sizes and weight of wire used?—A New Subscriber.

[68406.]—**Battery—Bunsens.**—Thanks to F. W Mason and S. Bottone for replies. In answer to F W Mason (query 68207), the zinc is at the bottom of cell, the porous cell standing upon it. The cells are square form, not round. There are three zincs, t them are 4 by 3 by 3-16, the other one, that in the about 3¼in. by 2½in. by 3-16in. Could I increa of vertical zincs to do away with the horizont that lying at the bottom?—Nimrod.

[68407.]—**Engineman's Query.**—To "T. C., Bristol," or Others.—What weight would a pair of 22in. cylinder horizontal engines, 5ft. stroke, with a 8ft. drum on the first motton, raise from a pit 260 yards deep, with a round wire rope, the boiler pressure 40lb. per square in., cut-off at ⅝ stroke, assuming what you think reasonable for friction, &c.? Kindly work the sum out in full length.—Gomer.

[68408.]—**Science and Art Exam.**—Will some reader kindly explain and work out the following:—A steam-engine is employed to drive machinery by means of a flywheel having teeth on its rim, and gearing with a pinion on the line of shafting. Why is this a good arrangement? The flywheel is 15ft. diam., and the crank which drives it is 2ft. long. If the mean tangential pressure on the crank pin is 16,450lb., what will be the driving pressure on the pitch circle of the pinion? And what is meant by tangential pressure?—Gomer.

[68409.]—**Tracing Paper.**—How can I prepare a cheap white tracing paper to copy drawings in ink? Would "white tissue" answer the purpose if properly prepared.—W. D., Newcastle-on-Tyne.

[68410.]—**Erratic Striking Clock.**—I have recently purchased one of the marble-cased striking clocks, presumably of French make, but the "critter" puzzles me, and, of course, I appeal to the readers of the "E. M." Struck round by lifting the pawl at the back it goes right enough. It also strikes right for hours together; but somehow or other it occasionally misses, and then gets so much out of order as to strike several hours behind. What can be the cause? It strikes the half as well as the hour, and the clock itself keeps good time.—Q.

[68411.]—**Threads of Common Paraffin Lamp Tops.**—Could "Jack of All Trades," or any other reader, inform me how they make the threads on common paraffin lamp tops? Also what tools are used?—Lamp Tops.

[68412.]—**Engine.**—Could the weight of two non-condensing engines, with boiler to supply them, to develop 180H.P., be confined within 1½ ton? The engines would require neither crank, shaft, nor flywheel. If it is possible, particulars will be appreciated.—W. J. G.

[68413.]—**Melting.**—Will readers of "ours" oblige me by giving their opinion of the cause and remedy for air holes or blisters in the melting of gold and silver, especially when poured into a skellet? Any hints as to the heat, &c., would help.—Young Jeweller.

[68414.]—**Blowpipe for Brazing.**—Will some of our readers kindly give me sketch of blowpipe with working diagrams of same, as I wish to make one for brazing parts together for making bicycles. Show how to make a fan, and attach a gas jet, as plainly as possible.—Novice.

[68415.]—**Dynamo.**—Would Mr. Bottone kindly give sizes and quantity of wire for 100c.p., Manchester type dynamo. Also if plates ⅛in. thick would answer for cog armature, and how many?—Lippet.

[68416.]—**Paraffin Pumps.**—Shopkeepers who sell this oil have a contrivance for emptying their barrels like two round discs about 6in. diam., like two penny pieces laid together edgeways, with a pipe emerging from between the two that goes in the barrel, and a handle to turn from one of discs. It fetches it up well and there is no pumping action. Can any reader say how it is made?—Gas Engineer.

[68417.]—**Detective Camera.**—I wish to make such as compact as possible. My idea is a box just larger than the plates; but I am at a loss to know best way to change front plate, after exposure, to back. Must plates be backed? Of course, by making box twice size of plate, exposed plate could be dropped down, or unexposed plate raised up; but this doubles the size of the apparatus. Is f.12 rapid enough lens for bright weather, near objects, rapid plates? If not, what is correct? What best simple shutter?—Diol Ullec.

[68418.]—**Celluloid Films.**—Has anyone tried these? What is the result? Can they be cut down? If so, how? How backed, if necessary? And what is thickness of film?—Diol Ullec.

[68419.]—**Decomposition of Water by Electricity.**—Will some one kindly help me with an answer to the following query which one of my customers has asked me, viz:—In decomposing a tank of water by the current from a dynamo, driven by a ½h.p. gas-engine, how much hydrogen gas might one expect to obtain in one hour? The dynamo is supposed to be of such a size as to require the full power of the engine to drive it.—J. Minuto.

[68420.]—**Musical Instrument.**—I want to make a comb for a musical box, which has about a dozen teeth broken off. The comb is in one piece, and about 11in. long, and has about 50 teeth. Can any reader tell me how to proceed? Would it have to be hardened?—Inquirer.

At a recent meeting of the Paris Academy of Sciences, a paper was read on "Homography in Mechanics," by M. Appell. It is shown that the method of transforming figures by central projection, which plays such an important part in geometry, may also be employed in mechanics. These remarks may be extended to the movement of a point in space, and even to the movement of several points, on the condition in the latter case of making a general homographic transformation, which shall simultaneously contain the co-ordinates of all the points.

It is reported that a valuable discovery of petroleum has been made at Yorketown, South Australia, and that the Government has granted the discoverer, Mr. A. Tocchi, the exclusive right to search over an area of 90,000 acres of Crown lands at Southern Yorke's Peninsula, in order to enable him to locate the spring from which the oil flows. The district is close to the sea coast, and is only 60 miles from Port Adelaide.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Tuesday evening, April 16, and unacknowledged elsewhere:—

W. C. Hughes.—Revelstoke Reading Room.—Pinto.—H. M.—D. N. Y.—Jes A.—G. P. B. Hallowes.—Glatton.—Chas. A. Jones.—Bedford.—C. E. Stretton.—S. R. Bottone.—T. C., Bristol.

F. E. Hollingshead. (If chemists cannot state what they have to say without using formulæ or signs which give the printer a great deal of trouble and quite unnecessary work, they must put up with the errors. Chemists who do understand the formulæ which require lines over letters—types which are not cast in the ordinary way—will readily understand what is meant, even when the lines are missing. Chemists and other scientists should have a little regard for the exigencies of printing when they devise their formulæ.)—A. J. Wilkinson. (You mean Cocus wood, and that can be obtained from any dealer in hard woods. There is not much demand for small quantities, but you can try such a dealer as L. Marshall, Wood-street, Old-street, E.C., or look in the "London Directory.")—Curious. (Why not try, or get somebody to try for you? How many people are interested in such a question? Vaseline is a hydrocarbon, and would oxidise in suitable conditions.)—Spa Water. (If the zincs are so much oxidised as to be ineffective, you must get fresh ones. Galvanic belts will not last an indefinite time.)—Lumsie. (We gave all the particulars as we found them in the article quoted. No doubt all necessary information for making linoleum can be found in back volumes.)—Nostaw. (No improvements have been made that we know of in either batteries or motors; but several ingenious arrangements have been devised, which we have illustrated from time to time.)—S. J. M. (Any patent agent will ascertain for you; we do not suppose the principle has been patented, but the details of different patterns have no doubt been protected.)—Dutch Subscriber. (We do not know the gas-lamp referred to.)—W. H. (The question was recently asked. The only way to blue steel is to heat it and temper at the proper temperature; but you can coat with a blue lacquer.)—Brook. (We have not the address of the maker of the horseshoe without nails.)—B. C. G. (There are several articles on nickel-plating, describing all the processes, in Vol. XLVII. See pp. 8, 57, 104, 124, 147, 170 in that volume. They were published about this time last year.)—Jim Crow. (Many designs for pantographs in back volumes, and the principle is described in the textbooks. 2. If the envelopes are "stuck" with damp, they must be wetted, and then dried when opened.)—Molybdenum. (We believe molybdenum is found mostly in Bohemia and Sweden.)—J. C. T. (No. Ericsson and Braithewaite's "Novelty" was withdrawn from the trial, some of the parts having given out, and there was not sufficient time for repairs.)—A. J. Pool. (We cannot reply by post. A spiral cut out of tin plate might do, if the thing to be revolved is in easy running bearings; but the most economical affair is a clockwork movement or a roasting jack. You will find several devices in back volumes.)—Anno Domini. (You can scrape the ivory, polish with whiting and spirit, and then put it in the sun near the window. There must be glass between it and the light, or it will crack or "craze.")—W. Noble. (You must give some more definite description of what you want to make.)—Indiarubber. (Add a little glycerine to aniline ink. Several recipes in back volumes.)—J. H. I. (There are many recipes in back numbers. See No. 1157, p. 304, for instance.)—Mars. (Tradesmen are alone eligible for the Engineers, and full details can be obtained of any enlisting sergeant. Every recruit must be a skilled workman. If of sufficient stature, though, a tinsmith might do well in the Horse Guards.)—Groombridge, Sussex. (It is a rather novel idea in these days of steam to apply manual power for grinding wheat, though, of course, mills for the purpose are as useful as coffee-mills, and we presume you only want to grind enough for family use, and have plenty of spare time. The steel roller mill will answer all purposes, as you do not need to grind the wheat very fine. Look through the advertisement columns of the *Weekly Times and Echo.*)—Shiny. (No effective remedy for shinyness in cloth coats, except raising a "nap" with teazles. Try cleaning with a solution of ammonia. See indices for other suggestions.)—Apprentice, Cardiff. (Plenty of sketches in back numbers, and in handbooks of model engine-making.)

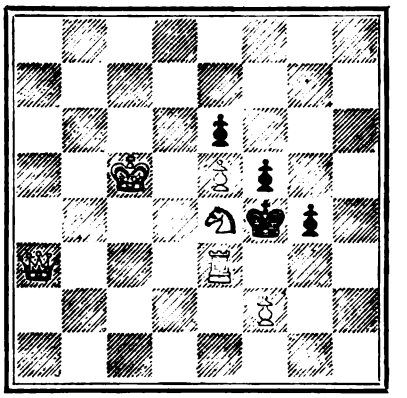
Rupture Sufferers should call at the MEDICAL BATTERY COMPANY'S INSTITUTE, 52, OXFORD-STREET, LONDON, W. (corner of Rathbone-place), and personally inspect Mr. C. B. Harness' valuable Hernia Appliances, which have been so strongly recommended by the medical profession. An experienced and skilful surgeon attends daily, and examines patients free of charge. Pamphlets gratis and post free.

CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Uplyme, Devon."

PROBLEM MCXLV.—By G. J. Slater.

Black.



White. [6 + 4

White to play and mate in three moves.

(Attention is called to the notice above.)

Solution to 1,143.

White.	*Black.*
1. B-Q R 3.	1. K-K 4 (*a*).
2. B-Q Kt 2.	2. Any.
3. Kt mates.	
	(*a*) 1. P or B moves (*b*).
2. Kt-K 4 (ch), &c.	
	(*b*) 1. Kt-Q 3.
2. Kt-Q 7 (ch), &c.	

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,143 by W. Gleave (three duals), F. C. Cook (two duals and triple), G. A. Macbeth, Janus (three duals), T. A. Pringle, W. L. Martin (two duals and triple), Mendelssohn, Fr. Fernando, J. E. Price, W. Jay (two duals and triple); to 1,142 by H. Warren (two solutions), J. W. Girling (ditto) A. W., H. G. Walsh, W. Jay, B. Green (2) (but as to third attempt, by rule 9 it cannot be recalled, corrected, or cancelled; and by rule 7 one point is forfeited for each incorrect claim), J. E. Smith (2), J. Kilbee, R. T. Hood (2), A. Bolus (2), T. A. Pringle, Janus (2), Link, and G. A. Macbeth.

G. S. Slater.—Many thanks for the problems, which are most acceptable.

T. A. Pringle.—There will be twelve problems in each section. They will not be marked Tourney Problems, as they will follow consecutively in two-movers and three-movers alternately. We are unable to tell you when the problem appeared; but if it had not been published we should still have it. We think it appeared more than a year ago.

Wesley College Quarterly received with thanks. There is in this last number plenty of chess pabulum.

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OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Wanted, Stocks, Dies, Taps, Plates, (Whitworth preferred), all sizes. Exchange Dissolving View Lantern, Old Violin, Double Breech-loader, Bicycle.—Mechanic, 47, Fernhead-road, Westbourne Park.

Gas Engine, 2H.P. atmospheric, vertical, by Otto and Langden, in working order, complete, with water vessel. Offers —W. Hutchinson, Liversedge, Yorkshire.

Equatorial Mount and mahogany garden **Tripod** Stand and Iron Column, suit 3in. or 3½in. Telescope, slow motion, by hooks, joint, and screw.—Hutchinson, Liversedge.

Dynamo, 2 arc light machine, by Jarman; pair 15in. Globes on mahogany stands, by Newton; Plate Machine, by Newton, in case.—Hutchinson, Liversedge.

Boiler, welded, 2ft. high, ⅜ plates, suit greenhouse; lot steel Bicycle Rims, Anvil 2¼cwt., nearly new. Offers.—W. Smith, Bilston-road, Wolverhampton.

Exchange beautiful **Celt**, 7in. long and perfect, for an Optimus Euryscope, 7 by 5.—Sutherland, Watchmaker, Lerwick.

"**English Mechanic**," Vols. XLV., XLVI., XLVII.; "Building News," Vols. L., LI.; "Engineering," Vols XLIII. and XLIV., clean, unbound. What offers?—F. Rayner, Sherwood, Nottingham.

Strong 5in. centre **Lathe**, good working order, hard wood bed, 6ft., worth 40s. Exchange and part cash.—Parker, 102, Brunswick-street, Ardwick, Manchester.

To Engineers, &c.—Set of horizontal Gas-Engine Patterns, Drawings, and Specifications, for useful exchange. Engine awarded Inventions Exhibition Medal.—Write Expert, 70, Balcombe-street, Dorset-square.

Wanted, Geological Ordnance Survey Maps. Exchange Astronomical Books, Map of Moon.—C. Franklands, West End-lane, N.W.

A good **Street Coil and Perambulator**, in splendid condition, and everything complete; a new 20-keyed Concertina, a two-way Switch.—See below.

Several numbers "**English Mechanic**," and Vols. XLVII. and XLVIII. complete, unbound; a pint and quart Bunsen's Batteries, and a new 2½ Electric Bell. Useful exchange or cash.—Coram, 6, Albert-villas, Clifton-road, South Norwood.

Complete Set of **Castings and Forgings** for double cylinder Launch Engine, 2 bore, 4 stroke. Exchange to value of 20s.—John Key, Lichfield.

Canoe, 15ft. long, made from stout sail cloth, only requires ribs to complete, never used. Exchange to value of 15s. Music wanted.—Above.

Vols. V. to XII. "**English Mechanic**," clean and well bound. Exchange small Dynamo, or self-centring Chuck, or 3in. Slide-rest, 3in. back-geared Heads, or offers.—M. Wilson, Park-road, Kirn, N.B.

Gas Engine wanted, must be in good working order, in exchange for vertical Steam Engine, Joiner's and Mechanic's Tools, Household Goods, all new.—E. Brocklehurst, Market Hall, Ashton-under-Lyne.

Self-acting Planing or Shaping Machine wanted. Would exchange Saw Bench, with two saws, and part cash.—Jas. Spencer, Wilton House, Bournemouth.

Horizontal Slide-valve **Engine**, 1½in. stroke, ¾in. bore, brass boiler, needs a little repair, price 10s., or "Jamieson on the Engine."—Young, Yarm, Yorkshire.

Pulvermacher's Patent Flexible **Galvanic Battery** Belt, gilt, new, cost 105s. Wanted, Model Engine or Boiler, or offers Edwards, 47, Marshall-street, Golden-square, W.

Wanted, Lantern Photographs, Continental Views. Good exchange or cash.—Robert Knight, Wellington, Somerset.

Astronomical Eyepieces, with sun glass, offered (with cash) for second-hand Micro. Stand, "Star" or other pattern. —J. Helliar, Castle Cary.

Engine, Oscillating, boiler, lamp, on stand, cost 30s. Exchange Coil and Battery, or offers in exchange.—W. Arthur, 24, Royal-crescent, Glasgow.

Wanted, "Chemical Society's Journal," "Chemical Gazette," "Chemical News," "Voyages and Travels," for "Holtzapffel's Turning," &c.—Gray, 42, Union-street, Aberdeen.

"**Cassell's Popular Educator**," complete, bound, in perfect condition and clean; "Roscoe's Lessons in Chemistry" (1882), clean. Offers.—Liber, 55, Buxton-road, Macclesfield.

Conjuring Apparatus, Dress Suits, and Tables, all of the finest quality and best make. Exchange Clothes, 20c.p. Dynamo, or offers.—Massena, Stamford-road, Mossley.

260 numbers of "**English Mechanic**" to date, "Mechanical World," 3 vols.; "Carpenter and Builder," 21 parts. Offer in exchange.—G. Mack, 113, Pilgrim-street, Newcastle-on-Tyne.

Swing Boat, on new principle, canoe shape, holds two, always keeps level, endless amusement for children, can be fixed indoors, three hooks screwed into joists above will fix it, safe, strong, light. Exchange to value 70s.—Andrews, Tavistock-terrace, Holloway.

A good six-keyed **Concert Flute**, slide head; a Camera Lucida for sketching, with clamping screw. Exchange for Photo. Sundries or good Violin. Approval.—P. J. Lambert, Malahide, County Dublin.

Fan.—Dorrington's Iron-blowing Fan, complete, treble speed. Offers in exchange.—A. Goodwin, 204, Devonshire-street Mile End, London, E.

"**English Mechanic**," volumes XVI. to XLVIII. '33 vols.), 1873 to 1889, unbound, in good condition. What offers?—Apply, Clarke, Advertising Agent, Market Hall, Dumfries.

Bright copper riveted loco. type **Boiler**, ⅛in. thick, with chimney and safety valve, water gauge cocks, will work at 100lb. pressure; also Model Beam Engine, 2¼in. bore cylinder, complete, all bright. Exchange to value of £10.—295, St. Philip's-road, Sheffield.

Seventy volumes **Musical Literature** for Astronomical ditto, Proctor and others.—Newcomb, Borrowash.

Three cast-iron **Tanks**, new, 3 by 2 by 2ft. deep, weight about 5cwt. each. Will exchange anything useful.—A. N. Hewens, Hayes, Middlesex.

Coil, wants repairs, could be made to give 4 or 5in. spark, quantity of Electricals, good Breechloader, and cash.—N. Hewens, Hayes, Middlesex.

Will exchange either **Gun**, Violin, Telescope, or Magic Lantern for good Opera Glass, reliable maker.—Cattell 35 Hill-top, West Bromwich.

Magneto Machine, good condition, cost £2. Exchange for Lantern Slides value 20s.—Gilkes, 118, Broad-street, Reading.

Wanted, Micro.-Polariscope. Will exchange two last Vols. of "E.M." and Micro. Slides, or mahogany Micro. Cabinet to hold 220.—W. F., 56, Markerfield-road, Guildford

"**English Mechanic**," volumes V., VI., and VII., bound; 12 years' "Calvert's Mechanic's Reference Almanacs." Exchange offers.—Wilson, 97, High-street, Upper Southtown, Great Yarmouth.

"**Engineering**," two volumes, XX. and XXI., and "The Mechanician: A Treatise on the Construction and Manipulation of Tools," by Cameron Knight. What offers? Electrical Apparatus preferred.—Write, Kellet, 29, Luton-road, Chatham.

Ten volumes "**English Mechanic**" to date; Phantom Instantaneous Shutter. Will exchange for small Slide-rest or wide angle Landscape Lens.—Balmforth, Scout-hill, Dewsbury.

Granule Batteries.—Will exchange six Granule Batteries for Bichromate Battery with lifting arrangement, suitable for working induction coil, or for Carbons.—Graham, Earnoch, Harrow.

48 Microscope Slides in exchange for Mathematical Instruments, Books, or Poultry to 14s., or offers.—Lintin, 170, Freedom-road, Sheffield.

Plain **Equatorial** for 4 or 5in. Glass, or exchange.— Newcomb, Borrowash.

Horizontal **Slide-Valve Engine**, ¾in. bore, 1½in. stroke, nearly new. What offers?—R. Taylor, 94, Kamballa-road, Clapham Junction, Battersea.

Scientific Appliances taken in exchange for Lathe Castings, Model Castings, or work done to order. List, stamp. —Butler Bros., Bentham-road, South Hackney, London.

Wanted, old Postage Stamps, especially those of the Colonies. No English excepting high values. Very good exchange offered.—Collector, 125, Coltman-street, Hull.

Electro-Plating. — Wanted, Second-hand Apparatus and Batteries for amateur's work, in exchange for Tools and cash.— Allen, Whitby Lodge, Thornton Heath, Surrey.

Electro-Plating.—Wanted, a Modern Book of Instructions for Amateurs, in exchange for Twist Drills and cash.—Allen, Whitby Lodge, Thornton Heath, Surrey.

Four French Bottle **Bichromate Batteries**, want new zincs; and 10in. Plate Electric Machine. Photo. offers to 28s. value. Also four quart Bunsen Batteries.—Below.

Six-key **Bassoon**. dark wood, splendid condition, large quantity sulphur casts of old medals, rare collection. Photo. offers.—Laundy, 62, St. Peter's-road, E.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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New Illustrated Price List of **Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp —Morris Cohen, 132, Kirkgate, Leeds.

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Lathes. Lathes Cheap, good. List 2 stamps.— Robinson, Catherine-street, Sheffield.

Electric Depot, 14, Deansgate, Manchester.— Handiest shop in the trade. Largest stock. Greatest variety. Lowest price.

"**The Amateur**," a paper for fretworkers, carvers, painters, inlayers, 6d. monthly. Catalogue, 37 to 31, with 900 engravings, 6d.—Henry Zilles and Co., 24 and 26, Wilson-street (late of South-street), Finsbury, E.C.

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Stencils for sack, box, and ticket marking. Price and quality unsurpassed.—Gilkes' Engraving Works, Reading.

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The **Above** contains all information, and is illustrated from photographs of the finished engines.

Two **New Features** introduced.—Triple-expansion Engines and Bent Steel Crankshafts are entirely original novelties.

Photos. of these Triple Expansion Engines can be had, price 6d., post free 7 stamps.

The **Designs** are all new, and are not copies of the stereotyped models of other firms.

We Court Comparison for novelty of design, finish of engines, and quality of castings.

Models of every description repaired and put in working order.

Lucas and Davies, Mechanical and Scientific Model Makers, 21, Charles-street, Hatton-garden, London, E.C.

Mr. With's Specula. Only seven left. These are perfection. The last opportunity.—G. H. With, Hereford.

Malleable Iron Castings by our new process, clean, sound, tough as steel.—Dronfield Casting Co., Sheffield.

Lathes! Lathes! Cheap, good. List, 2 stamps. —Robinson Catherine-street, Sheffield.

Greenhouse Stoves, portable, require no chimney, no fixing; cheap and effective.—Peters, Bartsch, and Co., Derby.

Self-Heating Box-Irons, for tailors, dressmakers, laundries, households, uniform heat throughout.—Peters, Bartsch, and Co., Derby.

Bedwarmers, Foot-warmers, Chest-warmers, Hot Dishes, giving splendid heat up to 16 hours.—Peters, Bartsch, and Co., Derby.

Protecting Wood against Decay and Walls against Dampness. Apply Carbolineum Avenarius. — Peters, Bartsch, and Co., Derby.

Astronomical Telescope.—Apparatus and parts made to order.—A. Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

Astronomical Eyepieces, any power, fitted to any telescope, 15s. each.—Clarkson.

Transit Instrument, by Ross, on iron stand, perfect adjustment, new condition; also others.—Clarkson.

Equatorial, by Cooke, of York, slow motions, will carry up to 4½in. telescope, £15.—Clarkson.

Equatorial with tripod, by Parkes, to carry up to 4in. Telescope.—Clarkson.

3½ft. **Telescope** complete, by Troughton and Simms in case, nearly new condition, £10.—Clarkson.

4in. **Telescope**, by Cooke, York, hardly used, on tripod stand, newest pattern, £40.—Clarkson.

Equatorial, by Cook, York, Driving Clock, Silver Circles, suit above, £25, or sell separately.—Clarkson.

Astronomical Telescopes.—Some in stock, by Merz, Wray, &c.—Clarkson.

Troughton's **Reflecting Circle**, by Troughton and Simms, new, suit astronomer.—Clarkson.

Astronomical silver-on-glass **Telescopes**, Mountings made for these; also flats, finders, rack, eyepieces, mounts.—Clarkson.

Astronomical Telescopes (good) sold for private owners if reasonable prices.—Clarkson, 28, Bartlett's-buildings, Holborn Circus.

Gut Band (Lathes), best, per yard, ⅛, 6d.; 3-16, 9d.; ¼, 1s.; 5-16, 1s. 4d.; ⅜, 1s. 11d. Hooks and Eyes (Steel), to ¼, 6d. 5-16, 7d.; ⅜, 8d.; 7-16, 1s.; ½, 1s. 6d. Postage extra.—Lunt's.

Taps (Engineers'), Whitworth, plug or taper, ¼, 5-16, ⅜, 8d.; 7-16, 10d.; ½, 1s.; ⅝, 1s. 3d.; ¾, 1s. 6d.; ⅞, 2s. 3d., 1in., 3s. each, postage extra.—Lunt, Tool Merchant, 297, Hackney-road, London.

Safety Bicycle, rear-driving, Bown's ball bearings both wheels, new cost £8 10s., £6 5s. for cash.—Harthill, Worcester-street Wolverhampton.

Dynamos, from 30s. upwards, made for any desired output. Reduced lists now ready.—H. Jones.

Manchester Gramme-type **Dynamos**, wrought cores, laminated armatures, high efficiency, from 6 lights upwards.—H. Jones.

New Lists now ready. Over 40 Dynamos to select from. Addressed wrapper or one stamp.—H. Jones.

Dynamos, lighting, plating, storing, &c. New list, one stamp.—H. Jones, Electrical Engineer, 14, High-street, Lambeth, S.E.

Diamond Drills, from 1s. Spring Drill Stock and postage, 1s. 3d.; Pump, do., 4s. 1½d.—Below.

Diamond Points for all kinds of engraving, writing, and ruling, from 2s. 6d.—Below.

Diamond Turning Tools, for truing Emery wheels and turning hard steel, from 5s.—Below.

Glaziers' **Diamonds**, from 6s. 6d.; re-sets, 2s. 6d. Circular Cutting Diamonds, Diamonds for Lapidaries.—Below.

Diamond Sparks, for China riveters, from 6d.— Woods and Toussaint, 54, Spencer-street, Clerkenwell, London.

Look Here! Workmanship Guaranteed, planing, Turning, and Screw-cutting; any kind.—Hodgson, Tool Maker Cleckheaton, Yorkshire.

Smoke British Herb Tobacco. — Splendid flavour, exquisite aroma. Quarter-pound packet, post free 7d.— Knight, Druggist, Portsmouth.

85 new **Trade Recipes** for 6 stamps. A fortune worth £50 if used.—Jackson, 20, Linenhall-street, Ballymena.

Armature Punchings, slotted rings and drums. Trade only supplied.—165, George-street, West Hockley, Birmingham.

Microscopic Mounting Materials.—All kinds of requisites supplied at Norman's, 178, City-road, on the lowest terms.

Success for You. Taylor's new List Money-Making Trade Secrets, gratis, post free.—Taylor, Woodbine-street, Dewsbury.

Plane Irons, no grinding, less whetting. Sample knife, screws, &c., 6d.—Hazelland Planer Co., Par, Cornwall.

Piles!—Palmer's "Indian Ointment" cures agonising cases, 13½d., 2s. 6d., internal remedies included.—Chapel-terrace, West Auckland, Durham.

Palmer's Renowned Prescriptions, 2s. 6d. Curing quickly Chronic Losses, &c. Thirty years' celebrity. Blood purifying remedies included.—Above.

Breechloader, double, central fire, by Carter, Lincoln's-inn, accept 55s.—Housekeeper, Leicester Lodge, Burtenham Estate, Hampton.

Royal Mail **Cripper Tricycle**, splendid condition, accept £7 10s., cost £34.—Army Contractor, Granville-road, Ramsgate.

Wheel-cutting and Dividing to 12 inches diameter, in brass only.—Cligg, Belinda-street, Hunslet, Leeds.

Write for **King, Mendham and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

Lathe Heads, Castings, 4½in. centre, back-gear, 5s. pair, strong (not toys.)—W. Whitham, Peel-street, Barnsley.

Electro-Plating and Gilding.—Perks makes this art easy. Requisites supplied.—41, West India-road, E.

Banjo Strings, gut, from 2d. to 6d. each; covered strings, 3d. to 6d. Photos. of Banjos, 4d.—Below.

Banjos, Strings, Fittings. Price list, one stamp.— Winder, Banjo Specialist, 16, Jeffrey's-street, Kentish Town road.

100 Packets of genuine, freshly-saved, hardy **Flower** Seeds for 1s., post free, 1s. 2d.; all named and every packet different. Probably the most extraordinary shillingsworth ever offered in any advertisement. If not considered worth four times the amount they can be returned, and the sum paid will be at once refunded in full, or the parcel can be sent without prepayment if satisfactory references are given. Fresh genuine vegetable seeds also for disposal. Respectable men wanted, to add to their income by selling above on commission.—T. Richards, 5, Cranham-terrace, Oxford.

Smokers, don't buy pipes before seeing the "**Medical** Patent," illustrated particulars, post free.—Address, Patentee, 52, Cotham Hill, Bristol.

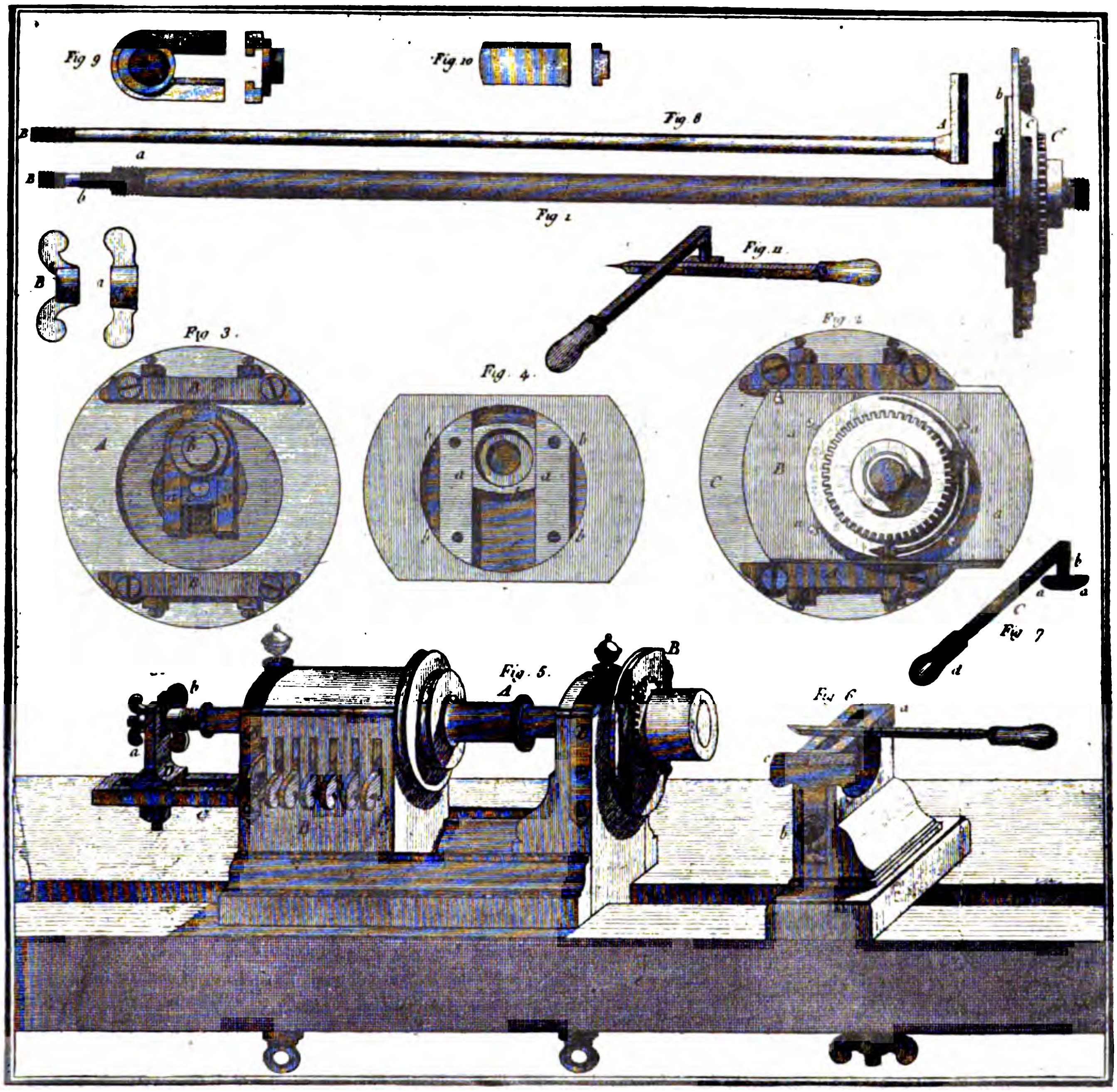
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 26, 1889.

EXTRACTS FROM BERGERON. —XXIII.

French Oval Chuck.

THE English oval chuck gives exact results; but unless a large diameter is given to it, it is only possible to obtain with this machine small or moderate-sized articles, because the elongation or, to speak more correctly, the eccentricity, which can be given to the sliding-ring, in order to lengthen the oval, is very limited, as it cannot exceed half the difference which exists between the radius of the mandrel-shoulder and that of the back-plate of the chuck. It is, in fact, evident that as soon as the guide-ring has traversed this distance its interior circumference will touch the shoulder of the mandrel, and cannot advance further. When, therefore, it is desired to execute work of large size—such as a picture-frame or a panel or other such article — the French ellipse chuck is preferably employed, the friction of which is less, and to which a much greater degree of eccentricity can be given in proportion to its diameter, as will be understood from the description of it, which we are about to give. Fig. 1, Plate 35, represents the immovable barrel of the elliptic chuck. This part, which is perfectly cylindrical within and without, receives a rod (Fig. 8), of which the extremity is seen at B. At the opposite end of this same rod is fixed a piece of iron, A, seen in plan (Fig. 4), of from two to four inches in length, according to the size of lathe and the eccentricity it is desired to give it. This piece—one end of which is fixed to the rod—rests in a fork also of iron, *a a*, Fig. 3, seen separately in Fig. 9, which has the power of extending or shortening itself according to the amount of eccentricity which is to be given to the chuck. This length once decided, the screw in *a*, Fig. 5, is tightened, uniting the two pieces, and securing the eccentricity of the fork.

Behind the lathe poppet B is an iron frame, C, on which is fixed a forked standard, D, between the branches of which the flattened part *b*, Fig. 1, of the rod already spoken of enters, and a wing-nut, *b*, Fig. 5, renders immovable the rod, its barrel, and the piece at the further end of it, which determines the eccentricity. The lathe mandrel A, Fig. 5, bored through its length, receives with friction the rod and its barrel, and turns upon it, since the rod and its barrel are immovable, because they are held fast by the notch, or squared part, B *b*, Fig. 1, and by the nut *a*, Fig. 5. On the shoulder of the mandrel A, Fig. 5, is fixed, by strong countersunk screws, a brass plate, A, Fig. 3, and C, Fig. 2, hollowed out to its centre with a recess, having a diameter equal to half that of the plate, and sufficiently deep to allow the fork *a a*, Fig. 3, to rest flush with its surface. This fork carries a small stud, *b*, Fig. 3, the eccentricity of which determines the length of the ellipse. Two guide bars of steel, B B, are fixed to the plate as in the English ellipse chuck, carrying a dove-tailed slide, Fig. 4. Upon the face of this slide and in its thickness is worked a recess, in which are placed two guide bars, between which slides a cam, *b*, which can only move lengthwise in the guide bars. The whole is flush with the large slide. This cam *b* is pierced in its centre with a round hole, into which the stud *b*, Fig. 3, enters. Thus when the slide, Fig. 4, is brought against the plate A, Fig. 3, and retained between the guides B B, Fig. 3, while the stud enters the hole of the small



slide *b*, Fig. 4, since the fork is immovable, if the mandrel and the back plate revolve, the large slide B, Fig. 4, replaced as it appears in Fig. 2, must necessarily move to and fro in the direction of its guide bars, and describe an ellipse. At C, Fig. 2, are represented the group of pieces, the working of which produces the ellipse when all the parts are mounted one on the other; *a* is the shoulder of the lathe-mandrel. To this is attached, by strong screws with countersunk heads, the brass-plate *b*, represented separately at A, Fig. 3, which carries the guide-bars, and forms one piece with them; *c c* is the movable-plate or slide represented at B, Fig. 2. If, then, it is desired to turn in the lathe a piece of ellipse form, the work is begun by loosening the back-nuts B and *a*, Fig. 1, and as the rod B, passing through the barrel A, is attached at its other end to the little iron plate *c* by one of its ends, and since this plate fits in rebates worked in the thickness of the fork *a a*, this fork acquires in this way the power to slide up on the plate, and to give more or less eccentricity to the pin *b*. This pin is to be set to such eccentricity as may be desirable by moving the slide to the necessary point in the direction of its length. A division-plate marked upon the guide-bar A, Fig. 2, gives the power of ascertaining this without trial. It suffices to measure the two axes of the ellipse which it is desired to form; half of their difference gives the distance which the stud must traverse. The nut *a* is then to be lightly screwed up, which, bearing against the barrel, draws the rod against it, and consequently also the little plate, and prevents the fork from sliding and altering its position. A little good oil is to be applied to the barrel and all parts subject to friction, and the work is to be done in the same way that we have explained in treating of the English ellipse chuck. Such is the ellipse chuck which has long been in use and which is still used by those turners who execute work of large size; but this machine needs a lathe and fittings of a special character which can be applied to no other purpose, and does not dispense with the need of an ordinary chuck lathe. We have, therefore, sought for and discovered a mode of adapting this apparatus to the ordinary lathe, of which the mandrel is bored, broached out, and its exterior turned upon its own bore, which does not prevent the attachment of all those other pieces of apparatus of which we have given or shall give a description.

O. J. L.

ASTRONOMICAL NOTES FOR MAY, 1889.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 56 56·64 a.m.	2 35 22	15 13 14	2 38 25·09
6	11 56 33·26 ,,	2 54 35	16 40 11	2 58 7·87
11	11 56 11·61 ,,	3 14 2	18 0 10	3 17 50·65
16	11 56 9·94 ,,	3 33 43	19 12 36	3 37 33·43
21	11 56 22·51 ,,	3 53 39	20 16 55	3 57 16·21
26	11 56 48·79 ,,	4 13 48	21 12 37	4 16 58·99
31	11 57 27·38 ,,	4 34 9	21 59 11	4 36 41·78

The method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 348 of Vol. XLVIII.

After May 22nd there is no real night in any part of the United Kingdom, twilight persisting from sunset to sunrise.

The intervals at which spots appear on the sun's surface continue to be very rare.

The Moon

Enters her First Quarter at 6h. 42·5m. a.m. on the 8th, and is Full at 6h. 42·2m. a.m. on the 15th. She will enter her Last Quarter at 9h. 53·1m. at night on the 21st, and be New on the 29th at 5h. 19·6m. p.m.

Occultations of (and Near Approaches to) Fixed Stars by the Moon.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°				
3	B.A.C. 1835	6½	†11 1 p.m.	S.	179	147				
5	63 Geminorum	5½	†9 53 ,,	S. by W.	190	148				
6	B.A.C. 2788	6	†10 18 ,,	N. by E.	15	333	h. m.		°	°
7	80 Cancri	6½	10 16 ,,	Dark	121	80	11 17 p.m.	Bright	278	237
8	83 Cancri	6	1 36 a.m.	Dark	73	37	‡2 18 a.m.	Bright	318	286
11	B.A.C. 3996	6	1 58 ,,	Dark	172	133	2 27 ,,	Bright	235	196
13	80 Virginis	6	2 55 ,,	Dark	78	41	*3 42 ,,	Bright	327	288
14	σ^2 Libræ	6	11 49 p.m.	Dark	75	75	12 45 ,,	Bright	331	321
15	B.A.C. 5408	6½	‡7 17 ,,	Bright	102	141	8 13 p.m.	Dark	300	334
18	B.A.C. 6343	6	2 23 a.m.	Bright	66	70	3 29 a.m.	Dark	298	292
18	26 Sagittarii	6	4 12 ,,	Bright	138	125	4 59 ,,	Dark	219	200
18	B.A.C. 6699	6½	‡11 2 p.m.	Bright	119	155	11 57 p.m.	Dark	246	277
19	53 Sagittarii	6	1 5 a.m.	Bright	147	171	1 43 a.m.	Dark	212	231
19	B.A.C. 6727	6½	1 14 ,,	Bright	149	172	1 51 ,,	Dark	210	228

† Near approaches. ‡ Moon below the horizon. * Star setting. An illustrated description of the construction and use of the above table will be found on p. 349 of Vol. XLVIII.

Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites, visible at Greenwich.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
2	Mimas	11·4 p.m.	5	Dione	10·6 p.m.	15	Enceladus	8·9 p.m.
3	Mimas	10·1 ,,	7	Tethys	11·8 ,,	16	Dione	9·4 ,,
4	Mimas	8·7 ,,	9	Enceladus	12·5 a.m.	19	Mimas	12·0 ,,
4	Enceladus	9·8 ,,	9	Tethys	9·1 p.m.	19	Mimas	10·6 ,,

A description of the construction and use of the above table will be found on p. 349 of Vol. XLVIII. The Greatest Eastern elongations of Saturn's principal Satellite, Titan, will happen at 11h. p.m. on the 4th, and again, at the same hour on the 20th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	1·4	1 6·1 p.m.
6	6·4	5 5·9 ,,
11	11·4	9 6·9 ,,
16	16·4	12 42·7 a.m.
21	21·4	5 45·0 ,,
26	26·4	9 36·2 ,,
31	1·8	1 23·7 p.m.

The Moon will be in conjunction with Mercury at 5h. p.m. on the 5th (Mercury 1° 9′ N.); with Saturn at 10h. p.m. on the 7th (Saturn 1° 28′ S.); with Jupiter at 3h. a.m. on the 18th (Jupiter 0° 15′ S.); with Venus at 4h. p.m. on the 26th (Venus 4° 30′ N.); with Mars at 4h. a.m. on the 30th (Mars 3° 3′ N.); and, for the second time this month, with Mercury at 4h. p.m. on the 31st (Mercury 1° 53′ N.).

When these Notes commence the Moon is in Taurus, in the course of her passage over which she arrives at 2h. a.m. on the 4th at the boundary of the extreme northerly part of Orion. She only takes five hours to cross this, and at 7 o'clock the same morning emerges in Gemini. At 11h. 30m. a.m. on the 6th she passes from Gemini into Cancer, and quits Cancer in turn for Leo at 2h. 30m. a.m. on the 8th. Her journey through Leo occupies her until 9h. p.m. on the 10th, and she then passes into Virgo. She remains in Virgo until midnight on the 13th, at which hour she leaves it for Libra. As she journeys across Libra she arrives at 3h. 30m. p.m. on the 15th at the western edge of the northern spike of Scorpio, which she traverses by midnight, and comes out in Ophiuchus. She leaves Ophiuchus at 9h. a.m. on the 17th for Sagittarius. At 2h. 30m. p.m. on the 19th she passes out of Sagittarius into Capricornus. She leaves Capricornus for Aquarius at 9h. 30m. a.m. on the 21st, which constellation she quits for Pisces at 1h. p.m. on the 23rd. Journeying across Pisces she arrives at 4h. a.m. on the 24th on the confines of Cetus, and enters that constellation. She re-enters Pisces at 1h. p.m. on the 25th, only, however, to plunge for the second time into Cetus at 11h. a.m. on the 26th. When she finally quits Cetus at midnight on that day, it is to emerge in Aries. After crossing Aries she enters Taurus at 6h. a.m. on the 28th, and, as at the beginning of the month, after traversing that constellation arrives at the most northerly past of Orion at 9h. a.m. on the 31st. She only takes three hours to pass through this, and then enters Gemini. She is, of course, in Gemini at midnight.

Mercury

Is an Evening Star throughout May, and is as well placed as he possibly can be for the observer. He attains his greatest elongation East of the Sun (22° 44′) at 7 p.m. on the 24th, and as he has very great North Declination about this time he does not set until after 10h. p.m. He consequently is a relatively conspicuous object to the naked eye after sunset over the W.N.W. horizon. His angular diameter increases from 5·2″ on May 1st to 9·4″ on the last day of the month.

Day of Month.	Right Ascension.	Declination. North.	Souths.
	h. m.	° ′	h. m.
1	3 3·7	18 5·7	0 25·3 p.m.
6	3 45·5	21 27·0	0 47·3 ,,
11	4 25·0	23 47·8	1 6·9 ,,
16	5 0·0	25 6·4	1 22·2 ,,
21	5 29·1	25 30·8	1 31·6 ,,
26	5 51·4	25 12·4	1 34·2 ,,
31	6 6·1	24 22·4	1 29·1 ,,

The study of the above ephemeris will show that Mercury starts from a point rather more than 1° south of the 4-5th magnitude star, δ Arietis, and travels across the entire width of Taurus into Gemini. He will be some 3° south of the Pleiades on the night of the 5th, but will not approach any conspicuous star otherwise. He will be in conjunction with Mars (1° 9′ N. of that planet) at 5h. p.m. on the 5th.

Venus

Is a Morning Star all through the month. She is not in a particularly good position for the observer, as she rises in such bright twilight. But her tenuous crescent presents a beautiful spectain the telescope. Her angular diameter diminishes from 58″ on the 1st to 41·2″ on the 31st.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	2 26·4	19 35·5	11 48·0 a.m.
6	2 15·8	17 35·0	11 17·8 ,,
11	2 7·6	15 37·4	10 50·0 ,,
16	2 2·7	13 56·7	10 25·4 ,,
21	2 1·5	12 41·6	10 4·5 ,,
26	2 3·9	11 54·6	9 47·3 ,,
31	2 9·5	11 34·3	9 33·2 ,,

The pendulum-like path above indicated lies wholly in a barren part of Aries.

Mars and Jupiter are both, for the purpose of the observer, invisible; and Neptune, who comes into conjunction with the Sun at 3h. a.m. on the 23rd, is, of course, absolutely so.

Saturn

Is now rapidly approaching the West, and to be seen to the slightest advantage must be looked for the moment it is dusk enough for him to be perceptible. He is in quadrature with the Sun at 1h. a.m. on the 4th. He Souths in bright sunshine even at the beginning of May, and, of course, does so sooner and sooner every day. His angular equatorial diameter dwindles from 16·4″ on May 1st to 15·6″ by the last day of the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	9 6·0	17 49·8	6 26·6 p.m.
6	9 6·7	17 46·6	6 7·6 ,,
11	9 7·6	17 42·7	5 48·8 ,,
16	9 8·6	17 38·0	5 30·2 ,,
21	9 9·8	17 32·7	5 11·7 ,,
26	9 11·1	17 26·7	4 53·3 ,,
31	9 12·6	17 20·1	4 35·1 ,,

This short arc is described in the blank eastern confines of Cancer.

Uranus

Should be looked for as soon as it is dark, on as near to the Meridian as can be managed, in order to be fairly well seen. His angular diameter decreases, quite insensibly, from 4″ at the beginning to 3·8″ by the end of May.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	13 11·3	6 51·4	10 31·1 p.m.
6	13 10·6	6 47·2	10 10·8 ,,
11	13 9·9	6 43·3	9 50·5 ,,
16	13 9·3	6 39·8	9 30·1 ,,
21	13 8·8	6 36·6	9 10·0 ,,
26	13 8·3	6 33·8	8 49·9 ,,
31	13 7·8	6 31·4	8 29·8 ,,

Hence Uranus will be found to be describing a short retrograde arc roughly in the direction from Spica towards θ Virginis.

Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of May 1st, 1889.

Star.	Souths. h.	m.	s.	
α Ursæ Majoris	8	17	6·61	p.m.
δ Crateris	8	33	58·67	,,
ε Corvi	9	24	28·15	,,
γ¹ Virginis	9	56	0·03	,,
α Canum Venaticorum	10	10	45·91	,,
Spica Virginis	10	39	11·73	,,
η Ursæ Majoris	11	2	57·66	,,
Arcturus	11	30	18·60	,,
α Libræ	*12	4	21·49	a.m.
α Coronæ Borealis	*12	49	29·11	,,

* On May 2nd.

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list on any other night in May, as also that of determining the Local instant of its Transit at any other station, will be found on p. 350 of Vol. XLVIII.

Shooting Stars

Are somewhat rare in May. The 1st, 2nd, 15th, and 30th are the most likely nights on which the watcher may be rewarded by their apparition. Fire-balls may be looked for at the very beginning and end of the month, as also about the 20th and 21st.

A METHOD OF ILLUMINATING A LARGE PARABOLIC JET OF WATER.

THE installation of the great fountain on the Champ de Mars for the Universal Exposition at Paris, provides for the illumination of several parabolic jets of water of large dimensions. The method which has so often been employed for the illumination of such fountains is one proposed so long ago as 1841, by M. Colladon (*Comptes Rendus*, t. xv. p. 800). In his arrangement the stream of water escapes from a circular orifice pierced in one of the vertical faces of a reservoir, shaped like a parallelepiped; the stream is illuminated interiorly by a convergent bundle of rays of light furnished by a lens set in the opposite face of the reservoir.

When, however, it is desired to obtain the same effect with a jet of water of *large* diameter and of *great* amplitude, it is found that by the old arrangement the water is only illuminated for a length of about one mètre, and that with difficulty. Further, that this length diminishes in proportion as the amplitude or the section of the jet is increased.

The idea has occurred to M. Bechmann to replace the ordinary jet by a hollow one, into which the light would penetrate without having to traverse the water of the reservoir itself. This has been realised by means of two metallic frusta of a cone fitting one into the other, and carrying prolongations of cylindrical form. The water is forced into the space between the two frusta and thus issues forth by an annular orifice forming a hollow stream. The rays of light are supplied from a focus situated behind the apparatus; after having freely traversed the interior frustum, these rays are reflected on to the internal walls of the jet of water, brilliantly illuminating them.

The diameter of the jet has been made as large as 0·22 mètre in the experiments, and it was even then found possible to illuminate the stream of water to a height of 4·50 mètres. The walls of the hollow jet can be made extremely thin; it has been reduced to three, and even two, millimètres without the light of an arc lamp being able to penetrate beyond it. In order to prevent the jet from breaking up too quickly into drops, partitions are placed in the space between the two metallic frusta, and these oppose the tendency to a spiral movement of the water which would otherwise be generated there.

An elaborate note on this invention and its application to the fountains on the Champ-de-Mars was read before the Paris Academy of Sciences on the 18th of last March, and attracted considerable attention.

IMPROVEMENT IN FRET-SAWS.

THE following description, with illustration, of an improved fret-saw arrangement may be suggestive to those of our readers whose mechanical operations are objected to at home. The invention has been patented by Mr. J. Charles, of Gloster-terrace, Weymouth, and consists in making fret-work machines to work with greater ease and less noise. Fig. 1 is a side view, Fig. 2 an end view, Fig. 3 a plan of the worktable or bench, and Fig. 4 a top view of the slide bracket *g*. *a* is a removable square bar, preferably of steel, held in socket *b* and metal plate *c*, which latter also serves as a stop for the work on the table or bench. To the free end of the bar *a* is screwed or otherwise fixed a round bar, *d*, the outer end of which reaches up to or a little beyond and over the position of the working fret-saw blade, and so that the two bars together form a kind of overhanging spring bar. This bar may, if preferred, be made in one piece of any suitable cross section or of more than one cross sectional form; *e* is a flexible or elastic band, with clip *f* which couples the end of the spring bar to the saw-frame; *g* is a bracket sliding up and down over fixed vertical guide-rods, *h*, the upper ends of which are held in the under side of the table and the lower ends stepped into part *i*. This bracket *g* may also be made in two parts, fixed together as shown in Fig. 5, the horizontal plate taking on to the vertical bosses and web. The saw-handle may be turned freely in the horizontal part of slide bracket *g*, so as to move the saw and saw-frame along the arc of a circle; *k* are indiarubber or other elastic rings, serving as noiseless stops to slide bracket *g* on its down stroke, and *l* is an elastic ring of similar material fixed on the saw-frame, and serving as a noiseless stop to slide bracket *g* on its up stroke; *m* is a tool drawer; *n* is a slot in bracket *g*, for the withdrawal of the saw without any unfastening. Instead of the flexible or elastic band *e* as shown, a metallic or other spring may be employed for coupling the overhanging bar to the saw-frame. The purpose of the overhanging bar and elastic or spring coupling is, when the fret-saw is being worked, to relieve the hand, more or less as desired, from the weight of the saw and working parts in connection therewith, assist the working of the same, and in conjunction with the slide mechanism keep the saw in the proper working position—this mechanism having for object to insure an undeviating reciprocal motion.

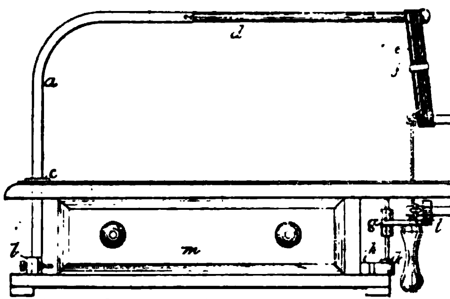


Fig. 1

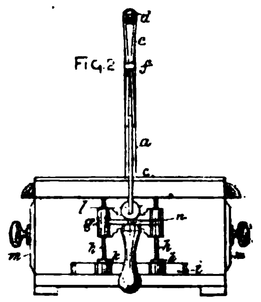


Fig. 2

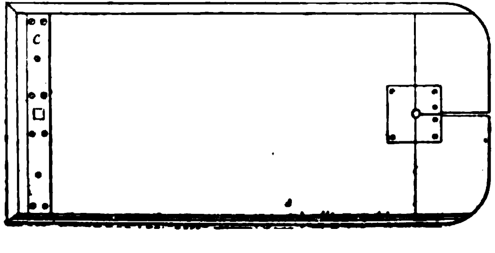


Fig. 3

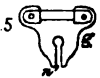


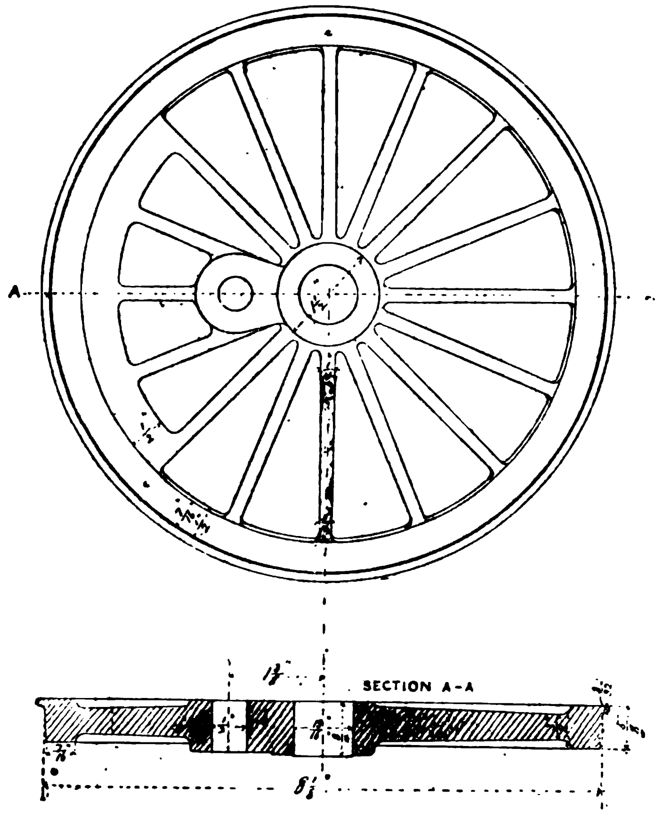
Fig. 5

Fig. 4

A MODEL LOCOMOTIVE.—VII.

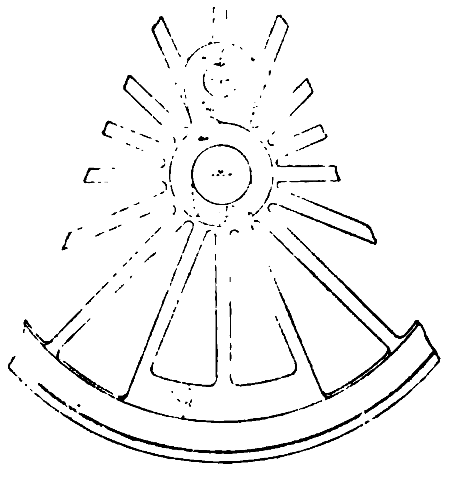
The Wheels and Coupling-Rods.

I WILL now describe the construction of these portions of our model. But as the wheels cannot, on account of their small dimensions, be made copies of their originals, with welded joints and tires, I shall, in the next article, discuss methods of construction, and the cognate matters of relative arrangements and proportions, &c. This will complete the first section of our subject, after which we shall proceed to the engines themselves.



DRIVING WHEELS
FIG. 21

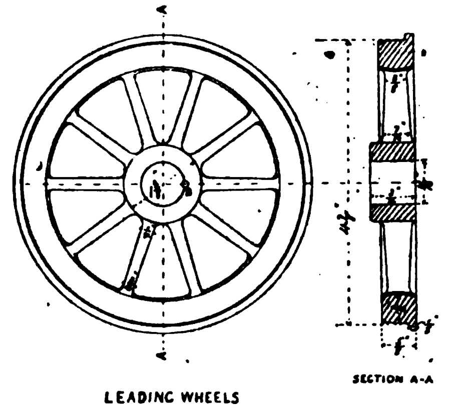
The number of spokes in our model wheels is not quite proportional to the number used in practice. In a wheel of from 6ft. to 6ft. 2in. diameter, for which the model drivers and leaders are proportioned, there would be from 18 to 20 spokes. I show 16 only, and they are quite close enough together for model-making. The number of spokes is nearly proportional to the size of the wheel—their distance apart, measured at the rim—generally about 11in. or 12in., being nearly alike in all wheels, large or small. They



TRAILING WHEELS
Fig. 2

are placed so close together in order to give ample support to the rim—a weak rim, or one insufficiently supported, tending to cause fracture of the tires. The section of the spokes is rectangular, and they taper from nave to rim.

For the model wheels we must make two patterns, and cast them in iron. It is not absolutely necessary to build the pattern rims in segments, and frame the arms together, but such is the proper method to adopt. If dry, straight-grained, moderately hard mahogany is obtainable, the rim and arms may be cut from the solid. In that case, turn the wheels as discs first, to the sectional forms shown in Figs. 21 and 23; then mark the spokes, bore holes between each with centre bits, and carefully cut through with chisel and gouge. This must be done tenderly, the wheel being well bedded on a piece of board the while, else the short grain will become chipped out. The edges are not left quite keen, but look better if slightly rounded. Being made in hard wood, the file may be used to obliterate the toolmarks previously to the application of glass-paper. All necessary dimensions are given for both wheels, and the only respects in which the patterns will differ from their castings is, that allowance will be made for turning upon the outside and edges of the "tire," and similar allowances for turning and boring the boss. The wheels will be cast in soft iron.

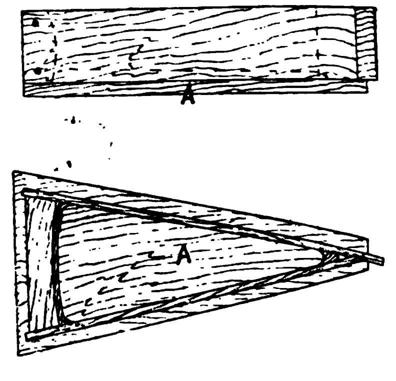


LEADING WHEELS
FIG. 23

This cutting from the solid is the quickest, but not the most durable, method of making the pattern, and except perhaps in the case of the smaller wheel I should not adopt it. The alternative and correct plans are by coring, or by the union of numerous pieces.

Take first that by coring. A solid piece of mahogany is turned to the outlines of the sectional views (Figs. 21, 23), as before, and prints, having the size and form of the interspaces lying between the arms, boss, and rim, are nailed equidistantly upon the wheel face. The prints should not be more than $\frac{3}{16}$in. or $\frac{1}{4}$in. thick, and their edges should be well tapered; otherwise the narrow ridge of sand between each will become torn up in moulding. A core-box (Fig. 24) is then made, having the same internal shape as the prints, its depth being equal to that

FIG. 24.



of the wheel centre and print combined. A dished bottom board, A, should be dowelled on the bottom edge of the box to give the shape of the curves next the boss and the rim. If these curves are not imparted to the cores, their place will be occupied with metal which will have to be removed by prolonged filing.

The moulder would prefer to use a pattern: but as this cannot be cut from the solid and retain its form with any degree of permanence, we must, to make it strong, build the rim up in segments, say, of about three rows, and the arms must be sunk therein, Fig. 25. At the boss, the arms are so close to one another that they must mutually abut by radial edges. If the fitting of these edges is accurately done, the arms made to abut also against a central disc, A, and front and back boss-pieces, B B, glued thereon; this will make a stronger centre than could be made in any fashion. Note that I show the stuff for the other spokes C originally planed wide enough to allow of the cutting of the hollows therefrom. This necessitates cutting all the inner faces of the arms with the chisel. But less trouble is involved by this method than in planing the arms to neat width, and fitting and glueing all the hollows afterwards.

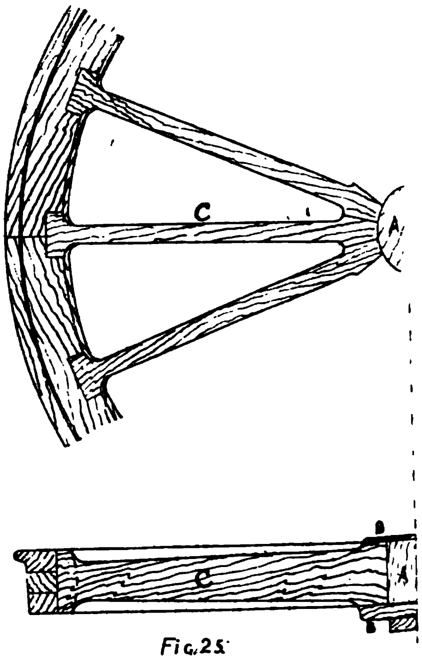


FIG. 25.

The larger pattern will be used both for trailing and driving-wheels, but the counterweights will not be alike in each (compare Figs. 21. [illegible] these weights are cast in, loose [illegible] will be fitted between the arms in [illegible] the pattern, or in the core-box, for some of [illegible] the cores if the latter method is adopte[illegible] position [illegible] Casting alike is the easier plan. In [illegible] bright [illegible] age stresses are apt t[illegible] arms, but by distrib[illegible]ents a beau[illegible] the weight between two or three arms, and using soft iron which is only moderately contractile, little or no risk of fracture is involved. In reference to the advisability of casting in the weights, in preference to fastening them in place after the engine has been built, each must please himself. If absolute results are required, experiment should properly supplement calculation, and the weights be added accordingly. The object of counterbalancing is the neutralisation of the unsteadiness which would be produced by the weight and the momentum of the reciprocating parts. The tendency of the rapidly-moving pistons, rods, and cranks is to cause a fore-and-aft, and a swaying motion of the locomotive, which, if not counteracted, becomes dangerous at high speeds. The conditions are different in outside and inside cylinder engines; and in coupled and uncoupled engines, the side-rods, crank-bosses, and pins affecting the results. For these reasons the correct counterbalancing of engine parts becomes a somewhat complicated problem, and different engineers often adopt different rules. If I have space I will enter a little into this matter in the next article. For the model I suggest two plans: one to weight the wheels approximately, according to dimensions given, casting the weights solid; the other to leave the weighting of the drivers until the engine is finished, and add counter-weight by pouring lead between sheet-iron plates, bolted, and afterwards riveted against the arm faces, or by fitting iron blocks against the inside of the rim, and securing them between plates. For the most steady results it would then be found that not only might the weights be more or less than those shown, but that their position would not be precisely opposite the crank pins, but slightly farther round towards each other. It will be observed that the weights are not concentrated between one pair of spokes, but disposed over several, in order to prevent injurious hammer-like blows of the revolving wheels on the rails.

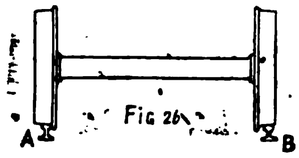
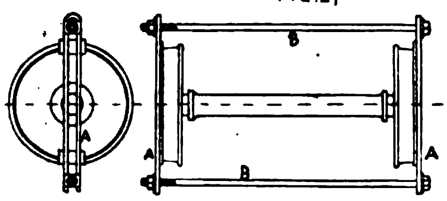


FIG 26

When cast, it will be necessary to turn the wheels all over, on the treads, flanges, rim, and boss faces and edges, and to bore holes for axles and coupling-rod pins. The turning and boring can be done on any face chuck, a separate chucking being necessary for each face, and the pin-hole can be drilled either in, or away from, the lathe.

FIG.27



Observe the coning of the treads, and the thinning down of the driving-wheel flange. The first point, the coning (to an inclination of about 1 in 24) is adopted by way of compromise, in order to enable the wheels to run both in straight lines and in curves. The correct form of wheel for straight running would be that with parallel tires. For curves, the wheels should form frusta of cones, whose apices would be at the centres of the radii of the curves. The centres of all the wheel axles should also be radial to the centres of the curves. Since it would be impossible to build engines after a design which would accord with both conditions, the wheels are coned, and thus engines are enabled to accommodate themselves to the varying character of the line.

The effect of coning is as follows:—The engine running on a stright piece of line, the flanges will be about equidistant from the rails. Entering on and passing around a curve, its tendency will be to run towards the outside rail of the urve, as though to pass off at a tangent. Then, A, Fig. 26, is the outside, and B the inside ll, the largest diameter of the wheel will mount A, and the smallest diameter of the other wheel will run on B. By the lateral slip of the wheels, those on the outer rails move over a greater space in the same time than those on the inner rails. Coning, therefore, maintains a variable relationship between the curve of the road and the rate of travel of the wheels, preventing or lessening slip, which produces torsion on the axles.

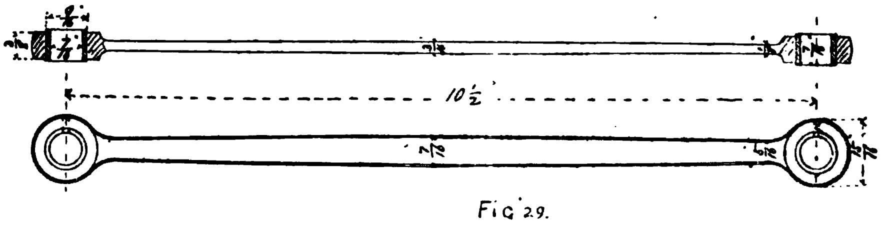


FIG 29.

In reference to the thinning down of the driving-wheel flanges, the running of an engine around quick curves imposes great stress on the flanges of the driving-wheels, and consequently endlong strains upon the crank-axle. This is because the flange on the inside driver forms with the flanges of the leading and trailing wheels the chord of an arc of the curve. The versed sine of the chord will, with a long rigid wheel-base and quick curves, be a very considerable dimension, causing great friction between the tire and the rail. Hence the universal practice now is to turn down the flanges of the driving-wheels to $\frac{1}{8}$in. or $\frac{3}{8}$in. thinner than those upon the front and hind wheels, and this, with the end-play, diminishes excessive frictional contact. The flanges might be removed altogether, as was done in the case of some of the early Stephenson engines, but for the safety they afford in the event of the leading wheels leaving the rails.

Wheels are forced upon their axles by an hydraulic pressure equal to 12 tons per diametral inch of that part which goes into the nave. Mr. Burnett employs a force equal to $1\frac{1}{2}$ tons multiplied into the square of the diameter in inches. A very slight taper—tight and slack by the calipers—is given to the hole and the axle ends to cause a better grip. In addition to the frictional grip, it is customary to insert a single rectangular key into the axle and the hole. Only upon one railway is this practice dispensed with. Mr. Stroudley, of the L.B. and S. Coast Railway, has abandoned the practice of keying, and states that the pressure of 12 tons per inch "has been found sufficient to retain the wheel in position without keys, collars, or any other than the nipping action given by the elasticity of the metal."

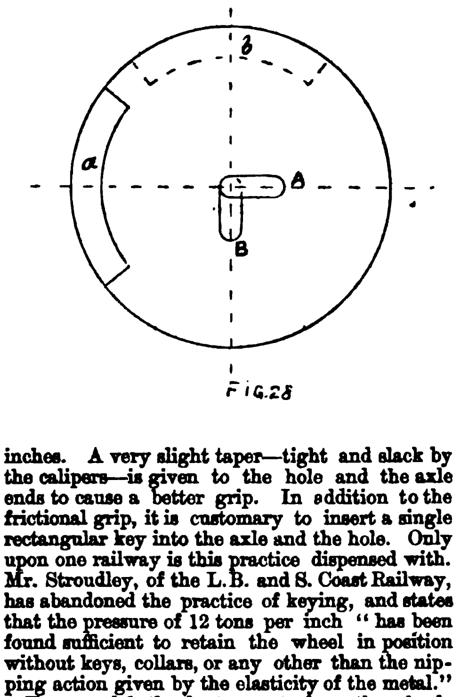


FIG.28

For a model, the best way to force the wheels upon their axles is shown in Fig. 27. Get two stiff bars of iron, A A, and bend them double to form loops. Having the holes in the wheel naves entered over their axle ends, let these bars embrace the wheel faces. Pass bolts, B B, through the bars, and gradually screw the nuts down until the wheels are pressed home upon their axle ends. If carefully fitted, no other security will be required. If not well fitted, drill a $\frac{1}{8}$in. or $\frac{3}{16}$in. hole, half-way in the boss, half-way in the axle, and drive a circular pin key in. (Fig. 23, B.) The leading and trailing wheels can be keyed in any position, but the drivers must be keyed in such a position that the counterweights come opposite the crank-pins, *a*, Fig. 28 being the weight for pin A and its attachments, *b* being that for pin B with its attachments. For perfect balancing these weights would have to be brought nearer towards one another by several degrees of angle, in order that each may not only balance its own crank, but partly also the one opposite; hence the advantage of experiment.

When pressing on the drivers, the bars must not be made to embrace both wheels, or the crank axle will become bent, but one of the bars must be placed against the inside face of the outermost crank-web.

After the wheels are drawn on their axles, the latter had better be run round between dead-centres, and if the tires are not perfectly true, corrected by lightly re-turning.

The coupling-rods are shown in Fig. 29. They have plain bushed ends only—a practice now entirely in favour. Formerly costly strap-ends were used for these rods, and were not a whit the better than are the plain bushed ends, but rather the worse, because of the stiffness of fitting.

The making of the rods is as follows:—A rough forging of each will be prepared, filed flat on opposite boss faces to $\frac{3}{8}$in. in thickness, lined off, $\frac{9}{16}$in. holes marked at each end, and bosses struck round. The holes will be drilled, and the outlines of the bosses and rods filed to the dimensions in Fig. 29. The gun-metal bushes, bored to $\frac{7}{16}$in., and turned to make a driving fit into the $\frac{9}{16}$in. holes, will be pressed or driven in. No device for holding these bushes in place will be required in a model. In practice they are variously held. Thus, a taper-turned pin passes through the boss of the coupling-rod and one side of the bush; or the stem of the lubricator is carried into the upper part of the bush, or a set-screw is tapped in.

Lubrication of coupling-rods is done with cotton-wick, siphoning the oil from the cup into the oil hole. A cover is screwed into the top of the lubricator cup. We cannot very well use a wick in so small an affair; but will simply drill and countersink an oil hole.

The pins for the coupling-rods are shown at Fig. 30. They are made of wrought iron turned to make a tight fit in the bored holes in the wheels, and the part entering the coupling-rod is properly case-hardened and ground. They are pulled into the wheels by pressure, hydraulic power being employed in practice. There is a thin collar interposed between the portion entering the wheel and that embraced by the coupling-rod. The bush of the coupling-rod makes a free fit with the pin, and the rod is held in place with a split pin passing through a washer and the pin end. To protect the pin from dust, the washer may be prolonged to form a capping over the end.

J. H.

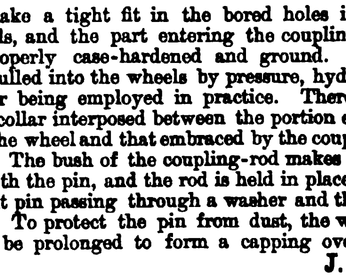


FIG. 30.

CHAMPNEY'S ALIMENTARY COMPOUND.

PERHAPS it is a sign of the times that we have so many patented foods, or "alimentary compounds," when years ago our forbears were contented with the simplest fare, and fared very well on that. Here is a "composition or compound," patented in this country by Mr. H. T. Champney, of New York, which consists of the following ingredients, preferably combined in the proportions stated—viz.: Defibrinated blood, 65 gals.; whiskey, 15 gals.; glycerine, 3·5 gals.; albumen, 13·5lb.; boracic acid, 1·5lb.; chloride of sodium (common salt), 1·5lb. The above-named ingredients are to be thoroughly mingled by agitation, and after being subjected to a ripening process for about thirty days, the product may be bottled in such manner as to exclude the air, and be put on the market ready for use. This preparation constitutes a liquid or fluid food, and is specially useful in cases of physical weakness, general debility, and any derangement of the digestive organs. The patentee prefers to make use of bullock's blood—that is, the blood of beef animals, freshly drawn, although the blood of healthy sheep may be substituted. The blood is defibrinated in any of the usual ways, a convenient and economical way being to take the blood just as it is drawn from the animal, and subject it to a vigorous stirring from ten to fifteen minutes, which will prevent coagulation and will aggregate the fibrin so that it can be readily separated. This separation is effected by passing the stirred blood through a fine sieve of about 120 to 130 meshes to the inch. when the fibrin will be left on the sieve and the remaining parts will pass through. He also prefers Bourbon whiskey, although other brands of good quality will answer. Chemically pure glycerine is preferred, and albumen obtained from eggs, although albumen from other sources will give fair results. In practice, for convenience and economy, the patentee has used the desiccated white of eggs, which, before being mingled with the other ingredients, is dissolved in water at a temperature of about 120° Fahrenheit. The proportion given above is for the desiccated albumen before it is dissolved. The boracic acid and chloride of sodium are obtained in their common crystalline conditions, and should be reduced to a fine powder before being mingled with the other ingredients. As the above-named ingredients are brought together, they are thoroughly incorporated by agitation. For this purpose a centrifugal mixing machine may be advantageously employed. When the mixing is completed the fluid is drawn off into barrels or other receptacles, which are bunged or otherwise secured to prevent admission of the air, and it is then preferably allowed to stand in a cool place for about thirty days for the purpose of ripening, when it can be bottled and is ready for use. The patentee has ascertained by a long series of experiments that the proportions of the several ingredients, as above stated, give the best practical results, although a marketable preparation similar in its effect can be produced by departing somewhat from the proportions above-named. This fluid food is preferably administered, in cases of extreme weakness and irritability of the digestive organs, in small doses, beginning with ten to twenty drops, diluted with about the same quantity of water or milk, and repeated every half hour, as the patient can bear it, to four tablespoonfuls per day for an adult. Larger doses are given with benefit where the strength of the patient will bear it. From five to ten drops may be given to bottle-fed infants in thair milk at each feeding.

ELECTRO MOTORS: HOW MADE AND HOW USED.—VI.*

By S. R. Bottone.

§ 23. PERHAPS of all the motors hitherto constructed, the one described in the last seven sections is the most efficient as regards the amount of power obtainable from a given mass of iron, a given quantity of wire, and a given battery power. But from the fact that the commutator slits *may* come to rest opposite the brushes, when of course no current *can* flow round the armature, this motor has "dead points," and when the commutator is in this position the motor will not start itself.

"For light work, Prof. S. P. Thompson" (see his "Dynamo Electric Machinery," from which this description is quoted) "has designed a small motor, which has some advantages over those of Deprez and of Griscom (both these are of the Siemens type of armature). The field magnets, which also constitute the bed-plate of the motor, are of malleable cast iron, of a form that can be cast in one, or at most in two, pieces. The form of them is that of a Joule's magnet, with large pole pieces, and wound with coils, arranged partly in series and partly as a shunt, in certain proportions, so as to give a constant velocity when worked with an external electromotive force of a certain number of volts. For the armature a simple form is employed, which, without any complication, obviates dead points. This result is attained by modifying the old Siemens armature by embedding, as it were, one of the shuttle-shaped coils within another, at right angles to one another. And having duplicated the coils, the segments of the commutator must also be duplicated, so that it becomes a 4-part collector. There are no solid iron parts in the armature; but the cores are made of thin pieces of sheet iron, stamped out and strung together."

FIG. 14.

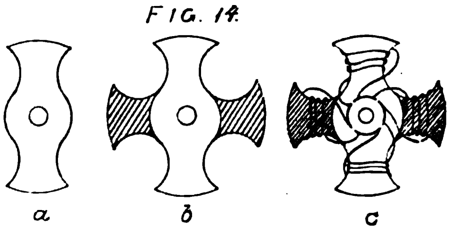
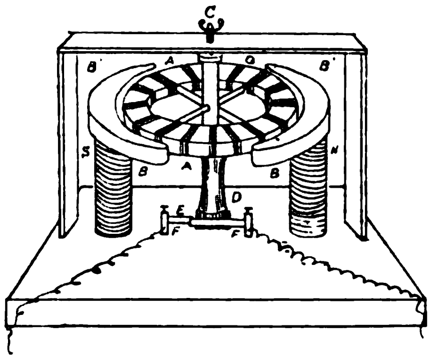


FIG. 15



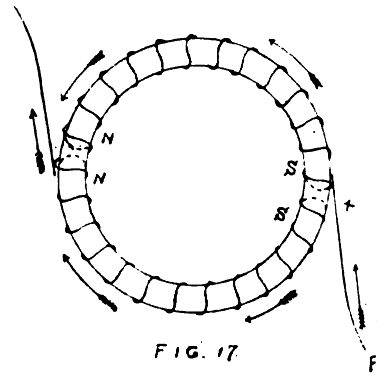


FIG. 17

§ 24. A dynamo and motor, with an armature almost precisely similar to this (of which Fig. 14 gives a good idea) was constructed in 1884 by F. W. Walker, and described in the English Mechanic for that year, Vol. XL. p. 136. For practice, however, it is found that even these four-part Siemens armatures (unless wound with closed coils, as in the "Walker" armatures figured) are apt to stop over the commutator gaps. Besides, they labour under the disadvantage of always carrying with them *one* coil which is doing nothing. For this reason no detailed description will be given of the Deprez motor, in which two armatures of the Siemens type were employed, one placed 90° in advance of the other, so that while one was at the dead point, the other was in full action; or of the Griscom (see Fig. 15), which differs from the Siemens type already described, only in the compact, ring-shaped field magnets, wound so as to have consecutive poles at the bare portions. One of the first really self-starting motors was that devised by Pacinotti in 1864-5, afterwards modified by Gramme in 1876. For the sake of its historical interest, a short description of the Pacinotti motor is here subjoined.

§ 25. The description and illustration of this machine is to be found in the Italian journal, *Il Nuovo Cimento*, for the year 1864. The machine itself, as described, can be used either as a *motor*, or as a *generator of electricity*; and its inventor, Prof. A. Pacinotti, calls special attention to these facts in the following words:—"It seems to me that what augments the value of this model, is the facility which it offers of being able to transform this electro-magnetic engine into a magneto-electric machine giving continuous currents."

The Pacinotti machine consists in two electro-magnets S and N (Fig. 16), which may or may not be united together below, affixed to a base board, so as to stand firmly upright, and so arranged with regard to the winding, that if the upper extremity of the one be made a south pole, the upper extremity of the other is north, or *vice versâ*. These poles are furnished with semicircular prolongations (*horns* or *pole pieces*) in soft iron B, B, B', B', between which is poised, on the spindle C, D, a soft iron ring, A A, furnished with projecting teeth.* This ring is attached to the spindle D by means of four radiating brass spokes. As there are sixteen teeth to the ring or "armature," so there are also sixteen spaces. Each space is wound with coils of insulated wire. The spindle is furnished with a commutator, E, in the shape of a wooden cylinder, in which are inserted sixteen copper or brass strips. The beginning and ending wires of each coil are attached to these commutator strips in the following mode—viz., the *end* of *one* coil is soldered to the *beginning* of the *next*, and then soldered to the nearest strip, and so on all round the ring and commutator. Consequently, the wire forming the coils, although capable of communicating electrically with the springs (or brushes) F F at opposite points of the diameter of the commutator, is really continuous. The ring can communicate its motion to any desired point by means of the rigger G, and a driving belt (not shown). If now the opposite poles of a battery are connected up to the binding screws F F, while the electro-magnets are likewise active, the ring becomes magnetised in a peculiar

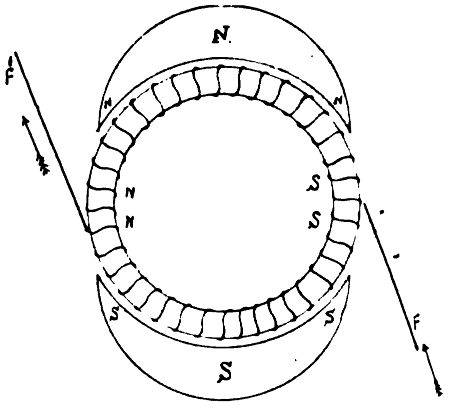


FIG. 18.

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* The presence of the projecting teeth, or "cogs," as they are now usually called, is of very great importance. Prof. S. Thompson has shown, by a series of classical experiments, that the concentration of the magnetic field due to the teeth augments the effect 33 per cent. over that given by the smooth ring.

manner, which will be best understood by reference to Fig. 17. From this it will be seen that the current, on entering the continuous coils, from the right-hand brush F, divides itself, and takes two paths: one round the coils on the upper half of the ring to the brush F', and the other round the coils on the lower half of the ring to the same brush F'. It must be noted that the direction of the flow of current is the *reverse* in the upper half of the ring to what it is in the lower, since in the upper half, the current flows from *over* to *under*, while in the other it proceeds from *under* to *over*. As a consequence of this, we transform the ring, during the passage of the current, into *two magnets*, the *upper* having a south pole to the right, and a north pole to the left, while the *under* has also a south pole to the right, and a north to the left. This is what Prof. Pacinotti called a "transversal magnet," and is virtually a ring with two consecutive north poles at one point of the diameter and two consecutive south poles at the opposite point of its diameter. This is actually the only way in which we can cause an electro-magnetic, of the ring form, to evince active polarity. It will also be noticed that on causing the ring to rotate between the brushes, although the iron mass of the ring with its accompanying coils of wire moves round, yet the N N and S S poles *remain* always at the *same points*—viz., *just under the brushes.*

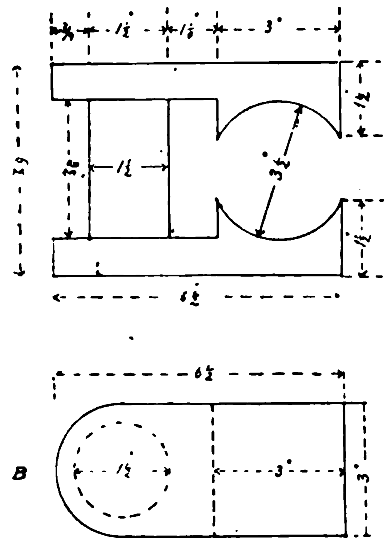


FIG. 19.

Now it will be quite evident that when such a ring thus magnetised is placed between the poles of an electro-magnet furnished with horned pole-pieces, as shown at Fig. 18, the right-hand half of the ring, being thus kept continuously south, will be continuously *attracted* by the north pole of the electro-magnet, and as continuously *repelled* by the south pole of the electro-magnet. At the same time the left-hand half of the ring, being north, will be continuously repelled by the north poles of the electro-magnet, and as continuously *attracted* by the south pole. As these four attractions and repulsions are all tending to move the ring in the same direction, the ring, if free to move, begins to rotate; and as, like the donkey with the cabbage suspended from its own head, its attracted portion can never get any nearer the attraction, so the ring keeps up a continuous rotation as long as current is supplied.

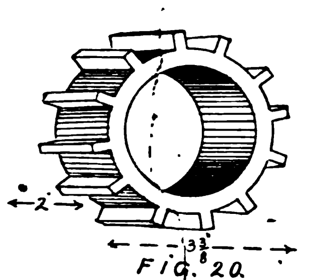


FIG. 20.

§ 26. Based upon the principles involved in Pacinotti's motor, assisted by the knowledge now possessed of the proper proportions to be given to the parts, and the importance of keeping the magnetic circuit as continuous as possible, we are able to construct a very compact and efficient *self-acting* motor. The term self-acting is here employed to denote that it has no "dead points," and consequently will start directly current is applied to its terminals, irrespective of the position of the commutator with regard to the brushes.

To construct this motor, the operator will need a casting (in "malleable" iron) for the field-magnet and pole-pieces. In order to secure the advantage of having the magnet circuit without any interruption, it will be well that these (F.M.'s and pole-pieces) should be cast all in one piece. For this reason a pattern of the general form and dimensions shown at Fig. 19 is to be made in wood, and from this the founder can cast and carefully anneal the casting. In the figure, A is a sectional elevation, B the ground plan. The dimensions are correctly given in inches, for a motor with an armature 3⅜in. outside diameter. It is not advisable to make a *smaller* armature of this type, owing to the difficulty of winding a ring having a smaller diameter. The armature is shown, drawn to scale, at Fig. 20, and consists of a ring of malleable iron, 2⅜in. in diameter, with 12 cogs, each about 3/16in. thick, ¼in. high. The thickness of the substance of the ring itself is about ⅜in., so that the internal diameter of the ring is about 1⅝in., leaving sufficient space to pass the wire easily while winding. The depth of the ring is 2in. In our next section we shall show how this motor is to be wound and connected up.

Fig. 2.

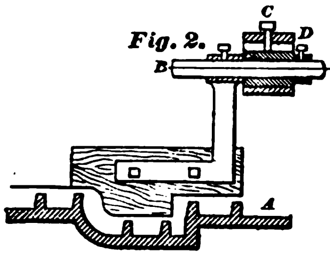


Fig. 3.

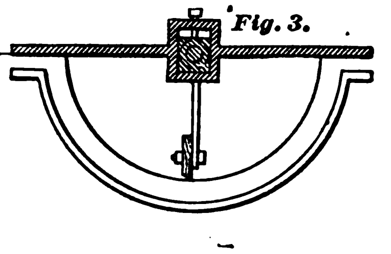


Fig. 1.

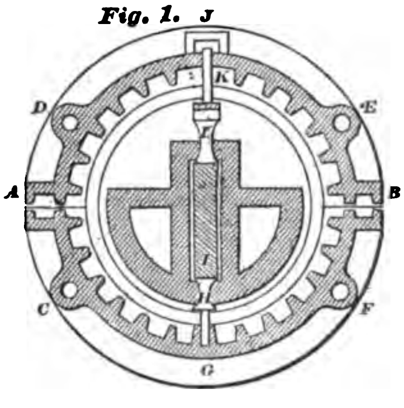
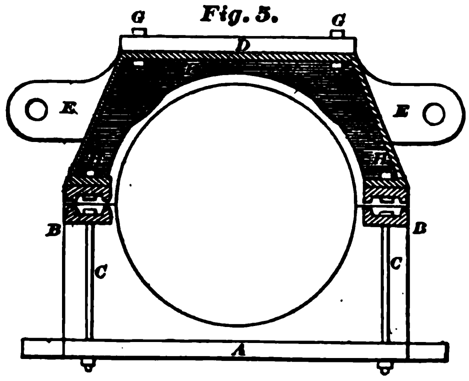


Fig. 5.



MAKING ELBOWS, BENDS, AND BRANCH PIPES IN LOAM.*

IN order to give a clear exposition of the method of moulding pipes in casings, let us proceed to make a 24in. socket pipe, 10ft. long, and bent to 14ft. radius. The succeeding instructions will serve for flange pipes as well. Fig. 1 is a sectional view of top and bottom halves of the casings required for moulding such a pipe. The thickness is 1in. all through, strengthened by ribs, 2ft. apart, extending all round, from flange A to flange B, as indicated by the outer line. Lugs for lifting purposes are shown at C, D, E, and F; these may be either separate or attached to the ribs, according to circumstances. In this instance 1¾in. is allowed for loam, which is held to the casing by the prickers shown. Let these prickers be 1¼in. at the base and ½in. at the top, for if they are made any lighter than this their life is short. They may be set in about 6in. apart, and vent holes cast in the same ratio.

It will be seen at G that provision is made for holding a stud with which to support the core; this socket is made to receive a stud 1in. in diameter, and must be set in exact position to catch the packing H, which, as shown, extends from the surface of the core to bar I. Provision for holding down the core, as shown at J, consisting of two clamps of wrought-iron 1¼in. square, cast in the casing; one on each side of the hole through which the stud K is dropped. A stout bar, resting on the stud, and firmly wedged under these clamps, secures the thing at once.

This stud K is seen to rest on a wrought-iron plate, 4in. square and ¾in. thick, and between this and the packing L is inserted a piece of wood 1in. thick, and of the same dimensions as the plate; this wood burns away in due time, and releases the core of iron. Of course, the casing is made to the form of the pipe, as seen at section of socket end, Fig. 2; and it is best to allow 6in. extra length, as shown at A. The core, extending the same distance past the bearing, forms a space into which sand may be rammed all round after the mould is closed, and by this means make it impossible for the iron to escape at any part of the bearings.

The mode of sweeping this mould is shown in detail at Figs. 2, 3, and 4. Fig. 4 represents a frame of cast-iron, made to the outer dimensions of the pipe on its inside edge (only at the print ends, which must be the width of the core at that place), and whose outside edge corresponds to the casing at A, B, Fig. 1.

This frame and a body sweep, in conjunction with the spindle attachment shown, constitutes the whole arrangement for forming the outside of the mould.

It will greatly facilitate the operations if the casings are set one on each side of a vertical spindle, with which to sweep off the joints; and should the spindles already erected not be available, one can very readily be extemporised for the purpose. The joints may be rammed with dry sand facing and swept with a straight board, after which the iron frame is placed thereon and the mould formed.

It will be seen that the spindle B, Fig. 2, works in a loose bush, which is held in its place by a set-screw C, and that it is prevented from moving endways by the collar D. The reason for having this loose bush is obvious; the centre of the spindle must be on a line with the joint of the mould, as seen in Fig. 3, and when the frame is reversed, and placed on the other half, the bush must be moved to bring the centre on a line with the joint, as in the former instance. If this were not done, two frames would be required, and four holes bored instead of two.

The horizontal spindle serves to form the ends, and also the bearings for the core, and, as will be plainly seen, flanges may be swept with the same facility as plain ends. The body of the pipe is formed by a sweep, made to rest on the frame as it is drawn from end to end. By using one frame for both halves an absolute fit is obtained by simply smoothing off the loam even with the outer edge of the frame in both cases, and carefully matching them when closing the mould.

The mode of pouring in this case will be governed by the style of core used. Should the core be made of a material which will allow the iron to be dropped on the top, a sufficient number of holes must be cast in the casing for the purpose of forming the gates. Or, if it is thought best to make the bottom half in dry sand, and the top green, then provision can be made in the bottom casing for the insertion of the necessary gates, and securing the runner box in which the pouring basin is to be made.

Again, should an entire green sand core be used, it will be best to provide for running in at the end, by casting holes at one end of the top casing for upright runners to connect with gates cut round the bottom bearing; these again connecting with the casting in the direction of its length. Such a runner is easily made by attaching a finger-piece to the sweep, at the point where it is intended to run the pipe, connecting it with the mould afterwards. The latter mode will be found applicable in nearly all cases, and is by far the best method, owing to the fact that neither cope nor core offers any opposition to the free ingress of the iron.

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* By S. BOLLAND, in *American Machinist.*

The labour of making cores for this job will be appreciably lessened by providing a half core-box of cast iron in which to make them. When such a box is furnished, all that is needed in the way of core-iron is a stout bar, made to the curve of, and central with, the pipe, on which loose frames are wedged fast along its length at a proper distance from each other, as shown in section at Fig. 1. With such a rig as this it is only required to ram about 6in. of sand solid all round, filling the inside with coarse cinders as the ramming progresses. The top half can be swept off with a strickle, made to work on the edges of the half box, and any little deviation from a correct half in the iron box can be rectified by adding to or reducing the strickle, as occasion requires.

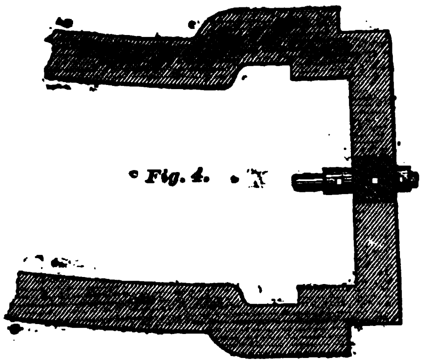


Fig. 4.

The utility of the method herein suggested for sweeping pipes is not by any means confined to moulding in casings. By referring to Fig. 5, it will be seen how easily it may be applied to a regularly-built mould, so prepared that an almost unlimited number of pipes may be cast therein with absolute safety, the frame and horizontal spindle being used in exactly the same manner as directed for the casing. The inner circle represents the mould, the bottom half of which is built on foundation-plate A up to the points B B, where another plate, which is a fac-simile of the flange on the casing, is placed and secured by bolts C C.

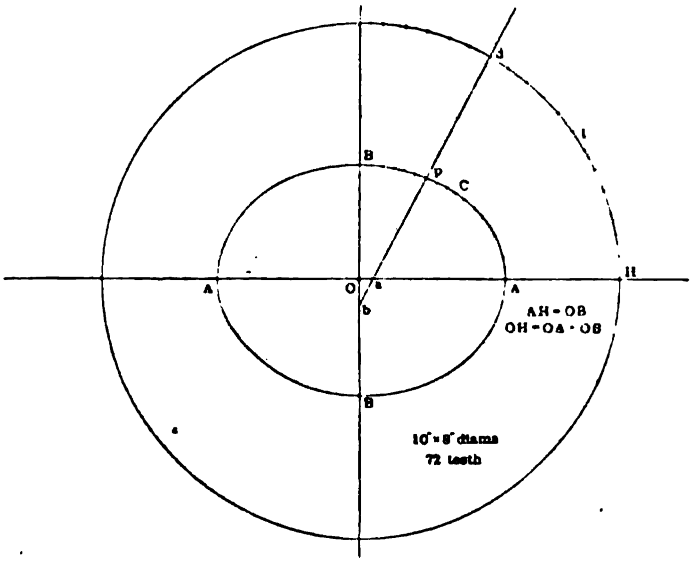
For the top half make the covering plate as shown with lugs or handles E E, set convenient for lifting and rolling over. Let holes be cast about every 12in. along each side of the plate for the purpose of securing cross bars F, which, as shown, have flanges, with holes cast to correspond with those cast in the top plate. Bars and plate are then made one by bolts G G, and similar plates to those at B B are secured to these bars by bolts at H H. The bars, having a flange along their outer edges, hold the bricks firmly in their place, while the lugs E E, extending beyond the outermost part of the mould, and set central with it, allow the cope to be rolled easily either one way or the other, resting on them (the lugs) throughout the whole operation of reversing.

SPACING THE ELLIPSE.*

I HAVE frequently found it necessary in the course of my business, which is specially confined to the making and cutting of gear wheels, to cut the teeth of an elliptic gear. Although I have always used the greatest care, and have had the advantage of experience and the best of tools, I have seldom succeeded in actually cutting such a gear to the combined satisfaction of myself and my customer, while, from a business point of view, nothing but a price that is almost prohibitory will make an order for such a gear in any way desirable.

The difficulty has been in the spacing of the curve so that the teeth could be evenly placed and give a smooth action. The usual method is to draw the curve and space it with the dividers, step by step, and, although the process is simple enough to describe, it is exceedingly clumsy, tedious, and inaccurate in operation.

Realising that the only impediment to the general use of the elliptic gear for quick return motions and for other variations of speed, in positions where its simplicity and its positive action make it unrivalled by any other mechanical movement, was the present expense of producing it and the poverty of the usual result, I undertook the construction of a special machine for the purpose. I had no difficulty in designing a machine that would keep the cutter accurately in the elliptic path, but it was only after a long search and many experiments that I found a device for spacing the elliptic outline that would serve that purpose even approximately.



The result of my search was the device here described, and it can be easily applied with a degree of accuracy that is far beyond the requirements of actual practice.

In the figure, suppose the ellipse to be described on the principle of the common trammel, the two pins *a* and *b* being confined to the two lines O A and O B, while the point *p* draws the curve.

Draw an index circle, I, from the centre O of the ellipse, and let its radius O H be equal to the sum of the radii, O A and O B of the ellipse. Then, if the line *b a p* extended accurately spaces the index circle at *d*, it will also space the ellipse with an accuracy that is practically perfect for cases that are in use for elliptic gears.

To show the accuracy of the device take a very common example. Given an ellipse with a major diameter of 10in. and a minor diameter of 9in., with 72 teeth. This ellipse, used as a quick return motion, would give a ratio of slow stroke to quick return stroke of more than three to one, and when used for variation of speed, would give a variation of fastest speed to slowest speed of about 6½ to 1. It is, therefore, a practical example, elliptic gears being generally much more nearly circular.

For this example the errors in spacing, although theoretically present, are practically nothing. The chord of the tooth space at the major apex A is ·41433in., while that at the minor apex B is ·41441in., giving an error of about $\frac{1}{12000}$in. The greatest error is on the quarter at C, and not at the apices, but the difference between the greatest and the least tooth spaces is not over $\frac{1}{2000}$in.

If we take an extreme case we shall find a greater error. For diameters of 12in. and 6in. and 72 teeth, which would be wholly useless for practical purposes, the greatest error is still very small, not over $\frac{1}{10}$in., while the error between the apices is still practically nothing. For the case shown in the figure, an ellipse having diameters of 8in. and 10in., and 72 teeth, the maximum error is $\frac{1}{400}$in. This gear will give a ratio of greatest to least speed of 16 to 1, while as a quick-return motion the ratio is more than 5 to 1. With the machine now being made, I confidently expect to be able to cut elliptic gears quite as accurately as I can now cut circular gears, and at an expense that is but little greater. When the elliptic gear can be well and cheaply made, I see no reason why its use should not be increased ten-fold, for it is one of the neatest and most useful of mechanical devices.

RULE FOR MEASURING THE POWER OF DRIVING BELTS.

THE horse-power of belts has furnished a theme for much writing, formulæ, and dispute, the fact being that the power of a belt or its working duty is not amenable to any exact rule. The qualifying circumstances, such as strain, condition of belts, the kind of materials, size of pulleys, speed, and so on, are not constant, but variable factors, and hence rules must be based upon "averages," a quantity unknown in exact computation. The most simple of all, and exact as any rule can be for practical purposes, is to allow so many square feet of belt to each horse-power—that is, the amount of belt surface passing a fixed point in a given time. If the belt moves 1,000ft. a minute, and is 6in. wide, then 500ft. of surface pass in the minute. If 3in. wide 250ft. pass, and so on. This divided by 75 will give average duty for common bands; 60 is a better divisor for leather bands, and 90 for gum bands of common thickness. There are in use two old rules for ascertaining the horse-power of belts—namely, 1,000ft. per minute, 1in. wide, one horse-power, and 500ft. per minute for the same width and work. One is to sell power by the other for purchasing. The first one is equal to 85 superficial feet to each horse-power; the other one-half 42½ft. per horse-power.

It is the custom to assume double work for double belts; but a double belt is an uncertain matter. All belts are made of a thickness in proportion to their width, or should be, and variation from this rule is a circumstance of manufacture. Leather belts exceeding 8in. wide-made of one thickness of common leather, are scarce to be considered; no one makes or employs thin bands of greater width unless for special purposes, so that the terms single and double apply only to leather belts of narrow width.

In respect to double work the rule does not hold good, unless we assume at the same time double strain, either by direct tension or weight, and a safer rule is to allow 50 per cent. increase of power for double leather bands less than 8in. wide.

In the case of heavy main driving-belts, the ascertained data and book rules respecting belts will be of some use when specific tension is assumed and maintained; but this, as we know, may vary as one to two, even when tension pulleys are employed.

Up to a certain point of speed the weight of a belt adds to its driving power; so does its length, because each of these things increase tension. Beyond this limit of speed, weight reduces the driving power by shortening the arc of contact on pulleys and for other reasons. Belts driven at 5,000ft. per minute, as many are, cannot be heavy. The writer some time ago substituted waxed cotton "webbing" for leather belts when a speed of 6,000ft. per minute was required, and found an increased tractive power with the cotton belts that were not one-fourth the weight of the leather ones.

There is not, perhaps, in the whole range of mechanical contrivances anything so far from being exact or definable as the power of belts; but there is, on the other hand, the compensating fact that they are never too wide, so no practical difficulty arises.

It is not uncommon to hear of devices to increase the tractive power of belts; one of recent mention is to perforate the rims of pulleys with small holes, so as to secure a kind of mechanical contact or interlock. We think short spurs set like the teeth of a card would be preferable, and certainly more effective. The effect on the belts in either case we leave to conjecture.

The fact is, belts have plenty of traction in nearly all cases. What they require is width and proper elastic tension. Effort spent in trying to have them "stick" is not only lost, but the result, when attained, is also a loss in the end, by reason of overwork for the belts.

There are, it is true, many cases where belts are exposed to fine, dry dust, and when stiff from this or other cause, they do not perform the amount of work their surface speed demands. In such cases leather bands require oil or tallow, but never resin or adhesive compounds, unless in case of emergency.

The manufacture of leather belts has been completely revolutionised by American makers during

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* By George B. Grant, Lexington, Mass., in the *Journal* of the Franklin Institute.

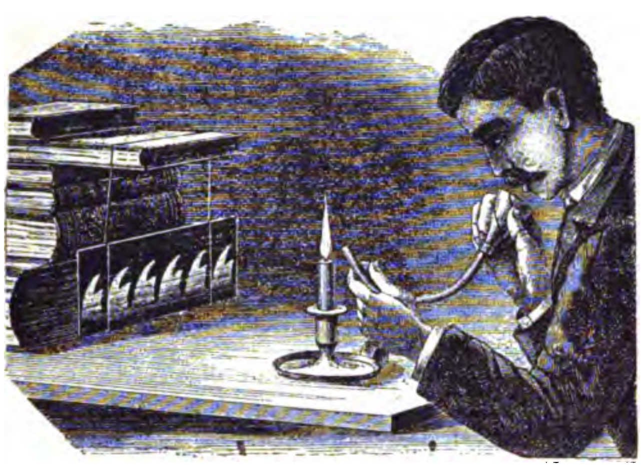

Fig. 1.—Simple Method of Producing and Viewing Vibrating Flames.

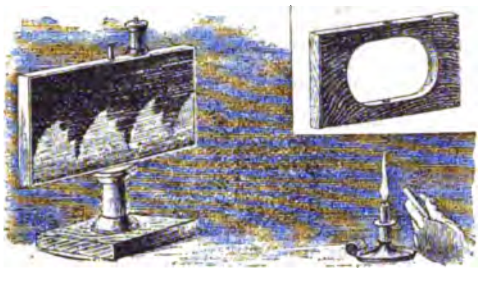

Fig. 2.—Rotating Mirror.

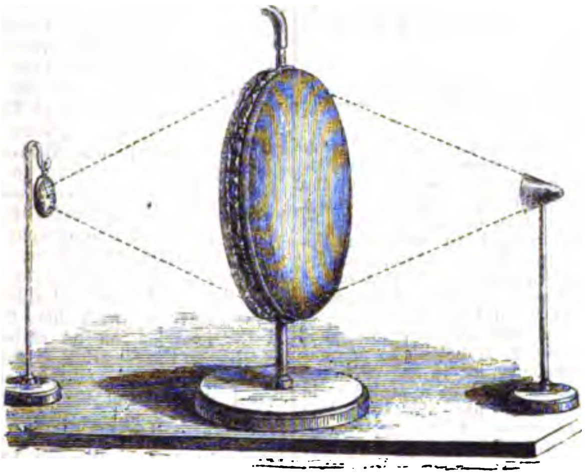

Fig. 3.—Sound Lens.

twenty-five years past. Previous to that the markets of Continental Europe, and England as well, knew only heavy, oil-soaked belts sold by the pound of weight. The fastenings were bad and the leather not stretched, so that high speed was near impossible. The advent of American belts changed all this. In 1887, 7,000,000dols. worth of leather belts were sent abroad.—*Tradesman* (U.S.).

SOME EXPERIMENTS IN SOUND.*

THE most perfect exhibition of vibrating flames can be made only with expensive apparatus; but the student can get very satisfactory results by the employment of such things as are shown in Fig. 1. A candle, a rubber tube, an oblong mirror, and a piece of thread are the only requisites, excepting the support for the mirror—which in the present case consists of a pile of books—and a little paper funnel inserted in the end of a rubber tube and forming the mouthpiece.

The thread is tied around opposite ends of the oblong mirror, and the mirror supported by passing the thread through the upper book of the pile, which juts over to allow the mirror to swing freely without touching the books. The mirror is made to vibrate in a horizontal plane by giving it a twisting motion. One end of the rubber tube is placed very near the base of the candle flame, and the other end, which is provided with the paper mouthpiece, is placed before the mouth and a sound is uttered which causes the air contained by the rubber tube to vibrate and impart its motion to the candle flame. The vibratory character of the flame is not noticeable by direct observation, but on viewing the flame in the swinging mirror, separate images of the flame will be seen. These images are combined in a series which, with a certain degree of accuracy, represent the sound waves by which the fluctuations of the flame are produced.

To show that these images result from a vibrating flame, it is only necessary to view the flame in the mirror. When no sound is made in the mouthpiece, only a plain band of light will be seen.

A somewhat more convenient arrangement of mirrors is shown in Fig. 2. In a baseboard is inserted a wire, ⅛in. or more in diameter and about 1ft. long. On this wire is placed an ordinary spool, and above the spool a thin, apertured board (shown in the detailed view), the board being about 8in. long and 6in. wide. The board is perforated edgewise to receive the wire. In the upper edge of the board, half-way between the centre and end, is inserted wire, upon which is placed a small spool, serving as a crank by which to turn the board. Upon opposite sides of the board are placed mirrors of a size corresponding to that of the board, the mirrors being secured to the board by strips of paper or cloth pasted around the edges. The image of the flame is viewed in the mirrors as they are revolved.

In Figs. 3 and 4 is illustrated an adjustable lens for showing the refraction of sound. The frame of the lens consists of three 12in. rings of large wire, soldered together so as to form a single wide ring with two circumferential grooves. In the central part of the ring, at the bottom, is inserted a standard, and in the top is inserted a short metal tube. Over the edges of the ring are stretched discs of the thinnest elastic rubber, which are secured by a stout thread wound around the edges of the rubber, clamping them in the grooves of the ring.

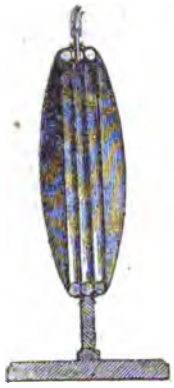

Fig. 4.—Section of Sound Lens.

By inflating the lens through the tube with carbonic acid gas, it may be focused as desired. A watch placed at the focus upon one side of the lens can be distinctly heard at the focal point on the opposite side of the lens, when it can be heard only faintly, or not at all, at points only slightly removed from the focus, thus showing that the sound of the ticking of the watch has been refracted by the lens, in much the same manner as light is refracted by a glass lens.

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* By Geo. M. Hopkins, in the *Scientific American.*

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday evening, the 17th inst., at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., president, in the chair.

Mr. R. C. Mossman and Mr. E. H. Ryan-Tenison, M.R.C.S., were elected Fellows of the Society.

The following papers were read:—

1. "On the Deaths caused by Lightning in England and Wales from 1852 to 1880, as Recorded in the Returns of the Registrar-General," by Inspector-General R. Lawson, LL.D. The total number of deaths from lightning during the 29 years amounted to 546, of which 442 were of males, and 104 of females. In consequence of their greater exposure, the inhabitants of rural districts suffer more from lightning than those of towns. It appears also that vicinity to the west and south coasts reduces the chances of injury by lightning, and that distance from the coast and high land seems to increase them.

2. "The Diurnal Range of the Barometer in Great Britain and Ireland," by Mr. F. C. Bayard, F.R.Met.Soc. The author has reduced the hourly records of the barometer at the nine observatories, Aberdeen, Armagh, Bidston, Falmouth, Glasgow, Greenwich, Kew, Stonyhurst, and Valencia, during the years 1876-1880. The curves of inland places are smoother than those of places on the sea-coast, and the curves of places to the westward are more irregular than those of places to the eastward. As we go from south to north, the general tendency of the curve is to get flatter with a lessened diurnal range.

3. "Note on a Working Model of the Gulf Stream," by Mr. A. W. Clayden," M.A., F.R.Met.Soc. The author showed this interesting model at work; it has been constructed to illustrate the formation of ocean currents in general, and of the Gulf Stream in particular.

4. "On the Rime-frost of January 6th and 7th, 1889," by Mr. C. B. Plowright, F.L.S. The author gives an account of the very heavy rime which occurred in the neighbourhood of King's Lynn on these days, when the fringe of crystals upon twigs and branches of trees was about 2in. in length. The weight was so great that nearly all the telegraph wires were snapped, and an immense number of branches of trees broken off.

ROYAL ASTRONOMICAL SOCIETY.

THE usual monthly meeting was held on the 12th inst., Mr. W. H. M. Christie, Astronomer Royal, President, in the chair.

Mr. Knobel read a paper, by Mr. S. W. Burnham, on the "Trapezium in Orion," in which he stated that after carefully examining the trapezium with the great Lick telescope, only one new star had been found in addition to the small double discovered by Alvan Clark. He compared the measures of position of the various stars with earlier measures made by Struve and others, and came to the conclusion that there is no evidence which tends to show that there has been any observable change of position, or that any of the stars are variable in brightness.

Capt. Noble said: It may appear rather presumptuous on my part to differ from so very experienced an observer as Mr. Burnham, but I do very decidedly as to the variability of the 5th and 6th stars in the trapezium. I wrote a paper on this subject some years ago for the now defunct *Astronomical Register*, in which I gave the results of observations with the small aperture of $4\frac{3}{16}$in., which I constantly use. For several successive years I failed to see the 6th star altogether, while I could see the 5th star fairly easily. Then for a little while the 6th was the plainer of the two. After that again I lost the 6th, and then the 5th became so faint that it was only knowing where it was that enabled me to see it. I think that possibly observing with a small aperture with which these stars are only just seen—or with which they are on the limit of vision—I have better opportunities of judging as to their variability than Mr. Burnham has.

Mr. Ingall said: It seems to me that the atmosphere has a great deal to do with their visibility. Sometimes I have seen the 5th star in brilliant moonlight. In 1870 I saw the star which has been mentioned as having been discovered at the Lick Observatory, and showed it to a friend. It must then have been very much brighter than it is now.

Mr. G. F. Chambers said: I should like to confirm Captain Noble's remarks with regard to the variability of the 5th and 6th stars. It seems to me that there is a greater difficulty in seeing them now than there was four or five years ago.

Mr. F. C. Penrose: Five or six years ago I used to see both the 5th and the 6th stars pretty easily on favourable nights; but on such opportunities as I have recently enjoyed, I have had great difficulty in seeing the 5th, and I have not been able to see the 6th star at all.

Capt. Noble: It seems to me that there has been something more than a mere difficulty of seeing both the stars, for that might depend on the observer or on the night; but there have been periods when the 5th was more easily seen than the 6th, and other periods when the 6th was most easily seen of the two.

Mr. Isaac Roberts read a paper on "Photographs of the Nebulæ Messier 81 and 82, and of the Nebulous Star in Ursa Major," taken by him at Moghull, near Liverpool. Enlarged paper copies of the photographs were handed round to the meeting. These photographs were taken by Mr. Roberts on the 31st of March last with an exposure of 3½ hours. The larger nebula, 81 Messier, was shown on two scales—one an enlargement of 5 diameters and one an enlargement of 15 diameters. It is most decidedly spiral in character, with a bright central nucleus, and faint rings or spiral streams of light stretching away in a north-preceding and south-following direction. Along these streams are very numerous stars or star-like points of light, evidently following the curves of nebulous matter. Messier 82 was described by Sir John Herschel as a beautiful ray, "very bright, very large, and very much extended." The Earl of Rosse describes it as an extraordinary object, at least ten minutes in length, crossed by several dark bands. Mr. Roberts interprets the photographs he has taken as proving it to be a spiral nebula seen in projection, and that each of the nuclei correspond to the sections of nebulous rings. The nebulous star in the same neighbourhood, which he had also photographed, he considers to be the bright central position of another spiral nebula, in which the rings are so faint that they are lost to sight.

Mr. Knobel said that he had made drawings of 81 Messier some 15 years ago, which showed its spiral character. He was so much struck with this nebula that he had begged Prof. Holden to give special attention to it with the Washington 26in. reflector.

Mr. Ranyard: This spiral nebula evidently seems to be similar in character to the great Andromeda nebula; but, with the exception of these two nebulæ, I am very much struck with the great dissimilarity of the structure shown by the different great nebulæ in the heavens. Mr. Isaac Roberts has kindly lent me during the last week or two his original negatives of the great nebula in Orion, and I have spent some most interesting hours in examining them. I am struck with the extraordinary difference between the detail shown in these negatives and in the negatives of the nebula in the Pleiades or in the Andromeda nebula. Much of the structure visible in the Orion nebula reminds me of the nebulous structures traceable in the corona of 1871, and in coronas generally. There is a great tree-like mass, which reminds one of a solar prominence, except that it must be on such an enormous scale. It is shown in Mr. Common's pictures as well as in Mr. Roberts's. It is close to the great curved structure which was called the great sword by Secchi, and close to it; branching out of the sword-like structure are two smaller tree-like structures, clearly shown in Mr. Robert's negatives, and above that is a great branching structure curving in the same direction as Secchi's sword, which is very similar in character to a nebulous branching structure in the 1871 corona. Another very curious fact is that if one draws a line through the middle of the nebula, passing through the neighbourhood of the Trapezium, all the great branching structures of the nebula seem to curve towards this line. They seem to constitute what in a corona would be called a synclinal group. One can hardly doubt that these structures all had their origin somewhere in the neighbourhood of the trapezium. They are all brighter at their base, which is turned in this direction, and they all fade away as they curve away from this region.

Mr. Knobel read a paper, by Prof. Holden, on "Photographs of the Corona," taken during the Solar Eclipse of Jan. 1, 1889. The paper was accompanied by a large drawing, which showed remarkably broad polar rifts filled with narrow structures curving away from the sun's axis of rotation. On either side above and below the equatorial regions are synclinal groups of coronal rays curving towards axes passing through the sun's centre and inclined at angles of from 30° to 40° to the solar equator.

Mr. Westley drew on the blackboard a large diagram of the coronas of 1878 and 1889, and pointed out the contrary flexure of the rays at the edges of the synclinal groups, which he said was a constant feature of coronal rays, indicating the action of forces drifting the rays in different directions at different altitudes.

The following papers were presented, and taken as read:—

Mr. H. Finlay, "On an Error in Brünnow's Formulæ for Differential Refraction in Distance and Position Angle"; J. G. Plummer, "Observations of Comets made at the Orwell Park Observatory in the years 1888-89"; A. M. W. Downing, "Probable Errors of Greenwich Determinations of Right Ascension at Different Zenith Distances"; J. E. Gore, "On the Proper Motion of 85 Pegasi"; Rev. T. E. Espin, "A Catalogue of the Stars of the IV. Type"; R. T. A. Innes, "Note on an Error in Le Verrier's 'Tables du Soleil'"; E. Crossley, "On a Method of Supporting a Large Mirror when Silvering."

USEFUL AND SCIENTIFIC NOTES.

The Value of Symbols.—An unexpected misunderstanding between the prescriber and the dispenser was recently brought to the notice of the General Medical Council by the Midland Counties Chemists' Association. One of the members of this association endeavoured to ascertain the opinion of local medical practitioners as to the meaning of the sign "Oss," and he found that out of twenty-eight replies from physicians and surgeons, twelve used this sign when they intended *eight* ounces to be dispensed, and sixteen employed it correctly for *ten* ounces. It is difficult to account for this lack of unanimity, or to see why the General Medical Council should be appealed to in order to solve a question they have already decided in the British Pharmacopœia. Another instance of ambiguity was lately the subject of inquiry—viz., the drug intended when "Aq. Menthæ" appeared in a prescription, leaving it an open question whether mentha viridis or mentha piperita should be employed. In this case, however, the practical results were not likely to prove as important as in the former, when the degree of dilution might lead to confusion, or at least to disappointment.—*Lancet.*

Black Snow.—At Aitken, Minn., on April 2, at 4.45 o'clock, it became so dark that lights were necessary in business houses, and the air was filled with snow that was as black and dirty as though it had been trampled into the earth. Six ounces of snow and ¼oz. of dirt and sand were found in the bottom of a dish. The dirt is very fine, something like emery, and contains particles that have a metallic lustre. This dirty snow fell to the depth of half an inch. The atmosphere at the time presented a peculiar greenish tinge. There was a little wind blowing at the time from the north-west, though there seemed to be considerable wind higher in the air. Solid chunks of ice and sand are reported to have been picked up in various places.

Tea cigarettes are said to be coming into fashion for feminine smoking in England. Only the choicest kinds of tea are used; and, though the fumes are not pleasant to the general public, the smokers find their nerves greatly soothed for a time. Afterwards, however, the inevitable reaction takes place, and they are apt to become somewhat excited.

The new Inman and International steamer *City of Paris* promises to be a great success. It is stated that she made the run from Liverpool to Queenstown in 11 hours 50 minutes, or at the rate of 20·3 knots the whole way. The actual time over was 6 days 19 hours. She encountered strong north-west gales the first three days out.

SCIENTIFIC NEWS.

The report of the Board of Visitors to the Melbourne Observatory shows that much good work is being done by the staff under the directorship of Mr. Ellery, and it is notable that the arrangements for the photographic survey of the heavens are so far advanced that Melbourne will probably be ready to start before any other of the associated observatories. Rather than run the risk of sending the mirror of the great reflector to this country, it has been determined to repolish it at home, and very wisely a number of experiments on smaller mirrors have been carried out by way of practice.

Elements and an ephemeris of Barnard's comet of March 31 have been computed by Herr von Hepperger, of Vienna. He gives the perihelion as T 1889, July 27·4812 Berlin M.T., and the position for April 30 Berlin midnight R.A. 5h. 7m. 4s., N. Dec. 15° 7·5'. The brightness ·90 as compared with unity at time of discovery. It is now near 15 Orionis.

Students of science will be sorry to hear of the death of Mr. Warren de la Rue, for he was one of themselves, and spent his money freely in the pursuit of knowledge. Mr. De la Rue was born in Guernsey, and was educated at the College of St. Barbe, Paris. For many years he was senior partner in the well-known firm, but retired in 1886. A man of great scientific attainments, his chief work was in connection with the application of photography to the recording of celestial phenomena. In 1860 he went to Spain with the "Himalaya Expedition," and was successful in obtaining a series of photographs of the total eclipse of the sun on July 18. The results formed the subject of the Bakerian lecture, delivered to the Royal Society in April, 1862. In conjunction with Prof. Balfour Stewart and Mr. B. Loewy he published "Researches in Solar Physics," founded on observations made at the Kew Observatory under his directions. He also took an active part in making the preparations for the photographic observation of the transit of Venus in 1874. He established a private observatory at Cranford, Middlesex, but it was dismantled in 1873, and the instruments presented to the University of Oxford, where they have been employed lately most successfully by Prof. Pritchard in determining by means of photography the distance of 61 Cygni and other fixed stars. In 1874 he fitted up a private physical laboratory, where, employing a battery of 15,000 chloride-of-silver cells, he, in conjunction with his friend, Dr. Hugo Müller, carried on an elaborate series of researches on the electrical discharge. The results have been from time to time communicated to the Royal Society and the Académie des Sciences, Paris. "The Phenomena of the Electric Discharge" were also made the subject of a most interesting lecture, illustrated by a great number of experiments, at the Royal Institution, in 1881 Nearly all the results of Mr. De la Rue's scientific work have been embodied in papers and memoirs, which will be found in the "Transactions" of the Royal Astronomical, Chemical, and other learned societies. He was a member of the International Electrical Congress, and of the jury of the Electrical Exhibition held there in 1881. He was also a member of the Consulting Council of the Electrical Exhibition held at the Crystal Palace, Sydenham, in 1882. He acted for some time as honorary secretary of the Royal Astronomical Society, of which he was also president from 1864 to 1866. He was president of the Chemical Society from 1867 to 1869, and again from 1879 to 1888. Mr. De la Rue was a corresponding member of the French Académie des Sciences for the Department of Astronomy; also of the Imperial Academy of Sciences, St. Petersburg, and of various other foreign societies. Three foreign orders were conferred upon him:—Commander of the Legion of Honour, Commander of the Order of St. Maurice and Lazare, and Knight of the Order of the Rose, Brazil. He had reached his 74th year.

The death is announced of M. V. A. Malte-Brun, secretary of the Geographical Society of Paris.

Prof. Paul Dubois-Reymond, brother of the distinguished physicist and himself a capable mathematician, is also dead.

At the annual dinner of the Institution of Civil Engineers the president, Sir G. B. Bruce, in acknowledging the toast of the evening, said it was well for engineers to look back on what had been accomplished, not, of course, by way of ministering to a self-satisfied complacency, but in order to inspire courage in seeking after what had not yet been attained. They would, indeed, be ungrateful if they did not look back thankfully; but it was better to be looking forward hopefully, and it was not necessary to be a prophet, or the son of a prophet, to forecast the strong probability that changes as vast as those their day had seen in the application of the powers of nature to the service and use of man, would be wrought out in the by no means distant future. They could but hope that this Institution would ever retain its place in the front rank of all such progress, the place which was won for it by the Telfords, the Stephensons, the Brunels, and the Siemens, who were gone, which progress had for its aim the lessening of human toil and the increase of human happiness.

The Turners' Company's Exhibition will be held this year in October at the Mansion House, the competition being in hand-turning of glass, wood, and metal, with a special section for amateur turning. Particulars can be obtained from Mr. Edgar Sydney, 4, Hare-court, Temple, and the prizes (for workmen) include the freedom of the Company and sundry medals and sums of money. Every turner should endeavour to compete in some way, as the company does what it can to encourage the art of turning, and the larger the number of competitors, the better the Company will be pleased.

The general meeting of the Institution of Mechanical Engineers will be held from May 1 to May 3, at the rooms of the Institution of Civil Engineers. The president, Mr. Chas. Cochrane, will deliver his address on Wednesday evening, May 1. Amongst the papers to be read and discussed is a report upon trials with the steamship *Meteor*, by Prof. A. B. W. Kennedy, representing the "Research Committee on Marine Engine Trials," and a "Description of an Apparatus for Drying in a Vacuum," by Mr. Emil Passburg, of Breslau.

Prof. Wilhelm Bunsen has resigned the chair of Chemistry at Heidelberg, which he has held since 1852. He began his career as a university teacher at Göttingen in 1833, and lectured successively at Kassel, Marburg, and Breslau. Prof. Bunsen is in his 78th year.

A curious method of testing the freshness of eggs is mentioned by Dr. D. G. Evans. He has observed that when a perfectly fresh egg is placed to the ear and violently agitated no sound is noted; but if the egg is stale a knocking sound is heard, as if the contents were not sufficient to fill the shell. The staler the egg the greater is the oscillation and the sound generated. Dr. Evans says the test is an infallible one.

The Italian papers report that an electric theodolite, which indicates with mathematical precision the position of an enemy's ship, whether at anchor or in movement, has been set up at Maddalena. The battery, which defends the island of Caprera, is situated in a valley separated from the sea by a high hill. On this is placed electric machinery communicating with the battery. There is also a very small "panorama" indicating the position of hostile ships, their direction, their distance from the battery, and the point to which the firing should be directed. The gunners do not see the enemy, but aim high, the balls passing over the hill. On the other hand, the enemy, having no means of ascertaining the situation of the hidden battery, cannot return the fire. The inventor of the machines is one of the heads in the engineers' department of the army, and has gone to Maddalena to direct the installation of the machinery.

An improved headlight for locomotives, recently brought out in America, has an adjustment which allows the engineer to conveniently direct the light, as he may desire, to various points off the line. The lantern is supported on a frame or platform, which has a movement to right or left about a vertical axis, and also up and down by the same means, the operating mechanism leading back to the cab, so as to be within ready reach of the engineer. He is enabled by this arrangement to examine dangerous or doubtful parts of the road, and in stormy weather to turn the light upon threatening trees or masses of earth or rock upon either side which are liable to fall. The device also permits of the lantern being turned so as to throw the light across sharp corners, and exhibit the line of track at some distance ahead of the train, and at points which would be entirely out of reach of the light in its usual fixed position. The question is, though, will the "engineer" so use his light?

A method of preventing rifle barrels becoming crooked while firing has been devised by Mr. H. S. Maxim. The gun barrel, having been finished in the ordinary manner, is mounted in a lathe so that both its external and internal surfaces are true. A current of carburetted hydrogen gas is then passed through the bore, and at the same time a series of gas jets are applied to the external surface of the barrel. As the barrel becomes heated it runs out of truth, and this is corrected from time to time by straightening it by means of levers or mallets, or otherwise, while it is in the lathe and while hot. The barrel thus treated is not liable to become crooked while firing. The current of gas passing through the bore prevents damage to the gun by oxidation during the straightening operation.

On the Brooklyn Elevated Railroad experiments are being made with petroleum as fuel for the engines. Experiments have been made on the New York elevated roads, but without good results, owing partly to the difficulty in making the experiments on roads with such constant traffic.

Most medical men would recommend elevated regions as the best spots for asthmatical and consumptive patients to reside in; but Dr. Lindsey, an American physician, says that regions below the sea-level are best, because of the higher atmospheric pressure. Excellent effects have, it seems, been obtained in the valley of Conchilla, near Los Angeles in California, about 273ft. under the sea (barometric pressure only about 7mm. higher). The most noteworthy place of the kind on the earth's surface is probably the Dead Sea district (– 1,289ft.), and the following are some others:—Lake Asal in East Africa 639ft.), the oasis of Araj in the desert of Libya (– 270ft.), the Arroyo del Muerto in California (– 230ft.), and the oasis of Siwah in Libya (– 123ft.), the borders of the Caspian (– 86ft.).

Mr. Eadweard Muybridge, of Pennsylvania, is announced to deliver two lectures on the "Science of Animal Locomotion" at the Royal Institution on May 2 and 9. The lectures will have special reference to design in art, and will be illustrated by the zoopraxiscope.

The Society of Apothecaries announce that a course of twelve lectures on Botany will be delivered by Mr. T. G. Baker, F.R S., at their garden, Chelsea, on Saturdays during May, June, and July, at 3 p.m. The lectures are open to all medical students and other gentlemen who may wish to attend. Tickets of admission can be obtained of the Bedell of the Society.

A congress of physiologists is to be held at Basle in September next, beginning on the 10th, with the object of promoting the study of physiology. Particulars can be obtained from Prof. G. F. Yeo, King's College, London.

At a recent meeting of the Physical Society, a paper "On Quartz as an Insulator," was read by Mr. C. V. Boys, F.R.S. In making quartz fibres the author observed that the ends of fibres broken during the shooting process coiled up into screws, and projected themselves against anything brought in their vicinity. After a short time they released themselves and sprang back to their original position. This could be repeated indefinitely, and the only explanation he could think of was that the fibres were electrified. If so, then to exhibit such phenomena the insulating qualities of quartz must be very great, and experiments were shown to demonstrate this deduction. A small pair of charged gold leaves were suspended from a short quartz rod in a moistened atmosphere, and the deflection fell ¼ the original amount in about five hours. A clean glass rod under the same condition would discharge the leaves in a few seconds. Dipping the quartz into water did not seem to diminish its insulating properties, and ordinary chemicals produce no permanent prejudicial effect. The author considers that quartz will be very useful in electrostatic apparatus, for the troublesome sulphuric acid may be dispensed with.

The first five-masted ship is about to be constructed on the Clyde to the order of a French firm. It will be of steel, and have a capacity of 6,000 tons dead weight.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

◆

THE NEW WOLSINGHAM OBSERVATORY—A LITTLE POPULAR ASTRONOMY.

[29859.]—As many of your readers may be aware, our 17¼in. reflector has lately been dismounted and re-erected at Towlaw Gulf, 1,000ft. above the sea, and a fine dome 20ft. in diameter has been built to receive it. The dome is the work of Landreth Brothers, of Wolsingham, and consists of a framework of wood covered with zinc. The walls are 4ft. 8in. high and are of wood, and the height of the dome is 14ft. There are three shutters, each 4ft. 6in. wide, running on iron grooves, and fitted with friction rollers. The dome rotates by rackwork, and is carried on eight large wheels and eight small rollers. The shape of the dome is a true circle, the shutters also being made of circular shape. The observatory was first erected in an open space, and was so made that the dome came into two parts and the walls into three parts. It seemed very important that no break should take place in the observatory work; consequently a large number of hands were employed in taking the 17¼ down and re-erecting it. Although the instrument weighs nearly two tons, so expeditiously was this managed that on the first day the telescope was taken down and packed, on the second it was transported up tremendous banks, and the third it was erected in its new position. The removal of the observatory and of the telescope was accomplished without any accident.

As may have been anticipated, conjecture was rife to an alarming extent during the construction of the observatory. As the whole of the construction of the observatory was carried on close to the main road, and right in the centre of the little market town of Wolsingham, it was the "cynosure of neighbouring eyes" with a vengeance. Work, too, was much impeded by the laudable desire for enlightenment. At first, when the round walls were put up it was believed to be a new gasometer of a patent kind, after that a "sea-on-land" and a "merry-go-round" formed the general belief. One aged inhabitant of Weardale refused to be convinced that it was not a new kind of balloon. But the best conversation about it was overheard in the primitive Weardale coach, which runs from Stanhope to Wearhead. One man was overheard to ask another if he knew what "that thing was that Mr. Espin was putting up at Wolsingham," and the reply was, "Why, man, it's a conservatory; Mr. Espin is an astronomist, and that's what he looks at the stars with." When the first cartload of the dome arrived at Tow Law it was followed by a large and anxious crowd of young people, who refused to be convinced that it was not a travelling circus. Then when it was put up it was generally taken for a hay-shed. Since that time the minds of my good neighbours have become reconciled to it, though still its curious habit of turning round and presenting its shutters or its glass window first on one side and then on another, are a cause of distraction. Apropos of the window, which is in the dome on the opposite side to the shutters, I did hear that a difference of opinion had arisen between two fellows. One maintained that as he passed along the road he had seen a glass window. The other who passed on the same day maintained there was none. As it happened, the first passed in the morning, and the night before work had closed with the shutters facing north; the other passed in the afternoon when the dome had been rotated to observe Venus in the south. It was said that from words they nearly came to blows!

I remember some years ago, when I was observing with the 7ft. refractor through a window, overhearing two boys arguing one with the other. Says one, "I say, there's Mr. Espin's microscope." Says the second, "No; it's his telescope," whereupon the first answered with emphasis, "I tell yer it's his microscope that he looks at the stars with."

A friend of mine has an observatory which he sunk in the ground so that the dome only comes about 2ft. above the ground at its lowest part. My friend has also a fine cow. One night he had a light in his observatory, and was anxiously watching an occultation of a star by the moon when suddenly the moon itself was occulted, and, looking upwards he perceived the cow looking down the object-glass end of the telescope.

T. E. Espin.

Tow Law, Darlington, April 20th.

VENUS IN INFERIOR CONJUNCTION.

[29860.]—This being a specially favourable opportunity to observe Venus in inferior conjunction, it is to be hoped observers will be on the alert. The following little table may be of assistance to amateurs who have only telescopes with altazimuth mountings:—

		Min.	°	′
April	26....+	21·1....+	7	43·0
,,	27....+	15·2....+	7	4·1
,,	28....+	9·3....+	6	24·5
,,	29....+	3·2....+	5	44·3
,,	30....–	3·1....+	5	3·5

It gives the number of minutes which elapse between the transit over the meridian of the sun and Venus, and the number of degrees by which Venus is higher. On the last date Venus transits before the sun.

As an example, let us suppose the observer wishes to look at Venus on the 29th April. At about 12 o'clock he will point his telescope at the sun, and then raise it in altitude 5¾°; in three minutes Venus will come into the centre of the field of view. Of course, the observer will use his lowest power, and the telescope must be accurately focussed beforehand. Venus will be 58″ in diameter, or one-third larger than Jupiter in opposition; but the crescent will be very narrow indeed, and an exquisite sight if the air is still.

The best time to point the telescope at the sun will be 11.57; but five minutes either way will not make much difference.

Tria.

SATURN.

[29861.]—Since my last letter, which arrived probably too late for acknowledgment, I have seen Major Watson's remarks (29835). To guard against misapprehension, I should like to say that the power I find most useful with Saturn is 275; on good nights I can use 325, and on rare occasions 425 brings out well certain features of the planet. On March 3rd, perhaps the finest night for definition I have ever seen here, the division in Ring A, which had been previously detected with the lower power, came out clearly with 425. The mirror I used on that occasion is described by Mr. With as "absolute perfection." The air of this neighbourhood is well-known for its clearness, and the position of this place is elevated above the surrounding country. It should therefore afford good opportunity for seeing what is to be seen.

P. H. Kempthorne.

Wellington College, April 20.

[29862.]—Dans mon dessin de Saturne, reproduit dans "l'E. M.," p. 153, if faut faire les corrections suivantes:—

1. Le globe doit être ombré dans toute la région qui est au dessus de la bande sombre principale.

2. L'ombre qui est au bord nord du globe doit se terminer par une ligne droite parallele au bord de l'anneau à peu près; cette ombre occupe donc un segment géométrique du cercle qui représente le globe.

3. La tache blanche *a* doit être contre l'ombre du globe et s'étendre jusqu'au bord interne de l'anneau B.

4. La division Cassinienne doit être plus noire.

5. La bande d'Encke doit être plus marquée du côté occidental.

6. L'anneau B doit être légèrement ombré à son bord interne.

7. La bande de Struve ne doit pas occuper tout le pourtour de C; à droite elle le montrait seulement à l'extrémité orientale de l'ellipse formée par l'anneau C; à gauche elle emergeait de derrière le globe et s'arrêtait à la pointe occidentale de la lunule.

Louvain, 21 Avril. **Dr. Terby.**

[29863.]—In answer to Mr. Hallowes' question (29182), I beg to say that I had no opportunity of looking at Saturn between Jan. 20 and Feb. 7; but on the latter date I have a note that the shadow was discernible on either side of the ball. I have only seen the division in the outer ring three times this year—March 3rd, March 15th, and March 27th; but the "anneau brillant" has been visible to me in both ansæ whenever definition was good.

P. H. Kempthorne.

Wellington College, April 15.

THE WHITE SPOT ON SATURN'S RINGS.

[29864.]—It may interest many readers of the "E. M." to know that Dr. Terby's "white spot" on the rings of Saturn is now an easy object for telescopes of moderate size. Since the 18th inst. the spot has every evening been a prominent object with my 6in. refractor, and last evening I tested its visibility with reduced apertures with the following results:—With the aperture reduced to 4in. the spot was beautifully seen; with 3½in. it was also well seen, and its lenticular shape could be just made out; with 3in. it was clearly visible, but its shape was not defined; while with 2½in. a bright spot could still be seen on careful examination, although it would probably have escaped notice had not the eye been trained to its appearance by the use of gradually diminished apertures. The power used in all the experiments with reduced apertures was 160.

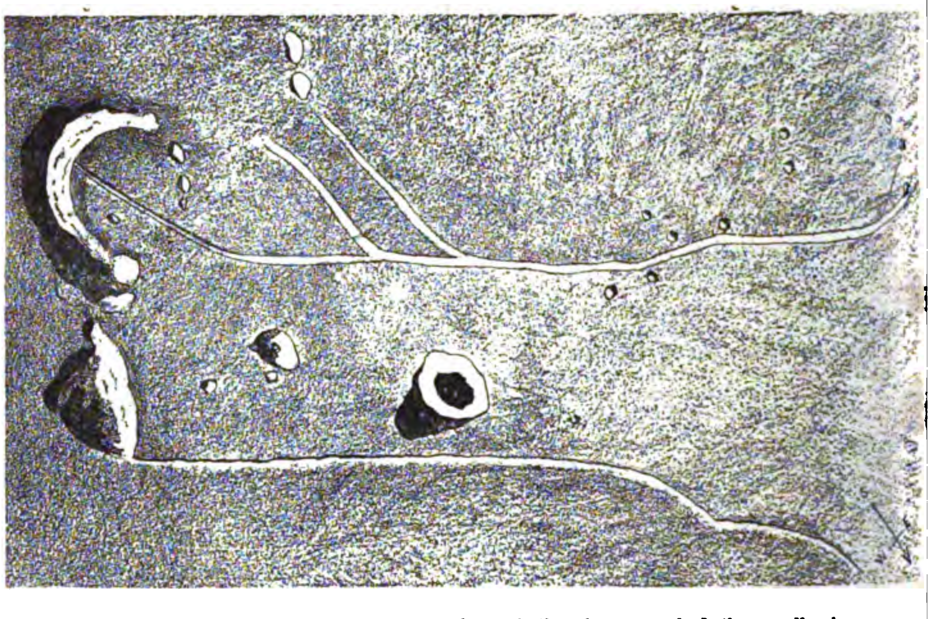
Kensington, April 23. **W. H. Maw.**

[29865.]—The white spot first noticed by Dr. Terby was seen here with the 10in. dialyte on two evenings, April 20 and 21. It appeared close to the black shadow of the ball, and at first sight gave me the impression that it was the effect of contrast between the brilliant rings and the exceedingly black shadow; but with higher powers, 320 and 600, and at periods of steadier definition, seemed to be like a little round brilliant spot on Ring B. On both nights it occupied the same position in the ring. Its minute study was difficult, owing to the exceedingly bad definition of the planet here. I certainly have never noted anything like it before, although I have frequently studied the edge of the shadow, to which its proximity still gives a suspicion of its being an optical illusion.

Champion Hill, April 22. **Herbert Ingall.**

[We have also an interesting letter from Mr. Elger, which we have to keep back a week, as there is not time to engrave a block for this number. —Ed.]

THE REGION NEAR CAUCHY.



[29866.]—As two drawings of Cauchy and its neighbourhood under morning illumination have recently appeared in the "E. M.," a sketch of the same region, made under a setting sun, between 12 and 13 hours, on the 26th August, 1888, may be of interest. The cleft η was very distinct, and was traced in a south-westerly direction up to the N. extremity of a range of hills. The object δ, which Mr. Gaudibert describes as a ridge, and which is shown as such in Schmidt's map, appeared for the greater portion of its length as a white streak, free from any shadow. Near its S.W. end, however, it makes a rather sudden bend, and seems to develop into a true though rather difficult cleft, which runs up to the base of what is either a curved mountain or broken-down crater. Two branches running S. from δ, which are shown in the drawings of Messrs. Gaudibert and Davis, were also visible as bright streaks without shadow. The surface of the surrounding *mare* is dotted with crater-pits.

The instrument used in making these observations was an 8½in. reflector, with powers of 225, 330.

It is possible that the object δ is a fault, similar to the "straight wall" near Thebit, or that between Diophantus and Delisle. If so, it would, of course, owing to its position, cast a well-defined shadow under morning illumination, and appear as a bright line without shadow under evening illumination. An observation made when this object is on the evening terminator would probably throw some light as to its nature.

Didsbury. **Geo. P. B. Hallowes.**

COPERNICUS AND LOCKYER'S "PRIMER."

[29867.]—The drawing in Lockyer's "Primer" is a copy of the one made by Jas. Nasmyth, and I have always understood that it was a photograph of a model (in the first instance), and not a drawing at the telescope, though the model itself must have been made from a study of careful drawings. If I am right in so saying, it does not represent Copernicus as actually seen at any given date, which is not the case in a drawing at the telescope.

In Vol. I. of the *Observatory* there is a beautiful drawing of this grand formation by John Brett, which I think would satisfy "Veretatem Teneo."

In the *Astronomical Register* for 1875 your correspondent will find a very fair critique of Lockyer's "Primer," which points out its merits and defects, though I cannot say whether or not these latter have been avoided in later editions.

E. D.

REFLECTING TELESCOPE—CAUCHY.

[29868.]—Thanks to Mr. Linscott for his reply to my suggestion for a reflecting telescope.

Would he kindly inform me whether the rays become chromatic before emerging from the prism?

I was glad to see our old contributor, M. Gaudibert, follow my sketch with one of his. The ridge S. of Cauchy, according to my sketch, certainly seems more like a fault—like the wall near Thebit —than a rill. I supposed its N. edge to be at a higher level than the southern.

Reading. **G. T. Davis.**

15in. CASSEGRAIN—THE FRACTIONS ENGRAVED ON SHORT'S TELESCOPES.

[29869.]—I am much obliged for Mr. Linscott's reply respecting refractor with inclined plane mirror in its axis. I knew the principle had been applied to reflectors, but not to refractors.

Will Mr. Linscott say to what curve he refigured the 15in. Cassegrain mirror, and how he tested it; also, whether he re-worked the small mirror or not? If he would also kindly give the result of testing on stars it would be very interesting, as so many contradictory statements have been made about Cassegrains.

Tulley's Cassegrain of this same diameter "bore 200 to 250 at most on the planets"—*vide* Kitchiner. On my own Short's Gregorian the fraction engraved is $\frac{228}{1263} = 18$; and if two "noughts" be added to the numerator the fraction is nearly true, and gives *the focal length of great mirror*. This may help the correspondent who inquired recently.

A. S. L.

CELESTIAL CHEMISTRY—EARLIEST AND LATEST.

[29870.]—Of the "crazy nonsense" that your "F.R.A.S." ascribed to Newton, p. 70, it seems he cannot now quote us one word! At least, he lets it alone in his letter, p. 153, to wander into "celestial chemistry," of which he assures us (and I quite agree with him) Halley knew nothing; but which he considers now so exhaustively known that, of the bodies in universal space capable of visiting our system as comets, more numerous, as Kepler said, than fishes in the sea—yea, than fishes in as many seas as the galaxy (formerly called uncounted and innumerable) contains suns—but every single unit of whose billions has now been "spectroscopically examined," as well as of all other galaxies, not one containing water, or its vapour, "does exist, or ever can or will exist."

Well, then, taking our anti-Newtonian's word for this inconceivably vast piece of omniscience, which I will not presume to question or doubt, let us compare it with a bit of professedly revealed "celestial chemistry." Some readers may not be aware that celestial chemistry was ever touched by the prophets. However, the Old Testament and the New each make one statement thereon—the former a negation, and the latter an affirmation. Genesis records the former as a divine oracle in Chap. ix. vv. 11-17. If "there shall no more be a flood to destroy the earth," and "neither shall all flesh be cut off any more by the waters of a flood," this is plainly declaring the next comet, or (as Halley said) "other transient body" that our earth will encounter is not watery. A very infinitesimal bit of celestial chemistry this, compared to our anti-Newtonian's information about the (commonly called numberless) bodies of universal space; but still, you see, the two agree, as far as the poor old oracle creeps. If no such "transient body" with aqueous vapour "does exist, or ever can or wili exist," then plainly the next that our globe enters will contain none, so that Moses and "F.R.A.S." are here agreed.

The other bit of revealed celestial chemistry—St. Peter's affirmative bit—still more startlingly corresponds with the spectroscopic examinations.

Those examinations, indeed, have been far short of what they ought to have been. Nobody seems to have yet caught with his spectroscope a star at the minute it shone through a cometic atmosphere, so as to find what rays the cometic gas absorbed, for which there have been scores of opportunities. But if, as we are told, the gas has always seemed a hydrocarbon, or non-oxygenous and inflammable, then plainly Peter's words (2 Pet. iii. 7), that this terraqueous world, since Noah's time, is "kept in store reserved unto fire," exactly describe the fact. Whenever our globe plunges into one of these, her present "heavens that are now," or oxygenous atmosphere, "being on fire shall be dissolved," as he adds (iii. 12), and must "pass away with a great noise" (iii. 10), their element melting "with fervent heat," sufficient to fuse the whole surface of the lands, so that "the earth also and the works that are therein shall be burned up." No coincidence can be conceived more exact grammatically and as to physical statement, than this between his words and the results of spectroscopic analysis.

I must still beg our "F.R.A.S.," however, for a specimen of Newton's "crazy nonsense."

E. L. G.

THE HAYDON CUTTER-BAR.

[29871.]—As many of your readers know by experience, this bar is an extremely useful tool in the hands of those who treat it properly; but to get good results from it it must be properly ground. It will not suffice for the cutting edges to be sharp, —they must also be ground to the proper angle. In order to do this the grindstone must be in good order, and running quite true.

How is it that so many amateurs, instead of regarding the grindstone as almost the most important tool in the shop, treat it as a necessary nuisance, and let it get into such a bad state that it is impossible to grind any tool well upon it? When properly ground, then, I have found the Haydon bar to be a most useful tool, and a slide-rest that allows it to chatter is only fit for the old-iron heap.

But no tool is perfect, and its overhang is against it, not on account of weakness, but because sometimes, in turning work as large as the lathe will take in, it is difficult to get the cutting edge sufficiently far back.

The quickness with which any sort of tool can be filed up from ¼in. steel, hardened, and put into use gives it an immense advantage over solid tools, and I have used it in a small shaping machine with the greatest advantage.

One of your correspondents can see no difference between the conditions under which a tool works in a lathe and in a planing machine. Allow me to point out to him that a planing machine is a slow-moving machine, and that, in order to work it economically, very heavy cuts have to be taken off. And not only must the tool be made proportionately stronger for this reason, but at the beginning of every cut the tool has to stand the sudden jolt which comes on it as it enters the material which is being planed. It must consequently be made stronger all round than the lathe-tool, no matter whether this latter is a solid tool or Haydon bar.

Notogsden.

[29872.]—My candid friends have not established a single point which I have ever called in question. No single point that I have advanced have they made the slightest attempt to disprove, either in theory or practice.

It seems useless for me to say I have not condemned the Haydon bar as a useful, handy tool to have for light cuts. Yet, though in my first letter I expressly guarded against this, it is persistently repeated against me.

I have said that the bar with $\frac{3}{16}$in. cutter was not fit for a cut which a solid tool will take in a 5in. lathe. Mr. Hines admits I am right. Letter 29801 says, "it is a first-class tool for light cuts." But no one questioned its use for *light* cuts. "A. H. S." tells us he has turned, in a 3in. lathe, a 4in. face-plate. Had he told us what amount of cut he took, it might have been somewhat to the point. But what he does tell is sufficient to show it could not have been a heavy cut. First, the lathe could not take more than would be a light cut for a 5in., and, in addition to this, the cut was taken sitting.

I have said (*a*) 2in. over-hand in the Haydon, as against 1in. with a solid tool, and with some other bars, is a disadvantage.

(*b*) The strain caused by this unnecessary overhang is most injuriously felt in a slide-rest which is at all weak or badly fitted.

(*c*) In a well-fitted one the stress is not removed because it may not happen to be felt. Have there been any attempts to prove me wrong in any of these statements?

A word now to "Dunelm," whose letter is of quite a different stamp to the others, though he too is mistaken in saying I have made out the Haydon as bad.

He could not give me an authority on any point in practical mechanics which commands more respectful and, I might say, universal attention than "J. K. P." Certainly I know no one whose opinion I have a higher regard for. The quotation given might then seem to cut all ground from under my feet; but what are the facts? "J. K. P." uses never less than ¼in. cutter, and often a $\frac{3}{8}$in. This he has told me since my first letter. Another high authority has told me, too, $\frac{3}{16}$in. cutter is not fit to take the heavy cut a 5in. lathe can and should take.

I never think of sitting while turning. When I want to take what I call a full cut, if self-acting, I always seize the bed with both hands to increase the power of the foot to tread, and if with only slide-rest find then as much as I can keep the lathe going at, with all my weight thrown on the treadle.

Now, as I have said, while I can do this with a solid tool without chattering, I cannot with the Haydon, and without constant breaking of cutters. I have been using the Haydon for nearly two years, and I still use it for light cuts as a very convenient tool for straightforward work in the lathe, but that it is a handy tool for other than plane turning I say is not proven. I think "Dunelm" will find this is "J. K. P.'s" opinion of it too, as in one of his letters on the subject, when I raised the question last year, I think he will find he says he never uses "the fancy tools" he once figured in "E.M." When he lent me his patterns I made copies of them all, right and left side tools, parting tool, screw tools, but have never used one of them for more than a trial. I thought all too weak, and, therefore, only used the 120° angle tool.

As to the defect "Dunelm" found in his sling, and which caused the breaking of his cutter, I have examined mine to see if that could have helped to account for its unsatisfactory work.

I find the cutter does now feel harder in the centre of sling than at the top, and it certainly would allow the cutter to have more spring than it should have.

The inaccuracy in my case has been caused by the breaking of so many cutters, as the sling is only soft steel. I shall correct it before using again, and thank "Dunelm" for drawing my attention to the point again, though "J. K. P." had last year warned me of the necessity of looking to this. I then looked after it; but I now seldom have a broken cutter, as I had learned that I must be content with only light cuts when using the bar.

As a parting word—"A. H. S.," and all timid mechanics, as far as I am concerned, may without fear, flood the "E.M." with their communications. I shall not make the most distant reference to them.

And, now, as my ban is removed, let us hope we will at once begin to get all those valuable letters, papers, and articles which I have unfortunately terrified the writers from giving us the benefit of seeing.

I hope, too, they will bear some *common mark* by which they will be known, and then it will be known that at least one of the charges preferred against me had some foundation.

Fredk. Carre.

CUTTER-BARS.

[29873.]—We have read a little lately about cutter-bars, and I venture to say that I think it would be of interest to the lathe men amongst your readers if some one well up in their uses would favour us with an article on that subject.

There are several varieties on the market, each no doubt having its own advantages. I am in the habit of using the bars of a well-known firm of tool-makers, and find them infinitely preferable to solid tools, but having only used this one form know nothing except in theory about others. The Haydon bar appears to me best adapted to carry wood-turning tools.

If memory serves me, a similar bar is described and illustrated in that connection in Holtzapffel's second volume, published some forty years ago.

R. R. N.

SENSITIVE FLAMES.

[29874.]—My attention has been directed to an article on "Sensitive Fames" in the current number of your journal, a reprint of a paper that appeared in the *Scientific American*. In this paper the discovery of sensitive flames is attributed jointly to Prof. Le Conte and Prof. Tyndall. As neither of these distinguished men has ever laid claim to this discovery, perhaps you will permit me to refer your readers to a paper on "Sensitive Flames" which I published in the *Philosophical Magazine* for March, 1867, or to a longer article by myself on the same subject which appeared in the *Popular Science Review* for April, 1867. In these papers I have described how I first came to notice the phenomenon in 1865, and give details of the experiments and investigation which I made upon the subject early in 1866. Dr. Le Conte, it is true, as I subsequently learnt, had previously noticed the spasmodic jumping of a fish-tail flame whenever a high note was sounded in its neighbourhood—an observation which others had also noticed. Dr. Tyndall first gave the name and publicity to sensitive flames at a Friday evening discourse on the subject at the Royal Institution, in which he also exhibited some additional experiments and suggested the probable explanation of the phenomenon. A little later I applied the discovery of sensitive flames to the investigation of the laws of the refraction, reflection, inflection, and absorption of sound, and by invitation delivered a lecture on this subject at the Royal Dublin Society on January 3, 1868, a lecture published in the *Proceedings* of that society.

W. F. Barrett.

Royal College of Science, April 15.

THE METRIC SYSTEM.

[29875.]—£3 17s. 6d. at 5 per cent., what is it at 3? is very easily answered if the money be in decimals; as is also £2 19s. at 5, what at 4 per cent.? The first in decimals is £3·875, which multiplied by ·6 gives £2·325, or £2 6s. 6d.; the second, £2·950 × ·8 = £2·360, or £2 7s. 2½d. Could this be done with equal facility by any other system, say by duodecimals, or by "E. L. G.'s" meristic plan?

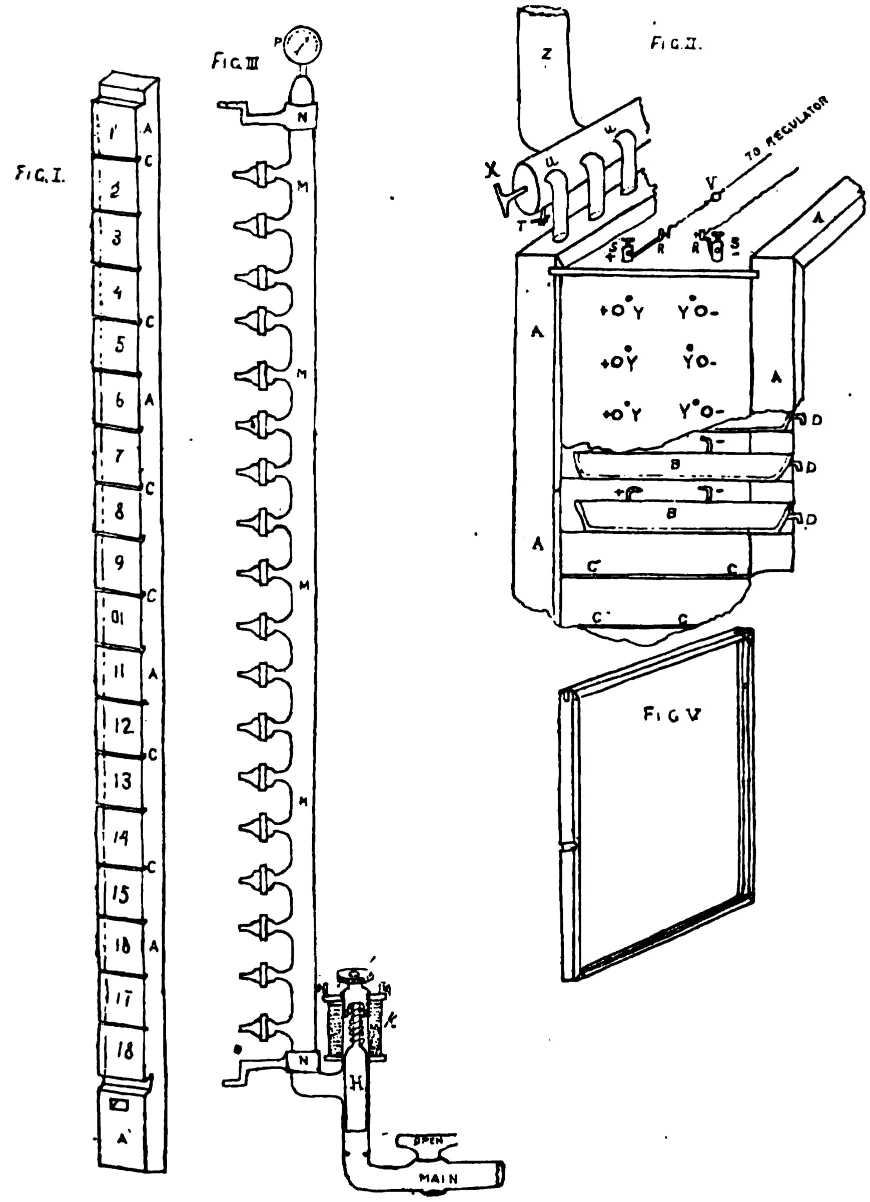
Ponto.

GAS BATTERIES.

[29876.]—In answer to the several correspondents who have requested further particulars with regard to the cell mentioned in letter No. 29773, p. 93, I publish, with the Editor's permission, the following details regarding the 18-cell battery I have designed, using material which can be easily obtained, and which requires no special construction, though it would have been all the better if the glass cells were less deep, as it would have reduced the height of the battery more than a foot.

I propose to place the cells in a framework made of vulcanised fibre, as it is far stronger than any other substance I know of, and is easy to work.

For the construction of the frame there will be required four pieces of fibre 50½in. by 2in. by 1in., and these will make the uprights; four pieces 15⅜in. by 2in. by 1in., for the cross bars; two pieces 13⅜in. by 13in. by ½in., for the top and bottom of frame; two pieces 46in. by 9½in. by ⅜in., for the two sides; and a piece of ¼in. plate-glass, 45½in. by 13⅜in. for the back, together with 19 pieces of ⅛in. patent plate-glass, 13½in. by 10in. And to construct the framework, first take one of the uprights, and having mitred one end across the thickness, take a saw cut immediately below the mitre, ⅜in. deep, and another one ½in. below that, and plough out the groove with a plow plane (vide Fig. 1, top end); then 3½in. and 4in. respectively from bottom of upright take two saw-cuts ⅜in. deep and plough out between them, making ½in. below lower groove a mortise hele ½in. by ¾in. This do to all the four uprights, afterwards cutting a ⅜in. rabbet on either side between the upper and lower grooves in the case of two, the other two being rabbeted on one side only as shown by dotted line, Fig. I. When this is done, take the two last uprights and cut seventeen grooves 2½in. apart, $\frac{3}{16}$in. deep, by ⅛in. broad; these will then have the appearance of Fig. I. Now take the two side-pieces, 46in. by 9½in. by ⅜in., and plane a mortise cut ½in. deep along the top and bottom of each, and after laying one of the grooved uprights upon them, mark off and cut seventeen grooves corresponding to the ones made in uprights. These must exactly meet when fixed in their places. Again, take one of the sides, and, marking off 1in. from the top, bore exactly in centre of side a ½in. hole and seventeen other ones 2½in. from each other; these holes are for the indiarubber tubing which conveys the



A, vulcanised frame; C, grooves for sliding glass partitions; D, overflow drip tubes; K, gas regulator; L, screw cap; H, core float; M, gas-cocks leading into cells; N, brackets for fixing gaspipe; P, pressure indicator; R′ R, shunt binding-screws; S, main binding-screws; T, tap for condensed water; W, condenser; V, lamp; X, damper for draught; Y, binding-screws from cells.

gas to the cells, and which are connected to the gas-taps M M, Fig. III. On the other side mark off in the same way, boring two ⅛in. holes 3in. from either side. These are for the connecting wires from cells (vide Fig. II.), Y Y being binding screws, the small dots above being the holes. This having been done, take the two top and bottom pieces 13⅜in. by 13in. by ¼in. and cut two rabbets ⅜in. deep on the bottom side of the top piece and the top side of the bottom respectively at the back—these rabbets being for the glass back to fit into—afterwards fitting them both to the sides by cutting their corresponding mitres on right and left. Now when two of the cross-bars have been mitred at their ends and the other two have had their ends shaped to tenons so as to fit into the mortise-hole at bottom of uprights, the framework ought to be completed and merely require fixing, which had better be done with bichromated isinglass glue, being careful to rough the parts to be glued with sandpaper or a coarse file, using small brass screws ⅝in. long for fixing the sides and cross-bars, and red lead putty for fixing the glass back.

When thoroughly secure varnish with a stiffish solution of shellac in spirit, to which has been added whilst warm 10 per cent. of solution of indiarubber in chloroform and 2 per cent. of copaiba oil. When the varnish is dry slide the glass plates into their grooves. Fig. IV. will perhaps give a general idea of the battery when fitted with cells, G G being zinc wings sloped forward in order to concentrate the draught and on which are hung two leaden tubes E E, with branches terminating in little cups to catch drips from battery cells, the above being so pivoted that they can swing round when the cells require to be taken out of their compartments. In Fig. III. will be seen three of the six pipes leading from battery box into chimney Z, which ought to be about 28ft. high, and which terminates with a large ventilating cowl to insure always a thorough draught through battery box, and of the other parts shown in Fig. II. W W is a receptacle for any water condensed in chimney, X being a damper contained in it, T being a small tap or outlet for condensed water. It will also be seen from Fig. II. the position of cells allows of a clear 2⅜in. space behind for draught. In Fig. III. M M is a brass tube fitted with eighteen nozzles and taps, by which to conduct hydrogen gas to cells, these being connected by means of short lengths of ¼in. indiarubber tubing. The brass tube terminates at the top with a pressure-gauge P, and has at its bottom end a regulator K, which regulates both the pressure and quantity of gas, for it will be seen that when the gas is turned on, the float H, which is made of thin iron, rises until a series of small perforations, half-way along its length, come opposite the opening of pipe leading gas to cells; then on any lamp being turned on in the main S S, a shunt current, R R, passes through regulator and controls the gas according to the resistances of the lamps in parallel; the regulator can also easily be adjusted by turning screw-cap L.

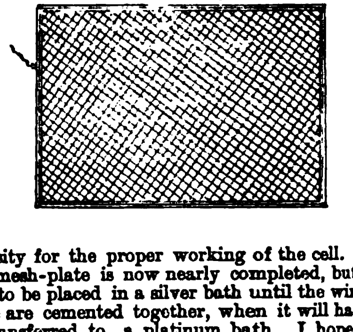
It may seem unnecessary to have both a pressure gauge and taps to all the nozzles; but, apart from the convenience of shutting off some cells, in case of a leakage of hydrogen gas, which has no smell, it can at once be determined, and the cell cut off. It will also be perceived that the bobbin of regulator is a shunt on the main leading wires, V being a lamp inserted in shunt; but this is quite optional, as by reversing the regulator and readjusting screw-cap, it can be used direct on the main leads.

Now to come to one of the most important parts of the battery—viz., the wire mesh frames to fit into glass cell (vide letter 29773). For these there will be required three dozen pieces of vulcanite, 12¼in. by ⅜in. by ⅜in., three dozen pieces 9¼in. by ⅜in. by ⅜in., and these will make the 18 top or positive frames, and for the bottom frames will be required the same number of pieces, 12¼in. by ⅜in. by ⅜in. and 9¼in. by ⅜in. by ⅜in. respectively. All these can be nicely cut out of two half-sheets of vulcanite ⅜in. thick. In addition to the above, there will be required eighteen pieces, 12¼in. by 9¼in., of silver wire gauze, 120 mesh, and eighteen pieces, 12in. by 9in., together with several lengths of copper or silver wire, No. 18 gauge, and a good many guttapercha whip-lashes for sealing in with, and three dozen strong elastic bands ¼in. wide.

The first thing to do is to mitre, mortise, and tenon all the vulcanite strips, and to take a saw-cut ⅛in. deep down the inside 3/16in. from the edge, boring a hole on one side, 4in. from top side, for the connecting wire to pass through; Figs. 5 and 5A will perhaps explain. On the other side in the centre on outside of frame file a small groove about ¼in. wide across it; this is for the indiarubber tubing.

The next thing, after fitting all the frames, is to fix the silver-wire mesh inside them, and to do this first take the gauze and turn it up ⅛in. all round, running a silver or copper wire, No. 18 B.W.G. under the lap, twisting the two ends together where they meet, vide Fig. VA; then taking the shorter piece of vulcanite with the hole in it, pass the twisted wires through and press the wire edging into saw-cut by means of a blunt screwdriver. This also do on the opposite side with the other piece, soldering the wires to the mesh with the metallic putty before described, and sealing over the saw cut with a piece of guttapercha whiplash, then take the two longer pieces, and having placed the other sides of the wire mesh into their respective saw cuts, fix the ends of the pieces in their place, with a solution of gutta, passing an indiarubber band all round the frame. Now press the wire edging home on either side to bottom of saw-cuts, soldering as before, and sealing with guttapercha. This will strain the wire mesh, and make it quite tight—an absolute necessity for the proper working of the cell. The wire mesh-plate is now nearly completed, but will have to be placed in a silver bath until the wires of gauze are cemented together, when it will have to be transferred to a platinum bath. I hope this description is sufficiently lucid, as all the other frames must be treated in the same way. Now, when the smaller frames have been sealed in the bottom of their respective glass cells, place the larger ones over them on the upper side of which has previously been placed about 1½lb. of granulated platinised carbon, about the size of 4 or 5 shot. The cells are now practically finished, except for the addition of the dilute acid, and can be placed in their different compartments.

FIG. V. a



Of course in describing the above I have left a good deal to the ingenuity and skill of the operator, and also many little details such as insulating the connecting wires, &c., have been left out; but I hope my somewhat hazy description may be a little guide in the construction of gas batteries, though no doubt the above is capable of many improvements, such as the corrugation of the plates, closing up the face of battery and using forced draught; but still I think the wire gauze plates will be hard to beat, and will only eventually be beaten by thin porous metal ones made of some less costly metal, for it is not a question of occlusion, but of a peculiar interposition of molecules throughout the plate, caused by the subdivision of the metal of which the plate is formed, and which permits the gas to permeate the plate readily without being exactly occluded in it. Many metals when finely subdivided have the power of seeming occlusion, and even some non-metals, notably carbon and pumice; but the real power of occlusion is the absolute liquefaction of the gas not *between* the molecules of metal, but amongst the mass itself, forming a mixed compound. This power is possessed by only very few metals, notably palladium.

To illustrate what I mean, I will mention the following:—In making a porous iron mesh plate in a solution of caustic soda, after having well washed it, I placed it to dry in a chamber of warm hydrogen gas, at the top of which a gas-burner was lighted so as to consume the aqueous vapour given off. Upon taking the plate out of the chamber, almost instantaneously—certainly in two or three seconds—the whole plate was red hot. As may be imagined, I dropped that exceedingly hot potato pretty sharp, and so broke the plate; but it was already useless, being converted, all but a few iron wires, into its original oxide. This was a proof of the intermolecular porosity carried to its extreme limit, owing to the subdivision of the metal, and had nothing to do with occlusion proper. Yet I feel sure that that plate, if properly treated, would have been a greater source of energy in a gas-battery than any platinum or palladium plate. However, to return to the question I am writing upon. The difficulty of the cell I have described is that it must be kept absolutely level, so that the positive or upper plate is never out of capillary attraction with the dilute acid in the cell, and yet it must be never underneath the surface. To remedy this I tried floating the positive plate; but this so diminished the available surface that I prefer the level kept constant by overflow tubes, such as D D, the evaporation being also kept constant by turning damper X. This latter will be fairly rapid, as the air not only passes over, but permeates through the layer of carbon in cell.

It is as well to mention that before turning gas on to battery, if all the cells are connected in parallel and coupled to eight half-gallon Bunsens grouped in series of two for about 10 to 20 minutes, discharging once or twice, but being very careful not to attack silver mesh, the intermolecular porosity of the plate will be much increased. The last charging had better remain in the plates until the gas is turned on to battery, as owing to what I call a molecular suction the freshly-liberated hydrogen from gas apparatus seems to take the place of the hydrogen disengaged in cell more readily when circuit is closed afterwards.

Now as to the cost and efficiency of the battery described. The cost of the above is easily calculated, and would be between £50 and £60; the absolute efficiency is difficult to calculate, but as the current density in discharging has varied from ·1 to nearly ·3 per square inch in the several kinds of plates I have experimented with, I think I should be justified in stating that a 25-cell battery constructed on the above lines exposing 140sq.in., or 1sq.ft. of negative area, would give about one electrical horse-power—a poor result from such a mighty edifice of cells—and would cost from £80 to £90, or not more than a first-class gas-engine of the same power. Of course, future improvements would greatly increase the output of the above, and might possibly reach 2H.P. or 1,500 watts.

With regard to the working of gas batteries, there is a critical point at which the greatest effect takes place; this is also pointed out by G. Lückhoff in one of his letters, but he does not mention what that point is. Now, my experiments have led me to the conclusion that it is that point at which the combining elements occupy the least possible space without giving or losing heat to the surrounding solution. Thus, in an oxy-hydrogen cell with perfect plates the critical point is 4 C., but the intermolecular porosity increases with the temperature, and the temperature increases the pressure of gas at a constant volume, therefore the temperature must vary as the thermo-molecular porosity of the material, of which the plates are composed of, and the pressure must vary as the temperature, to obtain a constant volume, and since it will be seen that the limit of temperature must lie between 4 C. and 100 C., in all probability unless the atmospheric pressure on positive plate is increased, the greatest effect would take place when the negative plate is heated to 100 C., using a pressure of gas at 5·21b. per square inch, the solution remaining at 4 C.; but, of course, in actual practice, a compromise must be made, so as to give the best results. Therefore, I suggest that the negative plate be made very thin, which also increases its molecular porosity, so that the energy of the current may generate the heat required, and that the positive plate be kept cool by the evaporation which takes place, so that the solution in the immediate vicinity of the plate where the combination takes place should be as nearly as possible 4 C.; also a low temperature is more conducive to the formation of ozone in the carbon above positive plate.

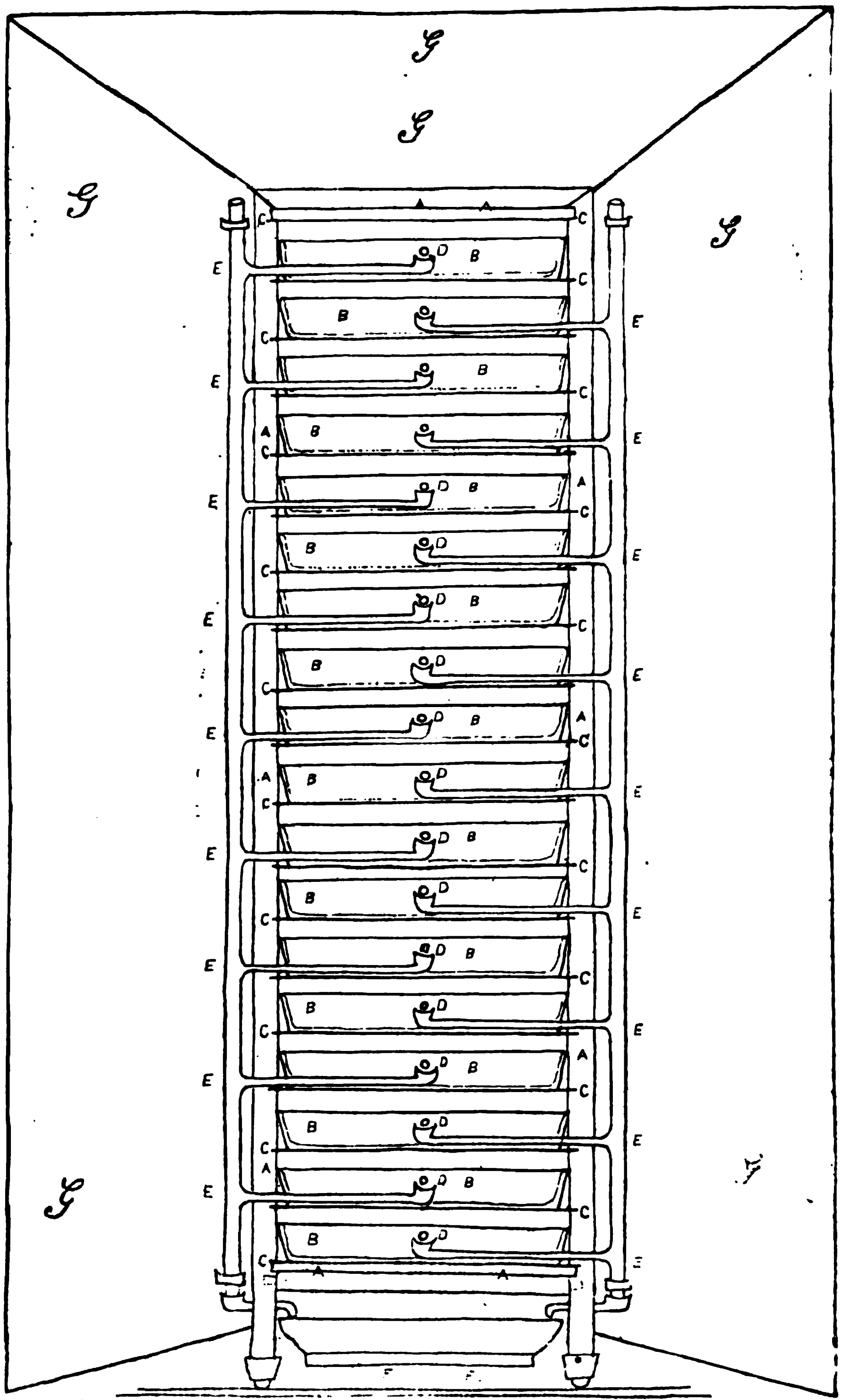
It may be worth mentioning that a very thin plate can be made by taking very thin metal foil and burnishing over a piece of iron wire gauze, when the metal will be pierced with tiny holes, according to the coarseness of the mesh used.

I cannot help thinking, in the not far distant future, that gas batteries will be used for the reduction of ores and metals, especially when one remembers that the atomicity and the combining heat of elements is the point of efficiency in a gas battery; but as I have not experimented much in this direction I will say no more, except it is quite possible to make the following combinations:—

	Solution.	Gas.
Chlorine	Hydrochloric acid ..	Hydrogen
Atmospheric air	Nitric acid and water	Ammonia
Oxygen	Sulphuric acid......	Sulphuric anhydride

and that iron and copper pyrites merely require reducing to metal. In fact, the combinations seem endless, and point to the theory that whenever two or more elements combine to form a new substance, electricity is set free by reason of the change in their respective molecules. This is perfectly compatible with the theory that electricity is an undulation of ether, or a pulsation of the envelope of ether which surrounds the molecules of matter. However, as I may be getting into water beyond my depth, I will close this letter by wishing success to all those who take up the question of Gas Batteries, and by hoping that the letters I have written will not prove altogether useless. I feel, however, I have greatly trespassed on your space by sending such an unconscionably long letter, but I do not know when an opportunity will again present itself, as my leisure for writing will be somewhat uncertain in the future. Moreover, I think that so far as I am concerned, "the question has been discussed to completeness."

Fig. IV.



A, vulcanised fibre frame; B, glass cells; C, plate glass supports dividing cell compartments; D, overflow drip tubes from cell; E, catch cups and tubes to lead away overflow drip; F, basin to hold surplus water; G, zinc wings to concentrate draught.

One word more. In mentioning the above battery I hope it will not be thought egotistical or presumptuous of me if I call the above after my own name, and ask others to do so, as I consider it is as great an advance on Grove's gas battery as the original Faure cell was on the Planté's, the two reasons which have prevented my patenting it, for I drew up a rough specification respecting it last November, are: (1) That since I am unable to thoroughly complete it, I should have to trust to former experiments for details and data, and should then not have sufficient time to improve on it myself. (2) That owing to the fact that many patents have already been taken for gas batteries—notably, No. 5198, 1881—I should have been in all probability involved in litigation from the outset. I hope, however, no one will take unfair advantage of my confidence, but give me some credit for what I have done, for what I have written in this letter is the experience of four years' hard work, and surely I deserve a little return for that.

I apologise to those correspondents who may have thought me discourteous in not personally answering their letters; but I am not desirous now of patenting my invention, nor could I do so, having given it gratis to the readers of the "E. M." especially, and to the public generally, so the above letter must suffice, though I shall be glad at any time to answer questions or give the addresses of materials used in the above batteries; but I cannot send material or my own particular experimental cells for two reasons:—(1) They have been packed up and sent away from here, so are not available; and (2) even if they were so, I think it is asking a little too much to ask for the loan of them; though, if I could have done so, I should have gladly shown them to anyone desirous of seeing them.

Leamington, April 3rd. **Alfred Treeby.**

ORGAN MATTERS.

[29877.]—I follow the train of thought so clearly described in Mr. Dixon's letter (29840), and can readily see that his recently-published scheme has been the result of much careful consideration. From my point of view, however, it is too elaborate for a true Chamber Organ, and insufficient for a Concert-room instrument. There would be no necessity, in inserting a small special string-toned division in one manual department, to have a fourth swell-box and its attendant expression lever. The best method of arranging the different departments is given in my "Notes on the Concert-room Organ." Mr. Dixon is correct in saying that it is difficult, if not impossible, to get the true imitative string tone from viol stops on light pressures of wind; but an artist in tone production, such as Mr. W. Tynne, can do wonders even on so light a pressure as 2⅜in. The viol d'amore in my own chamber organ is voiced on the "système Gavioli," on 2⅜in., and is strongly imitative of the old instrument after which it is named; but of course the tone is extremely delicate, and has little of the rasp of the bow in its speech. With reference to the amount of 16ft. tone in the manual departments a few words may be said. Mr. Dixon must acknowledge that his scheme is a most ambitious one, and, in my estimation, it appears deficient in 16ft. tone: hence the suggestion made in my previous letter. Such an amount of 16ft. tone in the manual does not in any way demand the presence of 32ft. tone in the Pedal Organ. One important matter must, however, be carefully attended to—viz., to keep the 16ft. manual tone thoroughly subordinate to the unison or 8ft. tone. As regards the appointment of a necessarily limited Pedal Organ, I can most conscientiously recommend the system introduced by my friend, Mr. Thomas Casson. Mr. Dixon has no call to apologise for any ideas he may have derived from what I have done or written. Unlike a certain writer of letters in these columns, I have no trade interests to serve; my only aim and desire is to help onwards a more thoughtful and artistic school of organ building, and I am glad to find that Mr. Dixon sympathises with me in this direction.

I now may just touch on the letter by Mr. Carlton C. Michell, so far, at least, as it affects myself, although I question whether it is worth my while to reply to the attack he makes in a half-hearted manner on me and my views. I do not care the value of the pen in my hand for either his approval or condemnation, for I am aware of the animus which guides his pen in my direction, and the worth of his opinions. Mr. Dixon will give his remarks on the organ scheme the attention they deserve. Mr. Michell has thought proper to say that "Mr. Audsley's Concert Organ design is an imitation of the organs of Roosevelt, of New York, by whom he swears." Now, allowing such was the true state of affairs, it would in my opinion be anything but to my discredit; but, as the matter really stands, beyond that obvious similarity which ought to obtain in the schemes of all large organs, perhaps Mr. Michell will point out wherein I have copied from the schemes by Mr. Roosevelt. He will doubtless allude to the use I make of swell-boxes; but in this direction I may just inform him that I advocated the multiplication of swell-boxes and much increased powers of expression in connection with the organ, and carried my ideas into practical demonstration some years before my late friend, Mr. Hilborne L. Roosevelt, founded the great firm which is now so ably presided over by his brother. I believe I am correct in saying that it was not until the eighties had commenced that Mr. Roosevelt thoroughly realised the importance of imparting powers of expression to nearly all the stops in the manual departments.

I have had the pleasure and advantage of a personal acquaintance with Mr. Hilborne L. Roosevelt, and now enjoy the same privilege as regards his successor, Mr. Frank Roosevelt and his talented and courteous manager, Mr. Walter F. Crosby; and I have spent days in their factory in New York, and have inspected several of their finest organs; and I venture to think that any English organ builder who aims at doing anything much in advance of what has already been done in this country, instead of endeavouring to discredit any "imitation," would do well to study and take to heart the lessons which may, unless the examiner is blinded with conceit, be learnt from an intelligent study of the Roosevelt organs.

Mr. Michell mentions the forthcoming organ in the church of St. Barnabas, Pimlico. Now, as it happens that it is through my admiration for the talents of his *confrère* that he has anything to do with that instrument, I may be allowed to feel some special interest in it. And with Mr. Thomas Casson and skilled mechanicians on one hand, and that master of tone production, Mr. W. Thynne, on the other, it will indeed be strange if the organ does not turn out a fine work, and furnish a "fair opportunity for the criticism of a piece of tone colouring."

Devon Nook, Chiswick. **G. A. Audsley.**

ORGAN NOMENCLATURE.

[29878.]—We have had a good deal of organ matter lately, and some suggestions for reform in nomenclature. A radical reform may be difficult, but one slight improvement appears to me to be easy enough. I refer to a stop which your correspondents describe as lieblich gedact, gedecht, gedect, &c., &c. No one seems to know the correct way of spelling the last word; neither do I, because I am not sure what it is intended to convey. It should obviously be either gedacht or gedeckt, but which? Lieblich means lovably, tenderly, sweetly, endearingly, &c. In German we have further the irregular verb Denken, to think; pret. dachte; p. part., gedacht; and the regular verb Decken, to cover; pret., deckte; p. part., gedeckt. If *lieblich gedacht*, then a free translation would read "sweetly thought out," or "happy thought." If *lieblich gedeckt*, 'covered may mean stopped, and it would imply "sweetly, charmingly stopped." Which is it? I do not remember to have ever seen either word quite correctly spelt, but always a sort of compromise between the two. Did I know as much about organ construction as about our finest organ players, I should require no help in coming to a conclusion; as it is, I think this little lesson in German may help Mr. Audsley or Mr. Robinson in settling upon a word which shall at least mean *something*. **G. W. S.**

PHRENOLOGY.

[29879.]—Mr. Moores' letter on p. 133 is an interesting one; will he kindly supplement it by further particulars of Mr. Bridge's method of analysis?

First, how does he settle the direction of the line through the ear? If the man represented in Fig. 3 held his head up, as in Fig. 3 *a* herewith, would the lines alter as in my sketch? If so, this would seem to point to hitherto unsuspected intellectual advantages to be derived from drilling. Am I correct in understanding Mr. Moores to mean that the ratio of the length of the heights $\frac{yz}{xy}$ is a measure of the mental capacity?

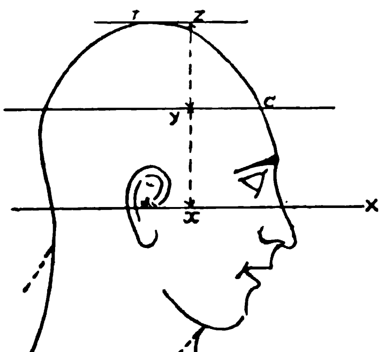


Fig. 3a

Secondly, how can I fix the position of the point *c* (the centre of ossification) on a real head, or the portrait of one?

Thirdly, have the vertical lines shown on Mr. Moores' sketches any importance? If so, what, and how is their position determined? If Mr. Moores had the skull only of Fig. 3 to deal with, how would he determine whether Fig. 3 or Fig. 3 *a* were correct? In Fig. 3 *a* I have dotted the lines of the neck, as shown on Fig. 3. **Glatton.**

[29880.]—In "E.M." of April 12th, Mr. Mark Moores gives its readers diagrams of four heads, with lines drawn across, by which he is able to read off the mental powers of the owners of the heads.

Will he explain how those lines are drawn, as he gives no guide further than the one which is drawn through the opening into the ear; but I observe in the one case the point of the line is considerably above the wing of the nose, whilst in the other it is below.

How does he find the centre of ossification in the frontal bone, and are the vertical lines arbitrary, and what is their purpose?

Is any account to be taken of the breadth of the head, as one may be long and narrow, another very broad? Assuming the lower horizontal line to define the base of the cerebrum, is the calculation made by comparison between what is below and above the line through the centre of ossification of frontal bone in each individual head—in the sense of being proportioned—or are the measurements compared with standard head measurements? How is the quality of the contents of the cranium arrived at, because external measurements would deal with quantity only? Some idiots have very different looking heads to the one depicted. Then there are the hydrocephalic heads; also all cranial bones have not the same structure, as some are very thick and porous, others have cavities between the plates. Though not occupying the same position as the contributor from Rotterdam in the same issue of "E.M.," I should feel more-satisfied if Mr. Moores or any other exponent of the science assured one of a firm footing to work upon. **Cymro.**

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67862.]—**Distribution of Load.**—This is, of course, a purely theoretical problem, and the figures I gave are a somewhat close approximation in the given case; but, as pointed out, the method is not generally applicable. I hope our friend "M.I.C.E." will tackle this with his usual ability, and trust he may notice this appeal.

Bristol. T. C.

[67862.]—**Distribution of Weight.**—If "W. S." can arrive at a solution of the following problem, which is similar to his own and much simpler, it will help him in solving the latter:—A straight rigid bar rests upon three supports, A, B, and C, in a perfectly straight horizontal line; B being distant from A one fourth of the distance from A to C. A given weight is placed on the bar at B. What is the actual or proportionate weight borne by each of the supports? I shall be glad to see the solution if there is one, as I make it out to be indeterminate. For, calling weight W, and the pressures on the respective supports a, b, and c, I can only obtain from the *data* two independent equations—viz., $3c = a$, and $a + b + c = W$, which are not sufficient to fix the values of the three unknown quantities, a, b, and c. Z.

[67894.]—**Compound Engine on the G.E.R.**—As "East Anglian's" numbers are at the binders, I may perhaps be allowed to explain my query by asserting that, so far from the sketch on page 441 representing a "unique" engine, it is a rough and crude drawing showing nothing whatever of the "compounding" which is the interesting feature in connection with No. 127. As drawn it looks like an ordinary six-coupled "goods," and the space it occupies is simply wasted. Diagrams, such as those on page 157 last week, are useful, but not such sketches as that on page 441 last volume. It should have shown the arrangement of the cylinders and the link motion to be of any interest at all—for it certainly is not a picture. Stratford.

[67904.]—**Round-faced Hammer.**—As your correspondent "Ohmi" asks for opinions on this matter, permit me to say that I lately bought an adze-eyed carpenter's hammer with the face slightly rounded for 3s., and find that for driving nails (which is what I bought it for) it is a complete failure. Disappointed.

[67934.]—**Wire Ropes and Cables.**—According to the Patent Law, the specification of an invention must describe it in such a way that an intelligent workman will be able to carry it out by the aid of such description, and I presume "J. P." knows that wire ropes and cables form the subject matter of several patents. I did mention where tables could be found, but was in doubt whether to reply at all, as few readers of the "E. M." can want to make "wire ropes and cables." Anyhow, I gave the "straight tip" where the information could be found. J. T.

[67963.]—**Watch.**—That the balance of your Geneva watch does not swing more than half a turn is no proof that it is faulty. They ought not to swing more than three-fourths of a turn. I should think from your letter that the hook in the spring has broken. I never heard of a cylinder watch being converted into a lever, though it might perhaps be done. I am not surprised that you have spent £7 in four years for repairs. Only the other day I heard a City firm charge 15s. for a job that might cost them 6s. Ordinarily a conversion costs £2 or £3 in Clerkenwell, where I advise you to send such jobs. Now as to the superiority of the lever over the cylinder escapement. The lever is a "detached escapement"—that is to say, that the balance and spring (the real timekeeper) is entirely disconnected from the train, except during the time of unlocking the lever and receiving impulse. Thus the lever is more of a scientific timekeeper, and approaches more nearly than the cylinder does to theoretical perfection, being only excelled by the chronometer escapement. The cylinder is a "ictional rest" escapement, and is never detached from the train, for it is either receiving impulse or has a tooth "resting" upon it. It requires more frequent cleaning than a lever does.

Charles A. Jones.

[68063.]—**Organ Pipes.**—Should like to see an answer from Mr. Audsley to this query. The stouter wood ought to give the firmer tone; but is there much difference between wood and metal diapasons when both are made of material strong enough to resist the vibrations of the column of air which produce the sound? An oblong section is supposed to give a different quality to a square section; but I suspect a great deal depends on the voicing. F. L.

[68064.]—**Dyeing Wicker-work.**—A "water-white liquid" might be a solution of sulphuric acid, which would naturally dye wicker. To use the copperas and logwood method, immerse the wicker in boiling decoction of logwood, and afterwards in boiling solution of sulphate of iron or green vitriol. Perhaps a better colour could be obtained by logwood first, and then a solution of bichromate of potash. Leave in the light some time before forming an opinion. Nun. Dor.

[68067.]—**Brazing Tricycle Parts.**—How long has this querist been a "Constant Reader"? It does not matter whether it is a tricycle, a saw, or a sewing-machine; brazing is done in just the same way. Grind up some borax thickly with water, and either mix the spelter with that or place round the joint. The parts should be filed clean, smeared with the borax mixture, tied with wire, and placed on a clear fire. As soon as the spelter is seen to run, remove from the fire. Use a good supply of the borax and spelter, and clean off when cold. I should think this question must have been answered in every volume. Nun. Dor.

[68070.] — **Gas Blowpipe for Hardening Small Tools.**—"A. H. S." should consult his back volumes, or else procure Mr. Fletcher's catalogue. I don't think Mr. Fletcher will recommend gas for hardening and tempering small tools; and certainly I think a charcoal fire preferable.

Nun. Dor.

[68083.]—**Fletcher's Bath-Heater.**—I thank Messrs. Fletcher and Co. and T. Heath most heartily. As I have (I hope) overcome my difficulty, perhaps my experience may be of use to the latter. Messrs. Fletcher and Co. most kindly sent their London representative to see the heater, and his opinion was that I should have yet again to relay the service-pipe, making it ¾in. instead of ½in. He was most untiring in his efforts to relieve me of my difficulty, and still offers to do so if, as he thinks, I have not overcome it. Messrs. Strode and Co., however, of 48, Osnaburgh-street, heard of my troubles through a friend, and sent me a new wind-guard they are making, which I put on the top of my flue, and, so far, my difficulty is at an end. I have waited for one or two good north winds before writing, and find my heater still acts—not quite so quickly as when the wind is in any other quarter, but without any of the blow-down I suffered from before. I strongly recommend anyone similarly plagued to try one of these wind-guards, and I beg again heartily to thank Messrs. Fletcher and Co., Messrs. Strode and Co., and T. Heath. I never yet asked a query in these pages that did not bring me kindly help as well as counsel. Kappa.

[68085.]—**Accumulator Cells.**—Why not try glass?—it is cheap enough nowadays; but wood boiled in paraffin wax ought to prevent the acid leaking. E. M. F.

[68089.]—**Japanning.**—The japan is applied to the cleaned surfaces by means of a brush, and then the articles are placed in a stoving oven at a temperature of from 250° to 300° Fahr., or more, according to the nature of the gums used in making the japan. It is best to buy that from dealers of repute, who can usually specify the stoving heat at which it works well. The querist should procure No. 1204, and read a reply on enamelling cycles, p. 173. There is, besides, much about it in back volumes. Nun. Dor.

[68100.]—**Tubular Pneumatics.**—There is an illustration and description of a patent tubular pneumatic action in No. 1242; the electro-pneumatic is illustrated and described in No. 1130, and there are several other Nos. containing illustrations. The action cannot well be described without diagrams; but, briefly, the pallets are worked by little bellows actuated by the wind-pressure, and backfalls, trackers, &c., are dispensed with. Organon.

[68111.]—**Phonograph.**—The needle for recording is a rather sharp little bit of steel, which cuts the wax away; that on the reproducing diaphragm is simply a needle with a rounding point to run easily over the indentations in the wax.

T. K. L.

[68107.]—**Extracting Hairs by Electricity.**—The electrolytic method of destroying growing hair is as simple as it is effective. A sharp-pointed needle is attached to one wire and a pair of pincers to the other. The pincers grasp the hair near the skin, the needle-point is inserted at the root of the hair, and the destruction is final. The pincers need not be connected: it is sufficient to make the patient one pole of the circuit, but the pincers are used then merely to pull the hair out. T. M.

[68113.]—**Basting Meat.**—Any large ironmonger can show the querist a "baster" working automatically. The same machinery as is used to turn the meat is used to pump up the fat or gravy and discharge it over the joint. I do not agree with Mr. Lloyd that a joint baked in an oven is "dry and insipid within." Nun Dor.

[68120.]—**Cupola.**—Will this querist get what he wants from Nos. 1,200 and 1,213, or refer to p. 573, No. 1,195? There are several cupolas shown fully dimensioned in back volumes, and some information in very recent numbers. J. C. L.

[68122.]— **Nickel-Plating.**—There were some useful papers in Vol. XLVII., which may help querist; but how any one can say whether his solution is at fault, or he uses too much battery power, passes my comprehension. He has forgotten to say what the battery power is, and also the composition of the solution. He should look up the back volumes. He will find all about nickel plating stated plainly. Nun. Dor.

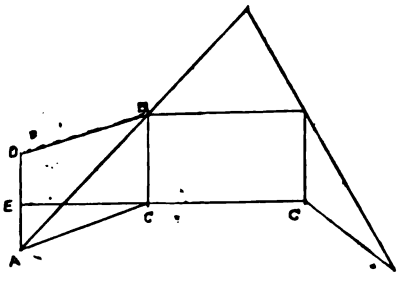
[68221.]—**Rusty Water.**—There is an error in my first reply. I am reported to have said, "lime and use will be the remedy;" as a matter of fact, I intended to write *time*, though I expect I omitted to cross the "t," and so wrote *lime*. It is customary for waterworks companies to limewash their mains; but I have never heard of applying the same to boilers and cisterns, though I should think it might apply. Fuzz.

[68294.]—**Small Elector-Motor.**—To "Phos."—You will find a motor described by Mr. Bottone, on p. 44, No. 1,251, that will suit your purpose. Use from eight to twelve Fuller cells, according to power required. This would probably wind a small clock-spring if geared. This may give you some idea as to the power one Leclanché cell would develop. I have a motor of the form mentioned—but about half-size: its power is very small. If you like to advertise your address, I will give you any help I can. Phos.

[68296.]—**Galvanometer.**—Coil 630 turns, mean radius two centimètres (1¼in. diameter). 14° = ¼, 26° = ½, 45° = 1, 56° = 1½, 63° = 2 milliampères current. Tangent.

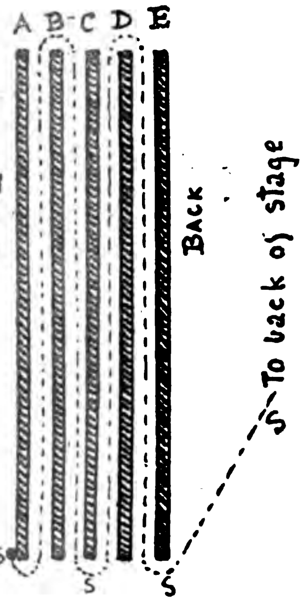
[68322.]—**Fluting Paper Like Fans.**—These fans are not made of a semicircle of paper, but of a parallel strip. There was a machine in the Irish Exhibition, in London, making them of wall-paper. The paper is folded to and fro in narrow parallel pleats, the whole, when squeezed together, being bent double in the middle. The centre being held tight, the outer edge can be spread out into circular form. T. F. S. T.

[68325.]—**Strains on Roof.**—Using your diagram, draw D B parallel to A C, and continue C C′ to E. Let A D = ½ W (½ weight on truss), then A B = thrust on rafter, E C pull on tie C C′, A C pull on tie A C, and A E = pull on B C. The thrust on collar-beam may be taken as C C′. Treat rafter as inclined loaded beam; but if this is a practical question, do not forget to get total load between principals—viz., slates, battens, rafters, purlins, snow and wind-pressure. Do not be too light in your dimensions; these things will not bear treating too theoretically, so do not be sparing of a bit of material.



Bristol. T. C.

[68328.]—**The Hartz Rising Cards.**—Answering queries which request explanations of conjuring tricks is, I think, hardly fair to those who make their living by it. However, I give explanation of this trick, which is worked in various ways, the following being one which R. Dunning himself can easily perform:—First, procure a forcing pack (i.e., a pack composed of three of a sort only) and an ordinary pack to match. Take out of the latter three cards the same as those in the forcing pack, and attach at the bottom of one a piece of black silk thread S, this thread is then brought up the back and passed over an indifferent card B, then under the next card C, and so on. In the inclosed sketch it will be seen that A C E are the cards to rise, B D simply acting as levers, so that when the thread is pulled by the performer, or by an assistant behind the scenes, the cards A C E will rise in reverse order. When the last card has risen the performer nips the thread, and hands the whole apparatus for examination. The audience, of course, choose their cards from the forcing pack, which is changed by the performer for the ordinary pack with the prepared cards at the bottom. The Houlette can easily be made of wood or tin, if a glass one is not procurable. Bedford.



[68329.]—**Cupola.**—Make your cupola not less than 6ft. high, 15in. diameter when lined, two tuyeres of 3in. diameter, 12in. from bottom of cupola to tuyeres. Make bottom of cupola to drop on a hinge, to save you from drawing when done melting. Charge at the top, break your pig in six pieces; get old funnel 25in. diameter, line with one row of firebricks and fireclay, which will give 15in. when finished. Cast Iron.

[68329.] — **Cupola.**—"Blacksand's" cupola would work much better if it was 12in. in diameter instead of 9in. You can't melt iron without fuel, and you cannot keep the metal melted at the bottom of cupola unless you are able to melt it very hot. To remedy the defects as stated, in the first place the bottom of the cupola ought to be of "sand" (say about 2in. thick) instead of firebrick; in the second place, see that you blow through "tap hole" until the bottom is quite "white hot." You can then put on some metal, but do not "stop up" until the metal begins to run out of the "tap hole." I should also increase the size of the "tuyere" from 1¼in. to 2in. The reason of the metal "setting" is—(1) Because the bottom of the furnace is not hot enough; and (2) because you have either insufficient "fuel" or "blast," or perhaps both. Another thing, see that your fuel and iron are both of good quality. J. N. O.

[68337.]—**Lathe Query.**—I had precisely the same trouble with a "No. 13" 3in. Britannia Company's lathe. The spindle ran so heavily it was almost impossible to treadle. I at last got it to run by lubricating with methylated spirit and plumbago, and sheer hard work. After a considerable time I found out the cause of the whole trouble. I had occasion to take the headstock off the lathe, when, to my surprise, I found the spindle set dead fast. When fixed again on its place it was free. The cause was that the holding-down bolt springs the casting out of shape. Presumably these spindles and bushes are fitted into the loose headstock, and when the head is bolted down firmly enough to prevent its sliding along the bed, the bushes are thrown just sufficiently out of line to nip the spindle. Certainly hardening the spindle and bushes would be most beneficial with proper fitting.

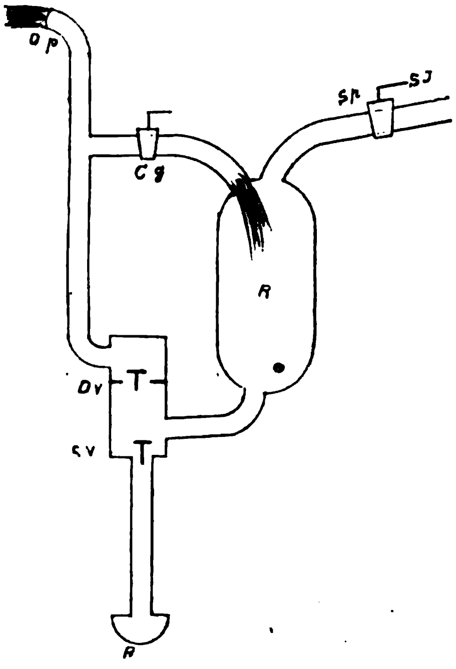
T. F. S. T.

[68366.]—**Paint.**—Why not use pure linseed oil hot? No poison in that, and it will dry of itself if you will give it time.

Bristol. T. C.

[68367.]—**Renovating Band Uniforms.**—In the English Mechanic of the 6th June, 1886, in reply to 59650, I gave the H.G. receipt for "Eau Ecarlate," used for renovating red coats without taking them to pieces. G. G. B.

[68338.]—**Savery's Engine Problem.**—I herewith send a sketch of the said engine. The problem may be worked this way:—Suction pipe 25ft. long or deep, suppose 1in. diam.; weight of a column of water 1in. diam. 12in. high = ·341; ·341 × 25 = 7·525, but when all taken into consideration 11·5lb. atm. pressure practically; discharge pipe, say, 30ft. × 1in. diam., as before, ·341lb. per foot; ·341 × 30 = 10·230; allowing for friction and condensation, other 3lb. = 13·230. S P, steam pipe; S T, steam tap; D P, discharge pipe; C J, condensing jet; R, receiver; D V, delivery valve; S V, suction valve; P, rose.



Bristol. Jes A.

[68359.]—**Poppet.**—You must fit the bottom in a slide, and have a screw the same as bottom of slide rest to set it over. I append sketch. But why not have a movable centre instead, if you have but little taper turning. See sketch No. 2.

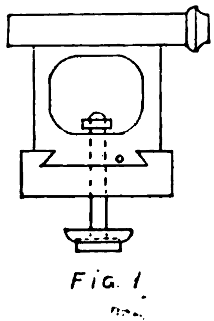


Fig. 1

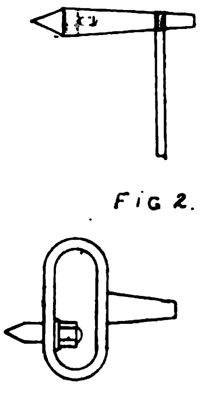


Fig. 2.

Bristol. T. C.

[68368.]—**Drums of Threshing Machines.**—The method of balancing gas-meter drums is as exact as anything that you can need. They are placed between centres, like a high pair of lathe centres, and spun round by hand. On coming to rest, the part that is uppermost is marked with chalk, and the drum again spun round. If it comes to rest with the chalk mark again at the top, it is weighted on that side, and tried again as before, until it comes to rest indifferently in any position.

Nephesh.

[68368.]—**Drums of Threshing Machines.**—Have a couple of thin bars on edge; take drum out and rest the bearings on these bars (which latter must be perfectly level). You will now find the drum turn until the heaviest part is at bottom, and you can weight the opposite side to balance. But it may happen that when running the drum may not be in "running balance"; if so, and presuming the drum is perfectly concentric, hold a piece of chalk to touch the part thrown out of balance when running, and then add a little weight on the farther side opposite to the mark.

Bristol. T. C.

[68368.]—**Drums of Threshing Machines.**—Take two pieces of steel, each 2ft. long by 2in. by ⅜in.; plane one edge of each and polish, so as to form smooth surfaces for the journals of your drum to roll on. Mount the steel pieces or "ways" on two trestles; place the trestles apart, so that the centres of the drum journals will rest on the "ways." See that they (the ways) are perfectly level; place the drum on them and balance it until it will rest at any position it may be rolled to. In putting on balancing-pieces arrange them so that the centrifugal force will be thrusting them against some strong part of the drum. Sandy Dunn.

[68369.]—**Lawn Mowers.**—The makers recommend you to sharpen by revolving the knives backwards in their place, with a little emery, if necessary. This also sharpens the fixed knife, against which they must be pressed by turning the adjusting screws. Nephesh.

[68369.]—**Lawn Mowers.**—To grind lawn mowers without removing cylinder-cutter, "Jim" should procure some No. 0 emery powder, and mix the same with a common oil—linseed I use—to the consistency of thick cream. Strip the gear off the machine, and attach a cranked handle to the cylinder spindle. Now apply the emery to the cutter, rapidly revolving the same in the opposite direction to its usual motion; this to be continued until a piece of paper can be cut between the cylinder and knife. Clean off and fit up.

Emery.

[68372.]—**Induction Coil.**—You will find the description (with cuts) of an effective coil-winder in an article by Perren Maycock in the "E.M." for 1887; or, if you cannot refer, you will find the same, figured and described, in my "Electric Bells," p. 71. See advertisement in Sale Column.

S. Bottone.

[68373.]—**Surgeon.**—The entrance is by competitive examination. Candidates must be between the ages of 21 and 28, and must be able to produce satisfactory certificates of their moral character. They must also pass a personal examination to be certified free from organic disease, or mental or physical defect. They must be able to produce licenses to practise both medicine and surgery, and be registered under the Medical Act. The subjects of examination are medicine, therapeutics, chemistry, and pharmacy, and will be partly practical. Languages and natural science will be taken up as extra subjects, and the marks gained in them will count towards the result of examination. Successful candidates will go through a course at the Royal School of Military and Naval Medicine, Netley, during which time they will receive 5s. a day with quarters, or 7s. without. Before receiving commissions they will pass an examination in—1, hygiene; 2, clinical, naval, and military medicine; 3, clinical, naval, and military surgery, pathology of diseases, and injuries incidental to naval and military service. The rates of pay for the first years of service are—Under 5 years, 11s. per diem; under 8 years, 12s. 6d. per diem, with retiring pensions and half-pay after a certain length of service. Some time ago the reorganisation of the Army Medical Service rendered it a much more desirable profession, and possibly the schemes to place the Naval Medical Service on an equal footing may have been carried out. The education is rather expensive, unless the aspirant has relatives in good practice. Eos.

[68375.]—**Atmospheric Pressure.**—What, no soap? Please make your query intelligible.

Nephesh.

[68375.]—**Atmospheric Pressure.**—There is some air left between bottom of piston and bottom cover and valve. If all is tight, you will experience the full atmospheric pressure until the piston moves slightly, when the pressure will decrease inversely as the volume the small quantity of air left occupies.

Bristol. T. C.

[68376.]—**Voltmeter and Ammeter.**—To Mr. Bottone.—There is a series of articles entitled "Electrical Measuring Instruments," written by me, now appearing in *Electrical Plant*, published by Wheatley, Kirk, Price, and Goulty, which will exactly meet your requirements.

S. Bottone.

[68377.]—**Manchester Dynamo.**—Armature of Pacinotti ring pattern, laminated, 7in. outside diameter, 8in. deep; field-magnet cores 3¼in. diameter, 10in. high; bed and top plate 1¼in. thick, 21in. long, 8in. deep. Series wound, with about 12lb. No. 14 on armature, and 15lb. No. 12 on each of the two F.M. cores, coupled in parallel. Use the Brochie Pell lamp. S. Bottone.

[68379.]—**Furnace Lining.**—Use circle firebricks and fireclay, and dry after being lined; then fill up any cracks with fireclay before charging with metal. You do not need any road sand or clay to go next fire. When your furnace gets holed, use fireclay and chips of firebrick to fill up with. Use limestone, or burnt iron, or oyster-shells to make slag liquid. Cast Iron.

[68380.]—**Circular Holes in Marble Slab.**—A piece of saw-blade or other thin steel, bent round into a circle, the size of the hole required, and rotated on itself, feeding with sharp sand and water.

Nephesh.

[68386.]—**Slow Motion by Band.**—Of course the band travels sideways, the same as a screw, and you cannot prevent it. Make the band embrace nearly ⅓ or so of the smaller circumference by means of a small guide-pulley placed on the slack side of band.

Bristol. T. C.

[68386.]—**Slow Motion by Band.**—Your idea will not work. The reason is, that a revolving cylinder gives off a band or strap at the same point in its circumference that it took it on at. A rope can be given on and taken off in the way you think, by using a smooth cone instead of a pulley; the cone allows the rope to "surge," but this is no use for your purpose. Crossing your band will help you a little; but, of course, will reverse your motion.

Sandy Dunn.

[68386.]—**Slow Motion by Band.**—The screwing-off effect is just what "would be expected." The querist should use a grooved pulley, and if the pulley is very close to the driven wheel he might have a guide pulley on the slack side of the line to compress it round the pulley and make it embrace a greater portion of its circumference. He could obtain the same effect by crossing his band. There is no really practical way of using a cord passed twice round the pulley; it is certain to chafe. Rosin the band well. Nephesh.

[68386.] — **Slow Motion by Band.** — The difficulty which "Antares" finds in driving from a small encircled pulley to a larger, occurred to me in trying the following:—A short piece of stick, pointed at each end, inserted towel-roller fashion between two cheeks of wood, drawn together by a twisted cord like a frame-saw. A cord, wrapped spirally for grip, round the stick, and pulled sharply to and fro, caused sparks to fly from the bearing points. When the friction at the points exceeded the grip of the cord, the roller would stop, and the cord slip, cutting a spiral and keeping in the thread thus cut so long as the roller remained jammed, but leaving it immediately the roller revolved, and travelling along it. Now, the driving band not being endless, allowed a lap to be put on, and one taken off for each revolution, and by doing so alone could the band be made to remain in the groove. The number of threads has nothing to do with the travelling of the cord: it is a question of a fresh lap for one travelled along. Use may be made of guide pulleys to lead on and off, a smooth faced pulley, or the driver, and driven pulleys may be set, not in the same axial plane. Joselene.

[68389.] — **Cavalry Regiments.** — "Mounted Infantry" will be an important branch of the army in future wars; already its great services in the Soudan and Burmah have induced the War Office to order its extended introduction. It can silence field artillery and repel cavalry by its mobility and long range of fire. Any young soldier who is a good rider and crack shot will be sure to rise rapidly. A dragoon in India during peace time leads a rather easy life for six months of the year; not so elsewhere, except in the Household Cavalry. The recruit should enter a smart infantry regiment, as the Rifle Brigade or 60th Royal Rifles. Eos.

[68389.]—**Cavalry Regiments.**—It is impossible to give an opinion from the data given, as to what branch of the service would be to the advantage of this young man. That depends upon his character, tastes, and inclinations. There is more work of a manual nature in the cavalry than in the infantry, as the trooper has to clean his own horse, saddlery, and stall; but he has less guard duty, as the cavalry do not furnish any garrison guards. If a young man has any go in him, though he may not like the drudgery detailed above, he could not find the riding-school irksome. After all, the life is a rough and active one, compared to that of a clerk in an office. However, should he enlist, he can now on very easy terms get his discharge, should he find the career unsuited to him. All these matters he can learn by inquiring at the barracks in rear of Trafalgar-square. G. G. B.

[68390.]—**Hagioscope.**—This is sometimes called a squint, and consists simply in a hole pierced through a wall or pier of masonry in such a manner as to allow of the altar being seen from an aisle, transept, or other portion of the church from which it would otherwise be invisible. In the unreformed worship, it was necessary that a worshipper should be able to see the elevation of the Host by the priest, when an opening was made in the outside wall, so that persons standing outside the church could see the same ceremony. It is usually called a lepers' window, often made broad and low, so that several persons can see at the same time. Nephesh.

[68391.]—**Hot-Water Circulation.**—"Nemo" may look out for "trouble in de house" if he alters his pipes as he suggests. He should most certainly carry his expansion pipe to the upper cistern, or the weight represented by the column of water in C, the new feed, will in all probability at some time or other force out the plug in X, or find an outlet elsewhere. With X plugged up there is really no expansion pipe at all. Gas ⅜ compo. will do for the supply, if "Nemo" wants to make an aquarium of his attic this summer and a skating-rink during winter; but if he wants to keep it high and dry, he had better use a proper lead water pipe. SKIBO.

[68392.]—**Four-Pole Dynamo.**—To Mr. Bottone.—Certainly there would be a great difference. 1st, during one rotation, supposing each of the four pole pieces gave as intense a field as the old two pole pieces did, the E.M.F. would be doubled; 2nd, the resistance of the armature coils being diminished by being cross connected, the ampères would be increased. S. BOTTONE.

[68393.] — **Dynamo.** — To Mr. Bottone. — Reckoning that you have got 2¼lb. No. 18 on your armature, you should get at 2,000 revs. per minute an E.M.F. of about 80 volts. I do not know whether I have read your meaning aright about four coils on the field magnets, as meaning that you have four wire spaces, each 1½ by 3½ by 2½; but even in that case you have far too little resistance in the F.M. wire to balance that of the armature. I reckon you have only 5lb. No. 20, or thereabouts, whereas you would need nearly 10lb. of No. 22 to give the best results. Mind, your machine will work with the amount and gauge you propose; but it will be wasteful of power. The machine, if well constructed, and of good iron, should be able to light 4 lamps of about 60 volts each, at a speed of 2,000 revs. per minute, absorbing while so doing about ⅓ to ½H.P.

S. BOTTONE.

[68396.]—**Dynamo and Transformer.**—To S. Bottone.—You may use No. 12 gauge wire on your armature, and remember that in the Weston machine these are coupled up in parallel. Put about ten yards on each of the six poles. The field-magnets must be wound with No. 10, and these also so coupled as to get N.S., N.S., N.S. poles alternately. But you will find the Weston a great nuisance for plating work, since, being series wound, it is so apt to "reverse." Weston uses a very ingenious automatic break, which breaks circuit when the speed slackens. But even with this, if the bath is sending a strong back current, the dynamo will reverse sometimes. Of transformers I know next to nothing. S. BOTTONE.

[68397.]—**Shellac Solution.**—Absolute alcohol, or spirit rendered pure by the bladder process, will be found to give good results, provided the lac be genuine and unadulterated. Bleached lac can be prepared giving an almost transparent varnish. In Holtzapffel's book, Vol. III. pp. 1393-4, are four distinct processes of decoloration, too lengthy to copy here. I think bleached lac can be bought.

EOS.

[68397.]—**Shellac Solution.**—Ordinary sealing-wax contains other substances besides shellac, such as chalk, plaster of Paris, or sulphate of barium. Possibly one or other of these, finely powdered and well mixed with the solution of shellac in methylated spirits, might act as a clarifier and carry down the insoluble fatty matter which keeps the supernatant liquid turbid. A detailed method of obtaining shellac in the condition to be soluble in alcohol is given in ENG. MECH., Vol. XXXVII. p. 26, also in Gmelin's "Handbook," Vol. XVII. p. 420. A. LLOYD.

[68397.]—**Shellac Solution.**—Some years ago I cut out of the "E. M." the following note, which may give the information required by your querist:—"A simple mode of clearing turbid solutions of shellac in spirits of wine is to add to the same a quarter of their bulk of benzine. If the mixture be agitated three or four times during the space of an hour, and then allowed to stand, it speedily separates into two distinct layers, the upper one is a solution of the fatty or waxy matter in petroleum spirit, the lower is a brilliant alcoholic solution of pure shellac. The petroleum spirit only dissolves to a slight extent in the other liquid, and the latter when drawn off is easily freed from it by slightly warming with gentle agitation. Crude lac of any kind may be caused to give an absolutely clear solution in alcohol if it first be roughly powdered and then washed with warm petroleum spirit once or twice, so as to dissolve out all the fatty matter. This latter has the advantage of simplicity, while at the same time the quality of the lac is in no degree injured." E. D.

[68399.]—**Ventilator.**—To M. Noble.—I think your two 10in. pipes are far too small. You do not give size of coppers, so cannot advise as to size of ventilator. I fixed three 2ft. 6in. ventilators with conical tops in a roof a short time ago to carry off steam from hot water used for washing purposes, and these are barely large enough, and no coppers in building. I think the best thing for you to do is to put cabin heads on your coppers, with sliding-doors, and (wood) funnel through roof, which will prevent steam from getting into building. Write and give size of coppers, and I will assist you. I fixed some this way last year, and they answer very well. B. T. J.

[68401.]—**Varnish for Boiler.**—Use Brunswick black.

Bristol. T. C.

[68405.]—**To Mr. S. R. Bottone.**—The size of F.M.'s for a 10c.p. lamp should be ⅝in. thick, 6in. high, 4in. wide; this includes the space for armature tunnel. The armature should be 3¾in. long, 1⅝in. diameter. Wind the armature with 4oz. No. 20, and the F.M. with 4lb. No. 22. Couple up in shunt. Supposing the lamp to be a 10c.p. of 22 volts, you would need 6 cells of an accumulator, each cell being 6in. by 6in. by 1in. I do not understand your description of motor, so I cannot reply satisfactorily. Send a sketch, and I shall see what you mean. S. BOTTONE.

[68407.]—**Engine Query.**—Practically I should take one crank as vertical (or, rather, square with connecting-rod), with the full pressure on it. This will be $22^2 \times \cdot 7854 \times 40 = 15{,}200$lb., and ⅝ths of this would act at circumference of drum, or 9,500lb. The rope would weigh 1½ ton, and the cage, &c., perhaps the same; these and the friction would make up for the other cylinder when running, but would not start with more than 3 tons.

Bristol. T. C.

[68408.]—**Science Exam.**—The reason why it is a good arrangement is that we obtain the desired movement with the fewest parts. The tangential pressure is the pressure acting in a straight line square with any radius of a circle. If the mean tangential pressure on the circle traversed by the crank-pin is 16,450lb., the mean tangential driving pressure on the pitch circle of both pinion and driving wheel (less friction) will be $\frac{4}{15}$ of 16450 = 4386·6lb.

Bristol. T. C.

[68410.]—**Striking Clock.**—The striking gear seems to be all right in your clock, but to fail in the letting-off. Perhaps the pins in the hour-wheel have got bent, or the lever wrong. Try the clock round by turning the fingers, and notice if it "warns" with regularity and certainty, and then lets off correctly at the hour, and the same at the half-hour. Of course, after missing once, the next time it strikes it will strike the hour it missed before.

NEPHESH.

[68412.]—**Engine.**—Not possible.

Bristol. T. C.

[68415.]—**Dynamo.**—To Mr. Bottone.—For 100c.p. Manchester type, with armature 4⅝in. diameter, 3in. deep, use 4lb. No. 18 on the armature, and 20lb. No. 22 on the fields. Plates ¼in. thick are much too thick. You might as well have a cast ring at once. My punchings are $\frac{1}{25}$in. thick, so 75 go to the 3in. required. S. BOTTONE.

[68419.] — **Decomposition of Water by Electricity.**—I presume your gas-engine indicates 2H.P. I give following on that assumption. Back E.M.F. = 1·5 volt, resistance of cell between electrodes 0·0225 ohm, effective electrical H.P. = ½ = 373 watts. Suppose we assume 100 ampères to pass, this gives 3·73 volts, of which 1·5 are absorbed in overcoming counter E.M.F., and 2·25 in overcoming resistance $= \frac{2\cdot25}{100}$ grammes of H per ampère hour = 0·03738 = 3·738 grammes per 100 ampères per hour. 1lb. = 453·58 grammes. $\therefore$ weight of H given off $= \frac{3\cdot738}{453\cdot58}$lb. 1c.ft. hydrogen = 0·0056lb. $\therefore$ c.ft. given off $= \frac{3\cdot738}{453\cdot58 \times 0\cdot0056}$ = 1·5c.ft. about.

Govan. ENGINEER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

67786.	Race Game, p. 507.
67809.	Solid Couplings, 508.
67815.	High and Low-Angled Lenses, 508.
67816.	Limelight, 508.
67825.	Oleaginous Water, 508.
67832.	Motive Power, 509.
67834.	Pulverising Metals, 509.
67840.	Scaffolds, 509.
67843.	Value of Constant, 509.
67844.	Magnetic Machine, 509.
67847.	Ivory Thimbles, 509.
67848.	Heat Rays, 509.

68069.	Division Plate and Index for Lathe, p. 60.
68074.	Coppers, 60.
68079.	Trigonometry, 61.
68088.	Preserving Vegetable Colourings, 61.
68093.	Colouring Benzoline, 61.
68101.	Engine Query, 61.
68104.	Catering, 61.
68106.	Clock and Watch Springs, 61.
68112.	Incubator Regulator, 61.
68117.	Derrick, 61.
68118.	Holland, 61.
68121.	Screw-cutting, 61.
68133.	Grey Parrot, 62.

QUERIES.

[68421.]—**Bicycle Head.**—What is advisable to do in this case? My bicycle head has started a crack about ⅜in. from its junction with the fork. Can it be repaired in its present condition?—MANCHESTER.

[68422.]—**Voice Lozenges.**—Can any reader give me a recipe for making a good voice lozenge for rendering the voice clear and melodious, one that would also give relief in sore throat preferred?—SUGAR BOILER.

[68423.]—**Cleaning Grand Piano by Collard and Collard.**—I have searched through many volumes of the "E. M." in order to discover how to remove the action of a grand piano by Collard and Collard. Unfortunately, Vol. XXXII., to which correspondents frequently refer, is missing, and I have, therefore, been obliged to try and find out what I wanted by putting two and two together. At pages 454 of No. 1,088 and 159 of No. 1,125, both of 1886, I found instructions by Mr. W. H. Davies which appeared to meet my case; but although I tried most patiently over and over again, I found myself unable to remove the white keys under which the screws that fasten the action are stated to lie. I had first removed a small bar of white wood, which it was obvious would have to be removed, as it lay flat across the centre part of the keys; but I conclude that the hammer frame referred to by Mr. Davies, is a piece of white wood (furnished with two knobs) that forms a sort of elevated bridge right in front of the hammers themselves. I suppose that has to be removed before the white keys will come out. How am I to do it? The screws at either end of this bridge are so placed that no screwdriver ever invented could be inserted to reach them. There is also a long screw with two brass rings, or nuts, that extends downwards from the centre of this bridge into the keyboard. Must it come out? It is in this elevated bridge (?hammer frame) that the tops of the notes (?hoppers—viz., things that look like a row of small railway danger signals with one arm up) persistently catch when I try to remove the keys. I am, therefore, at a standstill in my efforts to clean out the well of the piano, and as the notes sometimes stick, and sometimes strike the strings with a dull thud, and at other times behave all right, I conclude that it is only dirt that causes it, by getting in where it should not. I have already removed an indescribable amount of dust, grit, birdseed, insects of sorts, chrysalides, spiders, and shreds of paper from parts of the piano where I should not have thought it possible for even one of them to exist. The strings are in perfect order. Will Mr. Davies or anyone equally charitable give me the simplest directions possible for taking out the action and removing the keys? Mr. Davies says the "box" or treble action has to be removed first. What is the box? Must the pedals be unscrewed or left alone?—BENGAL.

[68424.]—**Reversing Model Locomotive.**—Will some of our readers kindly tell me how to reverse model locomotive with single-action oscillating cylinders? —J. J. B. W.

[68425.]—**Bicycle Chains.**—Can any reader kindly tell me if bicycle chains are hardened and tempered? If they are, how, and what colour and temperature are required?—H. S.

[68426.]—**Lamp.**—Will Mr. Bottone oblige by telling me what lamp I could use with four quart chromic-acid battery, double-fluid, to light two or three hours a night; I mean voltage, and c.p.?—JAS. A.

[68427.]—**Sweaty Soles.**—Would "Jack of All Trades," or some equally great authority on boots, kindly advise me as to causes and cure for a certain dampness or sweating in the soles of some boots, leading to cold feet? I have boots I cannot wear on account of this fault, probably due to some carelessness in tanning the leather. My shoemaker pooh-poohs it; but I know, who wear the boots.—SOLVARDO.

[68428.]—**Problems.**—Can any of "ours" with a mathematical turn assist me in solving one or both of the following problems, recently set by the Science and Art Department in the third stage? 1. In the formula—

$$\text{Cos. } A = 4 \cos.^3\frac{A}{3} - 3\cos.\frac{A}{3}$$

If the value of cos. A be given, show geometrically that there are three different values of $\frac{A}{3}$, and point out all the angles to which they belong. 2. Show geometrically that—

$$\text{Sin. } A + \sin. B = 2\sin.\tfrac{1}{2}(A + B)\cos.\tfrac{1}{2}(A - B)$$

when each of the angles is less than a right angle. Are there any books published which give geometrical solutions to these formulæ and similar ones?—H. M.

[68429.]—**Problem.**—In Williamson's "Differential Calculus," p. 26, No. 22, the following problem is given. If—

$$(x + y\sqrt{-1}) = (\alpha + \beta\sqrt{-1})^n$$

Prove that—

$$\frac{dx^2 + dy^2}{x^2 + y^2} = n^2\,\frac{d\alpha^2 + d\beta^2}{\alpha^2 + \beta^2}$$

How is this result obtained?—J. L.

[68430.]—**Induction-Coil Making.**—To F. W. Mason.—I have made a 4½in. induction coil, as described by you in "E.M.," Feb. 1, Vol. XLVIII.; but, having by me a quantity of No. 34 d.c.c. wire, have used this for secondary (about one pound), which I soaked in hot melted paraffin wax previous to winding. Each layer is well insulated with good paper thoroughly soaked in hot wax, and at every two layers a wire is carried through the coil end, and soldered to studs of a six-power switch arrangement, concealed in the coil base, as illustrated at (3) Fig. 6. Using it as a medical coil, with one chromic-acid battery, without condenser, the current through the first power (two layers) is so much weaker than the second, and the third so very much stronger, and doubly so each power up to the 6th, that I should like to add some form of regulator, other than the water regulator, in order to get a more graduated current, and thus prevent the too sudden jumps from one power to the other. Can this be done?—and how?—without injury to the coil? With the condenser on, the first power is disagreeably intense, and the second too strong for anything; but if switched on to the sixth power, which throws the whole pound of wire into circuit, I get nearly a ½in. spark. I have not room in the coil base for a condenser of 50 sheets tinfoil 3¾in. by 3¾in., but have used 85 sheets 1½in. by 2¾in. Is this sufficiently large to obtain the best results? I have room for more sheets, 1½in. by 2¾in. Should there be any sparking between the point of contact breaker and clapper when the condenser is on? I have not fixed a commutator to alter the direction of the current, but have arranged a switch to throw the current on and off. Can you describe a switch that will change the direction of the current; all the connections to be hidden in the base? Shall be pleased to see your promised paper "Coil Phenomena" in an early number of "Ours."—H. Green.

[68431.]—**Strength of Beams.**—Some writers on this give the equation $M = I\,p$, M being the bending moment, I the moment of inertia, and p the intensity of stress on the area element at unit distance from the neutral axis, or $p = \frac{M}{I}$. Then the intensity of stress on the extreme area element is $\frac{M}{I} \times \frac{1}{2} D$ or $\frac{M}{{}^1/_{12}\, B\, D^3} \times \frac{D}{2} = \frac{M}{{}^1/_6\, B\, D^2}$. Applying this to a cast-iron bar, 1in. by 1in., 12in. between the bearing points, with 1 ton in the centre, M is ½ ton × 6in. = 3in. tons, and $\frac{3}{{}^1/_6\, B\, D^2}$ = 18 tons per square inch. But no cast iron will bear a tensile strip of 18 tons per square inch. Does not this mean that in the case of a material of which the tensile and compressive strengths are equal, the strength modulus depends on the shaded area in Fig. 2, and not on the shaded area in Fig. 1, and that, in the case of cast iron when the bar is loaded to breaking, the neutral axis 0-0 approaches that part of the bar which is in compression, or have I gone wrong in applying the formula?—Student.

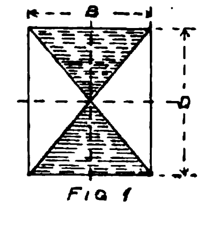


FIG 1

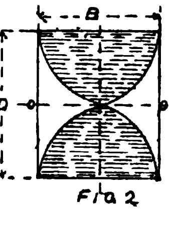


FIG 2

[68432.]—**Horn.**—Will one of our readers kindly give me a tried and practical way of dissolving and softening horn, so that I can mould it to any form?—E. Parfitt.

[68433.]—**Bacterium.**—I have been examining some hay-tea which I had prepared to generate bacteria. In one tube I had the tea boiled, in another the tea was unboiled; both tubes have been placed together for the same time in a damp place. On my examining the unboiled tube I found fungus situated on top of the tea, resembling "penicillium"; also the bacteria in abundance. I, however, failed to observe the oscillating motion in the bacteria. I also found in this tube some torulæ. In the tube containing the boiled infusion, I failed to observe any bacteria; I found some torulæ. Would any microscopist help me in explaining if I am right with the fungus, and why did I not see any movements, as should have been? How did the torulæ come to be there? Would they be the same as the torulæ found in yeast? In the boiled infusion, the boiling would have destroyed the organisms; but should the bacterium in the air not find their way into the tube? The tube is ¾in. in diam. and 6in. deep—would they find their way into so small an opening, they being so light in weight?—J. B. P.

[68434.]—**Air-Pump.**—Will anyone tell me how to make an air-pump of any sort cheaply without a lathe, to be used for vacuum tubes, &c. What would be the cost of mercury in a Sprengel pump? Could one be made with water instead of mercury without being very enormous? I suppose not?—E. M. Eden.

[68435.]—**Screw-Cutting.**—My difficulty lies in the fact that, on taking a second cut along the work, the clasp-nut does not always engage with the guide-screw, so that the tool falls into the previous path traced out by it. I understand that if the work and guide-screw both contain an equal number of complete threads per inch, not necessarily multiples of one another, the saddle can be moved back any complete number of inches after taking a cut, and the nut will close all right; also a similar proceeding with regard to half-inches. Could any of "ours" give a practical rule for unequal pitches between work and guide-screw? I understand manipulating the change-wheels.—A Young Turner.

[68436.]—**Equatorial Telescope.**—In Webb's "Celestial Objects for Common Telescopes," page 9, it is stated in a note that a very cheap equatorial stand is described in the "Astronomical Register" XIV. 35. On inquiry I learn that no such description appears in that publication at the place indicated. As Webb's work is often mentioned in the English Mechanic, I shall feel obliged if any reader will inform me whether the mistake lies in the name of the book, in the volume, or in the page quoted. What I want to know among other particulars is, how the circle for right ascension should be graduated, and whether a meridian line, drawn from a magnetic observation, allowing for the deviation of the compass, is sufficiently accurate for an equatorial roughly graduated on cardboard?—G. G. B.

[68437.]—**Blowpipe.**—Can any reader give me instructions and drawings for making a gas-blowpipe for glass blowing, and bellows or fan to work with it? I have no lathe, and the bellows I have made are not nearly continuous enough.—E. M. Eden.

[68438.]—**Spirits of Camphor.**—What is the effect of this when taken internally? My wife took a teaspoonful for a cold. It certainly cured the cold; but she has been in a very low state of health ever since, now over two months ago, but not until two or three days after taking it. Symptoms, a kind of dyspepsia. She wants to know if this was the cause, as there seems to be some doubt on the subject in the minds of all I have asked.—N.

[68439.]—**Gas-Works.**—I have charge of a small gas-works, with four cast-iron retorts in one furnace. It is very hard work to keep them at a very dull red heat. Now we are going to rebuild them in furnace. Will any kind reader please give me a rough sketch the best way to arrange them in furnace, with flues and height of chimney? I burn the cokes for heating retorts with. In the winter time we use about 6,000ft. of gas per night, and it takes me all my time to make it. I put 1cwt. of coal and one quarter of cannel in each retort per charge, and four charges a day in each retort; the last charge is put in between 9 and 10 o'clock at night, and drawn again between 5 and 6 in the morning. Any information on the above query, or name of a good book on the production of gas-making, will be thankfully received.—Gas-Man.

[68440.]—**Optics.**—Given the refractive index of light, say between air and water; and also between air and some other medium, say glass, is it possible from these data to calculate the index between water and glass? And if so, how?—J. L.

[68441.—**Trade Directory.**—Can any of "ours" kindly inform me if there is any published directory, or other means of obtaining the names of those engaged in any particular trade, as, for instance, watchmakers, throughout the kingdom? The "Post Office Directory" contains the addresses of residents in London; but how can the same information be obtained as to country towns and villages?—Amor Bosquets.

[68442.]—**Casting.**—To "Jack of All Trades."—In your reply on p. 264 of last vol., you do not state what is necessary to be done to prevent the damp powdered bath-brick from adhering to the pattern. This it did with me in every instance, and I have had to give it up till I hear your reply. I tried every shade of dryness and dampness in the sand. I also tried greasing and oiling the medal being used as pattern, but all of no avail. Although not the original querist, I am greatly interested in this subject, and will feel obliged by your advice.—Lux.

[68443.]—**Telescope.**—Would Mr. Lancaster, or some other reader of "Ours" who understands the subject, be kind enough to tell me how to alter the haziness of my telescope. It has plenty of power, but objects when in focus are not clear—in fact, a much smaller one in my possession, not half the power, makes things look perfectly distinct. The lenses are quite clear, and free from scratches. Being a watchmaker, perhaps a few useful hints would enable me to put matters right.—O. C. T.

[68444.]—**Ventilation.**—1. I desire to get rid of gas fumes from a much-used apartment. A ventilator into the chimney smoked, and had to be closed. Holes in the ceiling over the gas-burners only cause a down-draught which makes the matters worse. I inserted tin tubes with bell mouths, with the same result: valves placed on the upper ends remained closed, by reason of the downward pressure of cold air. I am at the end of my resources. Can any one help me? 2. What would accumulators for three 5c.p. lamps cost?—Nomad.

[68445.]—**Dust all about.**—Will some reader help one in a fix? 4 pair of 4ft. 6in. stones grinding coprolite, and have a fan for heated air. The coprolite passes through breakers and rolls before arriving at the stones, 20 tons per day. During this process the mill is continually full of dust. Will an additional fan pull this dust away? Please oblige with advice, and sketch of fan, or other method. Cannot connect to present fan, for it has all it can do.—Very Dusty.

[68446.]—**Flat-Bottomed Canoe.**—Will some one kindly tell me if a flat-bottomed canoe can be used with a sail? If so, by what means is the hold got on the water? Would a keel fastened with screws do, or must a centre-board be used? All directions as to thickness of wood, method of fastening, &c., will be thankfully received. What would be the best shape for sail?—Rhenus.

[68447.]—**To "Jack of All Trades" or Mr. Clark.**—I want to paint inside a grocer's shop mahogany, and as I can only do a small portion at a time, as goods require to be moved out of batches and drawers and there left until the work is finished, something is required to dry quickly. Will you give me a recipe for a quick-drying paint containing not too much turps, nor one that works fatty, and proportions of colour for ground for light mahogany (the grain I can imitate in distemper), and what description of varnish to use? Will spirit-varnish or brush polish do, or will the work crack if done with this? I have carriage varnish and also quick-drying oak, but these are slightly tacky for a day or two, and goods stick to them if placed on shelves, &c., next day.—H. G.

[68448.]—**Horizontal Engine.**—Thanks to "T. C., Bristol," for giving sketches of bed and ports of engine; but will he say what cut-off it will give? I want to get as early a cut-off as possible. Also say what sizes of valve rods, eccentric rods, and connecting rods; also length of same, as I cannot scale them near enough. Please say if bosses are cast on bed for holding down bolts and centres of same.—Amateur.

[68449.]—**Watchmaking.**—To "Welsh Horologist."—Please say how I must fit new verge in watch, as you said I should have to do.—Amateur.

[68450.]—**Portable and Standard Cell.**—Would F. W. Mason say why a sulphate of mercury cell made with the same care as the above, does the same work just as well as the silver chloride, at least for coil working? It would be quarter the cost and one-sixth the size for the same coil.—B.

[68451.]—**Red Shadow.**—Whilst I was standing in front of a window, with panes alternately red, blue, orange, and white, I noticed that my shadow on a sheet behind me was distinctly red. I have often tried this since, but the shadow is always red. There is no other window in the room. Explanation will oblige.—D. N. Y.

[68452.]—**Electric Light.**—Would some electrical correspondent kindly tell me the voltage of three quart Bunsen cells, what c.p. lamp they would light, and how long they would light such a lamp?—G. M. R.

[68453.]—**Dumpy Level.**—Will any of your readers kindly give me a sectional sketch of the conical axis of a 12in. dumpy level, with sizes?—Pink.

[68454.]—**Enamelling Iron and Steel.**—Will "Potter" or any of our readers tell me how to enamel cast-iron or steel articles white or grey?—Primus.

[68455.]—**Electric-Light Carbons.**—Why are some arc-light carbons cored? What is the advantage gained? Also which should be uppermost when fixed in the lamp, the solid or the cored one? Can the wires from the dynamo be connected to either upper or lower carbon—that is, does it matter which is positive? Some carbons are coppered. Is this to improve their conductivity only, or does it affect the light produced? Are cored carbons ever coppered? I ask because I never saw one.—F.R.Met.Soc.

[68456.]—**Combination of Colours.**—Will one of "ours" kindly refer me to some book from which I can learn how to produce a large number of different tints by the admixture of various colours?—L.

[68457.]—**To Mr. Bottone or Others.**—I have an Elwell-Parker dynamo, 260 volts, and 10 to 25 ampères, which lights five arc lamps. How can I run 20 incandescent 45-volt lamps along with the five arc lamps from this machine? Kindly show method of connecting up. Can you tell me which are the best arc lamps (16-hour) for using with this machine? Can a compound-wound machine be used for either arc lighting or incandescent lighting, or charging accumulators. I wish to make a 10 arc light dynamo myself, as the five-lighter is not large enough for my purpose. Will you sketch me the best shape for field-magnets, also quantities of wire required, and best method of constructing the armature and commutator?—D. N. Y.

[68458.]—**Metal Slips.**—I want some strips of metal, 1ft. long, and ⅜in. by ¼in., with shallow, ratchet-like teeth on the narrow face. Can anyone give me a hint as to kind of metal that will give a sharp casting? Would type-makers supply them?—Constant Reader.

[68459.]—**Greek Pitch.**—What is Greek pitch? It is used for insulating purposes.—Elektron.

[68460.]—**Coil.**—Will Mr. Bottone or other electrical friend kindly let me know how to make a small pocket medical coil, 1½in. dia., 2½in. long? If possible, to work with Leclanché.—South Wales.

[68461.]—**Wotton Railway.**—Can any reader oblige me with information as to this line running from Quainton to Brill; as to the rolling stock used, length of line, and any other particulars known. It seems to me that the time that the journey is advertised to occupy is very great in proportion to the length of railway, as shown in all railway maps.—W. E. C. B.

[68462.]—**Turbine.**—Could any readers give me the dimensions of a turbine to fix to house main, ¾in. or 1in. supply pipe, also speed. I was wanting to drive a model dynamo. A rough sketch would greatly oblige.—Elektron.

[68463.]—**Small Dynamo.**—To Mr. Bottone.—I have made a small dynamo, 5c.p., according to instructions given in your book "The Dynamo." Commutator and insulation are all right, so are the brushes. When F.M.'s are connected to a battery I get a slight current in the armature, but none otherwise. I hope someone will put me right.—Dynamo.

[68464.]—**Oxyhydrogen Blowpipe.**—Will some of "ours" give me a few hints on using the above? I want to know the kind of jet to be used, the advantages over other heat, and the precaution to be taken for brazing purposes with compressed gases.—H. O. T.

[68465.]—**Induction.**—To Mr. Bottone.—I wish connect a battery and microphone with a primary coil, and a telephone with a secondary coil, so that I may hear the ticking of a watch very loud. What principle should guide me in selection of length and gauge of wire in the two coils and strength of current?—Caw.

[68466.]—**Breech-Block Lock.**—Would some of our obliging correspondents give sketch of breech-block and lock for central-fire walking-stick shot-gun, tube ½in. bore?—A. F.

[68467.]—**Coach Painting.**—Will any correspondent kindly tell me how the very dark greens and browns commonly seen on tradesmen's carts are produced? The colour I wish to imitate is a very dark green, almost black, picked out with light green. Is boiled oil an advantage to use with the colour for picking out? Why is a sable brush better than a camel for lining? Also, how is pumice-stone dust to be used in flatting down, and is it usual to give one coat of varnish before picking out? Any hints will greatly oblige.—A Poor Blacksmith.

[68468.]—**Queen's Taxes.**—In Feb. last a tenant of mine, owing rent from Michaelmas, left without giving notice, and, of course, also without paying the year's Imperial taxes then due; and I have not, up to the present, been able to discover his whereabouts. A new tenant has now just taken the premises, and a demand is made upon him for the year's taxes due. I wish to know whether this claim can be legally enforced either against the new tenant or myself as landlord, as, although I am justly liable for half-a-year's property tax on the rent I have received, I am not likely ever to recover the remainder, nor have I anything whatever to do with the charge for house-duty.—H. E. T.

[68469.]—**Coil Boilers.**—I am anxious to make a coil boiler to heat 36ft. of 3in. hot-water piping in a greenhouse, lean-to, about 10ft. square, and 8ft. at the ridge. I should be glad if any reader would kindly instruct me how to proceed—the size pipe in making the coil; also the class, steam or gas. Would like it to be about 10in. inside diam. Must the seam in the pipes be on the inside, outside, or on the top, and what heat would the pipe want to be before it was bent? Also the best mixture to fill the pipe with before heating. I may say I have a small portable forge and a few tools which would be sufficient for the job, I believe.—Amateur No. 1.

[68470.]—**Engine Turning—Machinagraphists.**—On a leaf I have are printed some 20 fine patterns cut by the rose engine and straight line chuck, such as would be used to engrave upon silversmith's work, &c. The leaf appears to have been cut from a pattern-book, and, at the bottom, there is a small shield with the words "J. E. and A. S. Bacon, Machinagraphist," upon it. Is this American? Could I obtain the complete pattern-book, and is it possible to see a bank-note lathe in London?—F. A. M.

[68471.]—**Circular Saw.**—Will some reader inform me the cause of saw rolling? It is not over-speeded, but the spindle seems to have worn lengthwise all one way, and saw does not run in centre of slot in table, which I think is cause of rolling, wind not being equally divided;

and if belt has more power over polished faced pulley, than one left rough from lathe tool? There is a difference of opinion in the shop I am in.—B. T. J.

[68472.]—**Painted Transfers.**—Having some railway and other coaches to paint and decorate, I should be glad if some kind reader could inform me of the process used for putting on of monograms, heralds, &c., by the transfer method, as I wish to paint the same on paper in spare time, and keep till ready to use, then transfer on another paper, and afterwards transfer again on to coach. What is put on the first paper, also on the second paper, or how prepared, as the paint will leave it freely and not damage the design and colour.—Chas. R. Chaplin.

[68473.]—**Gauge of Wire on Armature.**—Mr. Bottone, in reply 68208, has taken the gauge of wire on armature as No. 18 instead of No. 19, as in my query. Will he kindly say to what extent this will alter his opinion as to the performance of the dynamo?—J. M.

[68474.]—**Connecting Dissimilar Batteries.**—Would some one kindly tell me if I can on occasions increase the intensity (or quantity) of current from three bichromate cells by adding two Leclanchés in circuit? As the Leclanchés belong to the house bells, I do not want to injure their closed porous cells. I should use my own zinc in the outer ones.—Mu Nu.

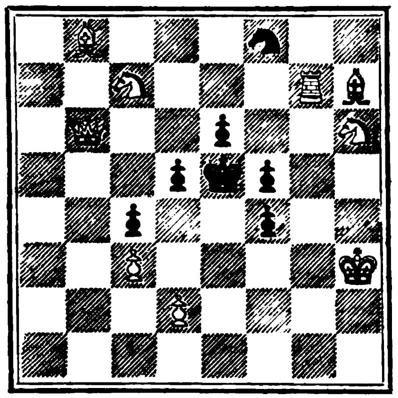
[68475.]—**Winding Electro-Magnets.**—To Mr. Bottone.—*Re* the small electro-motor which you described last February, p. 472—would you kindly tell me (1) should the cores at opposite ends of yoke be wound in opposite directions? 2. Supposing each magnet be made of one piece of rod, bent to shape (instead of two cores screwed to a flat yoke), would there be any advantage in extending the wire coils beyond the angles on to the back or yoke part? 3. What is the easiest way of testing for insulation, as you direct?—Mu Nu.

CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Uplyme, Devon."

PROBLEM MCXLVI.—By Black Pawn.

Black.



White. [9 + 7

White to play and mate in two moves.

Solution to 1,144.

White.	*Black.*
1. B-K 8.	1. Anything.
2. Q, B, or P mates, or K-K 4 disc. mate.	

(Five variations.)

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,144 by F. C. Cook (very good, but rather easy), A. Wheeler, J. E. Price, Muzio, A. Dean (but Q 3 put for K 8), Retchford, Othello, F. Fernando, A. Bolus, Mendelssohn, J. Kistruck, H. V. Tattersall, J. W. Read, F. W. N. Read (very neat), E. Sanders, J. C. Bremner, H. Warren, and J. Kilbee; to 1,143 by J. Bryden (duals, &c., good of its kind, but rather easy), J. W. Read, Muzio (duals), A. Bolus, Retchford, A. Dean, A. Wheeler (duals), J. Ough, E. Sanders, and J. C. Bremner (duals).

F. C. Cook.—Class A, for which you are entered, only includes three-movers. Your solution to Mrs. Baird's problem is quite correct.

J. E. Price.—No two-er is worth anything if it begins with a check.

F. F.—All depends on the kind of work you want, whether for problems, or games, whether advanced or elementary. If you will state your wants more definitely, we shall be pleased to recommend the best works we know of.

J. Bryden.—We must go on now as we have begun. Correspondents can easily keep their own score. Points are allowed for every additional continuation.

Muzio.—You are credited with full marks for 1141. See notice above to J. Bryden.

J. G. Hankin.—Suppose 1. Kt takes P, where is the mate in 1144?

J. Kilbee.—Yes. See last number.

F. W. Lambert.—Certainly.

H. Warren.—It appeared in last week's notices. Suppose on black's second move, white has more than two ways of continuing the attack. These additional methods are termed "continuations," and each counts. If there are only two ways of proceeding, the second is termed a dual; if only one way, the problem—so far as that variation goes—is sound.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 24, and unacknowledged elsewhere:—

T. C. Clements.—Steam.—Miner.—A. Smith.—D. B., Whitehaven.—J. W. Horton.—J. W. W.—W. G. C.—D. D. Taylor, jun.—W. Ridler.—N. S. R.—F. C. Lees.—Engine Greaser.—O. G. B. Jones.—Novice.—Very Much an Amateur.—Designer.—G. L. C.—F. W. Mason.—Light.—Appendiculata.—Elektron.—Student.—Engineer, Govan.—T. F. S. T.—Thos. Gwyn Elger.—F. A. M.—A Struggling Microscopist.—A Fellow of the Royal Astro. Soc.—Baker.—A. R. B.

F. S. H. (Cinder ash would have been better than sawdust to absorb the sulphuric acid from the broken carboy; but lime would be better than chalk, because chalk is a natural carbonate of lime, and coming into contact with sulphuric acid, carbonic acid would be given off. When a carboy of oil of vitriol is accidentally broken, use cinder ash, if lime is not handy; but lime is about the best thing (it may be old mortar rubbish), for the acid converts that into sulphate of lime, and fewer deleterious fumes are given off than if chalk were used. The chalk would, of course, speedily neutralise the acid; but carbonic acid would be given off, and free ventilation would be absolutely necessary.)—Joseph Stubbs. (The fowls which eat each other's feathers are in unhealthy surroundings, and should be turned out, to ramble over grass land preferably, or over any waste land where they can wander about. Fowls cannot be easily kept in health when cooped up, even when the "run" is "lofty," which is nothing so far as the fowls are concerned. They want a rambling-ground.)—W. W. S. (They are presumably made of fulminate of mercury, but you will find several recipes in back volumes. See Hints No. 6.)—Draughtsman. (If you cannot find what you require in back volumes, perhaps one of the handbooks of photography may answer your purpose—though what that is, or what it is you want to know, it is impossible to discover from your query.)—Mechanic. (It has been frequently stated that there is no process of cold brazing that can be relied upon where any severe strain comes on the joint. The only process that is of any use at all is that described in No. 888, and that is by an amalgam.)—Fredk. W. Chapman, Melbourne. (If the scurf is excessive, better consult a medical man; but Sir Erasmus Wilson said scurf is natural, and that, unless excessive, a daily brush is all that is needed.)—Bootle. (Is there any special feature in the injectors used on the L. and N. W. Railway? If so, mention some of the locomotives to which it is fitted, and you may possibly obtain information. Is it not the air brake to which you refer?)—Sarniensis. (Please send.)

Men who feel Weak and Nervous should wear HARNESS' ELECTROPATHIC BELT. It generates a mild, invigorating, galvanic current, which effectually restores impaired vitality, strengthens the nerves and muscles, and speedily promotes the health of the entire frame. For particulars, book of testimonials, or advice, apply at once to the MEDICAL BATTERY COMPANY, Limited, 52, OXFORD-STREET, LONDON, W. (the largest Curative Electrical Institute in the world.) Pamphlet and advice free.

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Every Additional Eight Words	0	6

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ADVERTISEMENTS in EXCHANGE COLUMN—for

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Twenty-four Words	0	3
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ADVERTISEMENTS in the SIXPENNY SALE COLUMN

	s.	d.
Sixteen Words	0	6
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*** It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post Office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

Vols. XXVI., XXX., XXXII., XXXIV., XXXVI., XXXIX., XL. XLII., XLIII., XLIV., XLV., XLVI., XLVII., and XLVIII., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

Holloway's Pills act directly on the system, removing all obstructions from the stomach, renovating the spring of life, and purifying the blood, totally eradicating liver complaints, indigestion, loss of appetite, pain in the side, &c. It is also a remedy on which the asthmatic may place dependence and obtain restoration to health.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Wanted, Stocks, Dies, Taps, Plates, (Whitworth preferred), all sizes. Exchange Dissolving View Lantern, Old Violin, Double Breech-loader, Bicycle.—Mechanic, 47, Fernhead-road, Westbourne Park.

Gas Engine, 2H.P. atmospheric, vertical, by Otto and Langden, in working order, complete, with water vessel. Offers—W. Hutchinson, Liversedge, Yorkshire.

Equatorial Mount and mahogany garden Tripod Stand and Iron Column, suit 3in. or 3½in. Telescope, slow motion, by hooks, joint, and screw.—Hutchinson, Liversedge.

Dynamo, 2 arc light machine, by Jarman; pair 15in. Globes on mahogany stands, by Newton; Plate Machine, by Newton, in case.—Hutchinson, Liversedge.

"English Mechanic," Vols. XLV., XLVI., XLVII.; "Building News," Vols. L., LI.; "Engineering," Vols XLIII. and XLIV., clean, unbound. What offers?—F. Rayner, Sherwood, Nottingham.

Wanted, Geological Ordnance Survey Maps. Exchange Astronomical Books, Map of Moon.—C. Franklands, West End-lane, N.W.

Self-acting Planing or Shaping Machine wanted. Would exchange Saw Bench, with two saws, and part cash.—Jas. Spencer, Wilton House, Bournemouth.

"English Mechanic," volumes XVI. to XLVIII. (33 vols.), 1873 to 1889, unbound, in good condition. What offers?—Apply, Clarke, Advertising Agent, Market Hall, Dumfries.

Seventy volumes Musical Literature for Astronomical ditto, Proctor and others.—Newcomb, Borrowash.

Will exchange either Gun, Violin, Telescope, or Magic Lantern for good Opera Glass, reliable maker.—Cattell 33 Hill-top West Bromwich.

Magneto Machine, good condition, cost £2. Exchange for Lantern Slides value 20s.—Gilkes, 118, Broad-street, Reading.

Plain Equatorial for 4 or 5in. Glass, or exchange.—Newcomb, Borrowash.

Horizontal Slide-Valve Engine, ⅝in. bore, 1¼in. stroke, nearly new. What offers?—R. Taylor, 94, Kamballa-road, Clapham Junction, Battersea.

Wanted, old Postage Stamps, especially those of the Colonies. No English excepting high values. Very good exchange offered.—Collector, 125, Coltman-street, Hull.

Locomotive, model of N.L.R., built off scale 1in. to the foot, 17in. long, cost £10; complete set Marine Engine Castings.—Below.

Boiler (vertical) complete and all fittings, stand 14in. high, 5 wide, iron; complete set of Horizontal Engine Castings, 1¼in. stroke, ⅞ bore.

Marine Engine, complete, slide-valve, new, 1¼in. stroke, ⅞ bore; copper and brass riveted Marine Boiler, holds one gallon water.—Below.

Horizontal Engine, complete, slide-valve, 1¼in. stroke, 1 bore, complete; Sewing Machine Stand.—Tilbury, 21, White Post-lane, Victoria Park, E.

Leading Screw, Rocking-Plate, Change Wheels, Slide-rest, rack, pinion, together or separate, for 5in., 4ft. Lathe, asked for part exchange.—Cox, Wells, Somerset.

Watch.—Sterling silver Regulator Watch, gold pivot, keeps time to a second, nearly new, warranted two years. Exchange second-hand Safety Bicycle, Light Tricycle, or offers.—W. Monks, Royal Oak, Deansgate, Manchester.

Exchange strong Compound Slide Rest, 22in. long, suit 8 or 9in. lathe, new, value £5, for Safety Bicycle or Tricycle—Baker, Robin-lane, Pudsey.

Slide-Rest wanted, 4½ or 5in. centres. Exchange "Bourne's Treatise on Steam Engine," cost 63s., and bound Vols. XXXVIII. to XLV. English Mechanic.—J. Dickson, 31, Spring-gardens, Edinburgh.

"Science for All," parts 1 to 53, 35 and 52 missing, Ward and Lock's "Technical Journal," 1 to 38; "Amateur Work," 1 to 30, 23, 26 missing; "Universal Instructor," 1 to 43, 20-1-4-5 missing; "The Metal World," Vols. I. and II., unbound. What offers? Would take Microscope.—C. Snazel, 78, James-street, Deptford.

Dynamo, 15 candle-power, nicely finished, and mounted on brass plates. Will exchange for Vertical Engine with reversing gear, or Castings.—Send particulars to C. Roberts, 37 Mount Stuart-square, Cardiff.

Wanted, Violoncello, also two B flat Cornets. Good exchange given. ⅓H.P. Marine Engine, nearly finished. Exchange anything useful.—Middleton, 65, Southampton-street, Camberwell.

Wanted, Stocks, Dies, Taps, or 4½ Slide-rest. Exchange "Studies in Design," by Prof. Dresser, outside cover soiled, otherwise no worse than new; cost 3 guineas.—Massey Neptune, Whitby

Small **Surveyor's Level**, with compass (Franklin, Manchester), mahogany box, no legs. Exchange for ½-plate Camera, lens, backs, &c.—W. Danby, Seacombe, Cheshire.

Shaping Machine, 5½in. stroke, by Ambler and Dickinson, Keighley, countershaft, &c., cost about £40. Exchange to value £25.—9, Wellington-place, Bowdon, Cheshire.

Wanted, Safety Bicycle. Exchange ½H.P. **Engine**, 20c.p. Dynamo, and Electrical Sundries.—A. S. Everett, Totnes, Devon.

Two **Induction Coils**, ½in. spark, best English make, with commutators and mahogany bases. Offers.—J. Cunningham, 66, Victoria-square, Liverpool.

Beautifully finished **Vertical Engine**, new, cylinder 2½in. by 4in., suitable for lathe or boat. Exchange Gladstone bag, value £6.—Cooke, Engineer, King-street, Southsea.

Upright Boiler, 2ft. 8in. by 23in., complete, in exchange for small vertical, or slide-rest, 7in. centres.—George Lessels, Grant's Bank, Dunfermline.

Fan Castings, complete, 20in., wants very little fitting, 2 to 4 forge fires. Wanted, tyre benders, castings, or patterns. —John Hall, Smith, Bradwell, Sheffield.

Anvil, about 2cwt. Wanted offers. Also Water Decomposer, Gold Leaf Electroscope, and 19 Smee Cells.—Above.

Splendid **Medical Coil**, with terminals for primary and secondary currents, draw-tube regulator; bichromate battery and handles, complete, quite new. Offers. Value, 30s.—Below.

3 Cabinets of **Conjuring Tricks**, nicely fitted up, cost 5s. each, never been used. Offers requested.—Geo. Harris, 17, York-street, Nottingham.

F.M. **Gramme Dynamo**, 350 watts, fitted, not wired, 12-cell Smee battery coil and box, American organ tube board, 2 sets reeds, valves, perfect.—Below.

Harmonium, 3 octave, percussion action, perfect, Pocket Accumulator, Lamp, and Brooch, new Pacinotti Ring Armature, 14in. by 4in., Tate's Air Pump, 8½in. by 1½in. Exchange Electric Bells, old Guttapercha. Offers.—Mitchell, 13, Orr-street, Glasgow.

Wanted, good **Hack Saw Frame**, also 2in. **Belting**, for large Screw-plate, Saloon Pistol, Rook Rifle, &c.—A. Halls, Cobholm, Yarmouth.

Whitney, The Scientific Exchange, 117, City-road, a few doors from Old-street. All kinds of scientific apparatus exchanged, bought, sold, and lent.

Induction Coil.—Box of six good Vacuum Tubes. Exchange for Turntable, or Micro. Accessories.—W. J. Woodward, Woodbine, Cecil-road, Upton Manor.

Splendid **Vertical Engine**, cylinder 3in. by 6in., new, sacrifice. Exchange offers.—For particulars, Alf Cotton, 1, Osborne-road, Liscard.

What offers for **Workshop Recipe**, cost 5s. 6d.; two Daniell's Batteries, cost 7s. 6d. each; single-cell Bichromate, cost 6s.; one dozen Carbon Plates, 5in. by 1½.—Barrass, 37, Bromley-street, Hull.

British Organette, new, cost £2, with music. Exchange for pair Lathe Heads, about 4½ or 5in. centres, with tee-rest.—Shannon, Thornby, Rugby.

Wanted, **Screw-cutting Lathe**, ⅝in. centre, in exchange or £18 10s. "Diamond" Frame Safety.—238, Holloway-road, London.

Coils, Dynamos, Electro-plating Baths, Bells, Cameras, &c., exchanged.—D. D. Taylor, Junior, 11, Borough-road, Sunderland, Durham.

Treadle and Hand **Sewing Machine**, by Wright and Man, suit shoemaker, cost 14 guineas, in good condition, for exchange, value £5.—Below.

Also 80 pair of **Wood Lace**, in good condition, and a Stove, nearly new. Exchange.—T. Harcourt, Zeals, Wilts.

Gentleman's Geneva Silver double-case **Watch**, splendid timekeeper, cost £3, for exchange value 25s.—Below.

Also sterling **Silver Watch Chain**, in good condition, cost 12s. 6d. Exchange.—Apply to Joseph Harcourt, Fords Water, Zeals, Wilts.

Wanted, Juvenile Tricycle, in exchange for new Dynamo to value.—Hellyar, Electrician, 144, Dalling-road, Hammersmith.

Sixty-five two-shilling parts "**National Encyclopædia**," complete, mostly uncut, and thirty-six 1s. parts "Museum of Natural History," complete, uncut. What offers, each or separate?—122, Mid-street, Keith, N.B.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—Harger Bros., Settle, Yorks.

New Illustrated Price List of **Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp —Morris Cohen, 132, Kirkgate, Leeds.

Billiards or Bagatelle, or Requisites for ditto, or Billiard Work.—Hennig Bros., High-street, London W.C.

Hat Bearer. A great luxury. Fits all hats, 6 stamps.—T. Rawson, Heaton-lane, Stockport.

Manchester Electrical Stores.—Medical Coils, Magnetos, Bells, Cells, Wires, Fittings, Chemicals. Best terms.—J. Bentley, 7, Newton-street.

Turning Woods.—Box, Ebony, Lignumvitæ, Redwood, &c. Parcels, 5s. and 10s., cut squares.—Harger Bros., Settle.

Lathes. Lathes Cheap, good. List 2 stamps.—Robinson, Catherine-street, Sheffield.

Electric Depot, 14, Deansgate, Manchester.—Handiest shop in the trade. Largest stock. Greatest variety. Lowest price.

"**The Amateur,**" a paper for fretworkers, carvers, painters, inlayers, 6d. monthly. Catalogue, 37 to 31, with 900 engravings, 6d.—Henry Zilles and Co., 24 and 26, Wilson-street (late of South-street), Finsbury, E.C.

Brass Door Plate, 9in. by 4½in., free, 4s. 6d. See specimens.—Gilkes' Engraving Works, Reading.

Stencils for sack, box, and ticket marking. Price and quality unsurpassed.—Gilkes' Engraving Works, Reading.

Mr. With's Specula. Only seven left. These are perfection. The last opportunity.—G. H. With, Hereford.

Malleable Iron Castings by our new process, clean, sound, tough as steel.—Dronfield Casting Co., Sheffield.

Lathes! Lathes! Cheap, good. List, 2 stamps. —Robinson Catherine-street, Sheffield.

Gut Band (Lathes), best, per yard, ⅛, 6d.; 3-16, 8d.; ¼, 1s.; 5-16, 1s. 4d.; ⅜, 1s. 11d. Hooks and Eyes (Steel), to ¼, 6d. 5-16, 7d.; ⅜, 8d.; 7-16, 1s.; ½, 1s. 6d. Postage extra.—Lunt's.

Taps (Engineers'), Whitworth, plug or taper, ¼, 5-16, ⅜, 8d.; 7-16, 10d.; ½, 1s.; ⅝, 1s. 3d.; ¾, 1s. 6d.; ⅞, 2s. 3d.; 1in., 3s. each, postage extra.—Lunt, Tool Merchant, 297, Hackney-road, London.

Greenhouse Stoves, portable, require no chimney, no fixing; cheap and effective.—Peters, Bartsch, and Co., Derby.

Self-Heating Box-Irons, for tailors, dressmakers, laundries, households, uniform heat throughout.—Peters, Bartsch, and Co., Derby.

Bedwarmers, Foot-warmers, Chest-warmers, Hot Dishes, giving splendid heat up to 16 hours.—Peters, Bartsch, and Co., Derby.

Protecting Wood against Decay and Walls against Dampness. Apply Carbolineum Avenarius. — Peters, Bartsch, and Co., Derby.

Astronomical Telescope.—Apparatus and parts made to order.—A. Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

Astronomical Eyepieces, any power, fitted to any telescope, 15s. each.—Clarkson.

Transit Instrument, by Ross, on iron stand, perfect adjustment, new condition; also others.—Clarkson.

Equatorial, by Cooke, of York, slow motions, will carry up to 4½in. telescope, £15.—Clarkson.

Equatorial with tripod, by Parkes, to carry up to 4in. Telescope.—Clarkson.

3½ft. **Telescope** complete, by Troughton and Simms in case, nearly new condition, £10.—Clarkson.

4in. **Telescope**, by Cooke, York, hardly used, on tripod stand, newest pattern, £40.—Clarkson.

Equatorial, by Cook, York, Driving Clock, Silver Circles, suit above, £25, or sell separately.—Clarkson.

Astronomical Telescopes.—Some in stock, by Merz, Wray, &c.—Clarkson.

Troughton's **Reflecting Circle**, by Troughton and Simms, new, suit astronomer.—Clarkson.

Astronomical silver-on-glass **Telescopes**, Mountings made for these; also flats, finders, rack, eyepieces, mounts.—Clarkson.

Astronomical Telescopes (good) sold for private owners if reasonable prices.—Clarkson, 28, Bartlett's-buildings, Holborn Circus.

Diamond Drills, from 1s. Spring Drill Stock and postage, 1s. 3d.; Pump, do., 4s. 1½d.—Below.

Diamond Points for all kinds of engraving, writing, and ruling, from 2s. 6d.—Below.

Diamond Turning Tools, for truing Emery wheels and turning hard steel, from 5s.—Below.

Glaziers' **Diamonds**, from 6s. 6d.; re-sets, 2s. 6d. Circular Cutting Diamonds, Diamonds for Lapidaries.—Below.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 3, 1889.

DISTRIBUTION OF ENERGY AND RESISTANCE IN PRIME MOVERS.

THE uniform and equable motion of a prime mover is essential to the satisfactory execution of its duties, and also to its own durability. The conditions of its existnce, however, are such that absolute equilibrium of pressure and resistance is practially unattainable, though by care in esigning, the speed may be restricted in its ariations, as nearly as is necessary for the conomic performance of work to absolute niformity.

In steam, gas, and thermo-motive engines ot only is the effort upon the piston varying n its intensity, but the resistance, uniform t the working point, is not uniform when educed to the piston. The steam-engine eing the commonest is the most convenient o take as an example to illustrate the bearngs of the question under consideration.

In this article it is proposed to deal only ith the differences arising from the arrangement of the engine itself, the resistance is assumed to be uniform at the crank-pin, herefore an analysis of the action during one troke of the piston will be sufficient for the resent purposes. Variations of resistance xternally caused are met by governing pparatus distinct from any with which we hall here deal.

To state the case generally, we have a proelling force acting upon the piston, which, uring one stroke, impresses a definite mount of work upon it, and during the conurrent semi-revolution of the crank an equal amount of work is transmitted through he crank-pin to the driving end of the machine. Friction is not considered in the nvestigation. Now, although the work given off is equal to that received for the period of the whole stroke, it is not so for any part of the stroke, so it follows that at one part an excess of work is being done, and at another the work of resistance is in excess of the energy imparted to the piston. In order to accommodate these differences, arrangements must be made to *store up* the excess of energy received from the steam in such a way that it may be given off when the resistance is greater than the propelling force. To this end the excess of work is accumulated in the flywheel, accompanied by a correspondingly increased speed, to be yielded subsequently with a falling speed, and the flywheel should be of such weight as to take up the excess of work without the increase in speed exceeding the proportion assigned as a limit.

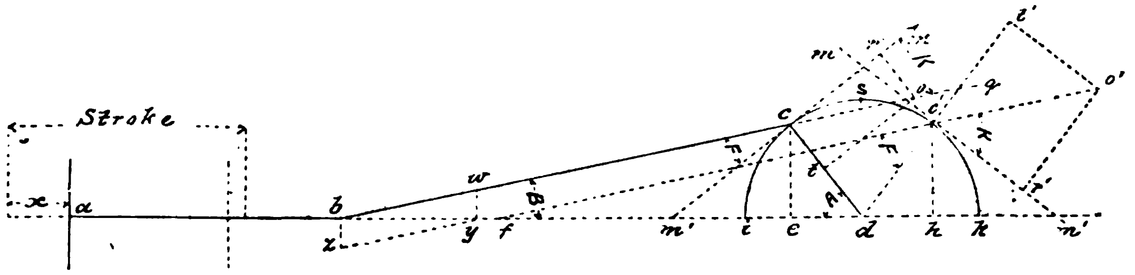

Fig. 1.

The stored or accumulated work existing in a mass in relation to its velocity may be found from the laws of falling bodies. Let W = weight of mass in pounds, h = height of fall in feet, then if U = accumulated work—

$$U = W . h.$$

But if g = force of gravity (= 32·2ft. velocity per second acquired in one second by a freely falling body), and v = velocity in feet per second of body after falling h feet—

$$v^2 = 2g . h.$$

Therefore—

$$h = \frac{v^2}{2g}, \text{ and } U = \frac{W\,v^2}{2g}.$$

If a moving body passes from one velocity to another, there must be a corresponding change in the amount of energy stored in it. Let E = the energy acquired or lost, as the case may be, while the body's velocity changes from v to v_1, and U_1 = the accumulated work at the velocity v_1, then—

$$U_1 = \frac{W . v_1^2}{2g}, \text{ and } E = U_1 - U = \frac{W . v_1^2}{2g} - \frac{W . v^2}{2g} = \frac{W}{2g} \left[v_1^2 - v^2 \right] \ldots\ldots\ldots (1).$$

As we may assign any relative values we choose to v_1 and v, it is evident that when the value of E is found that of W securing a certain limit of variation of speed can also be found, this being in practice the weight of the rim of the flywheel.

It must here be impressed upon the student that the absolute value of E is what is required; its relation to the work being done as a whole is not a factor in the calculation, and does not appear in the equation.

In order to ascertain the excess of energy to be taken up by the flywheel, it will be necessary to plot on one base two curves, one showing the resistance and the other the steam energy at every part of the stroke of the piston. The areas of these curves will give the total work of energy and of resistance for the whole stroke, the two being, of course, equal, and the area intercepted between the curves will be that corresponding to E. We will first determine the curve of resistance reduced to the piston. This curve once plotted will apply to every case, where the same proportion of crank to connecting-rod is kept.

Fig. 1 is a diagram showing the centre lines of the main movement of a steam-engine. ab is the piston-rod, bc the connecting-rod, and cd the crank revolving about the centre d of the main shaft. The semicircle ick is the path of the crank-pin centre during one stroke of the piston. The stroke of the piston being taken as a base (fg, Fig. 2), distances x, corresponding to successive angular positions of the crank, will be marked of, and at the points so found ordinates will be drawn of lengths equal to the respective resistances reduced to the piston. These distances (x) may be marked off geometrically, or, with more accuracy, calculated trigonometrically as follows:—

Let u = total work done in one stroke of the piston; R = resistance at crank-pin (assumed uniform) reduced to position of piston; R_c = resistance at crank-pin in pounds; R_1 = do of connecting-rod; C = cd = radius or length of crank in feet; L = length of connecting-rod bc in feet; x = distance of piston from commencement of stroke in feet. Also let A = the angle made by the crank cd with the centre line da; B = angle between connecting-rod and centre line; through the point c draw the straight line $m\,m'$ at right angles to dc, and produce bc to q; let K = the angle mcq, and F = the angle $m'cb$. From the points c and c' let fall the perpendiculars ce and $c'h$ upon the straight line ak.

Now, if the crank cd is in the first quadrant ics, it is evident $x = bc + cd - bd = L + C - bd$. But $bd = be + ed$. In trigonometrical terms, $\frac{be}{bc}$ = cosine B. ∴ be = L . cosine B; also $\frac{ed}{cd}$ = cosine A. ∴ ed = C . cosine A, and bd = L . cosine B + C . cosine A. Therefore x = L + C − [L . cosine B + C . cosine A]. The numerical values of the sines, cosines, &c., may be taken from any reliable book of trigonometrical tables.

Let the dotted line dc' show a position of the crank in the second quadrant; then $x = L + C - fh + dh$. By similar reasoning to the above, fh = L . cosine B, and dh = C . cosine A; therefore, for values of A in the second quadrant $sc'k$, x = L + C − L . cosine B + C . cosine A. For the distances x, then, we have:—

For values of A from 0° to 90°, x = L + C − [L . cosine B + C . cosine A].

For values of A from 90° to 180°, x = L + C − L . cosine B + C . cosine A.

Having these expressions for the distances, a formula must now be found for the ordinates, showing the corresponding resistances (R) against the piston.

u being equal to the work done through the path isk of the crank-pin, the resistance of the crank-pin at any point in that path in the direction of its motion will be $= \frac{u}{3{\cdot}1416 . C}$. From c mark off $cs = R_1$, and complete the parallelogram $crot$; then the ratio of R_c to R_1 is as cr to co; but $\frac{cr}{co}$ = cosine K; therefore $R_c = R_1$. cosine K; and the same argument applies to the position shown by the dotted lines $c'r'o't'$. In the first position, K = F = 90° − [B + A]. Because the three angles bcd, cdb, and dbc together = 180°, and $m'cd$ = 90°; ∴ $dbc + cbd$ + F = 90°, and dbc = B, and cdb = A). In the second position, K = 90° − F = 90° − [180° − (B + A)] = (B + A) − 90°. Hence in each case (B + A) is the *complement* of K, and therefore sine (B + A) = cosine K, and $R_c = R_1$. sine (B + A); whence—

$$R_1 = \frac{R_c}{\text{sine } (B + A)}.$$

Again—

$$\frac{ce}{L} = \text{sine B, and } \frac{ce}{C} = \text{sine A;}$$

$$\text{therefore sine B} = \frac{C}{L} . \text{ sine A.}$$

From b upon bd mark off by, draw bz at right angles to bd, and complete the parallelogram $bwyz$; then the ratio of the resistance on the piston to that on the connecting-rod bc will be that of by to bw; but $\frac{bw}{by}$ = secant B, therefore R_1 = R . secant B; and—

$$R = \frac{R_1}{\text{secant B}}.$$

The complete expression for the value of R is, therefore—

$$R = \frac{R_1}{\text{secant . B}} = \frac{R_c}{\text{sine } (B + A) \text{ secant . B}}.$$

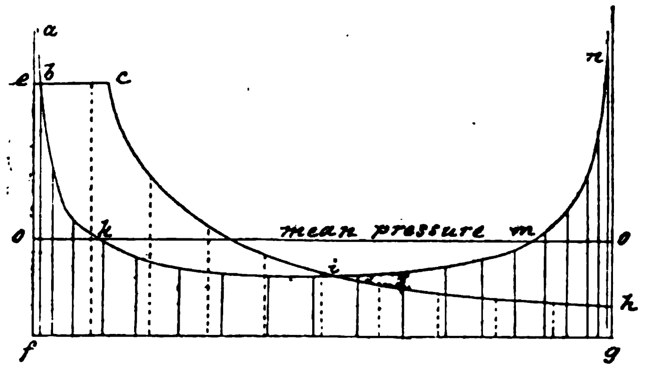

Fig. 2.

Although this curve may be worked out on a basis of $R_c = 1$, it will be more interesting to assume numerical values for a steam-engine, and this will more fully explain the course to be pursued in especial cases to which the co-efficients we obtain may not apply. Let the area of the piston be 450sq.in. (= diameter about 24in.), the stroke = 4ft., and the length of connecting-rod = 4 × radius of crank. Let the semicircle *i s k* be supposed to be divided into arcs of 9° each, and the distances and resistances at the piston calculated for each division.

For the first quadrant—

$$x = L + C - [L \,.\, \text{cosine } B + C \text{ cosine } A] = 10 - [8 \,.\, \text{cosine } B + 2 \,.\, \text{cosine } A].$$

For the second quadrant—

$$x = L + C - L \text{ cosine } B + C \,.\, \text{cosine } A = 10 - 8 \text{ cosine } B + 2 \,.\, \text{cosine } A.$$

Let the *mean absolute* pressure of the steam = 50lb. per square inch.

$$u = 450 \times 50 \times 4 = 90{,}000\text{ft.-lb.},$$

$$R_c = \frac{90{,}000}{2 \times 3{\cdot}1416} = 14{,}324\text{lb. (nearly).}$$

Because—

$$L = 8\text{ft., and } C = 2\text{ft.} \quad \text{Sine } B = \frac{C}{L} \,.\, \text{sine } A = \frac{\text{sine } A}{4}.$$

As the numerical values of the sines, &c., have to be taken from printed tables, it is convenient to tabulate the different factors of the equation as under :—

Table of Values of *x* and R.

x	A	B	Sine (B + A)	Sec. B	R
·034	9°	2° 14′	·195	1·001	73,456
·122	18	4 26	·382	1·003	37,399
·274	27	6 31	·552	1·006	25,809
·470	36	8 27	·700	1·011	20,260
·714	45	10 11	·821	1·016	17,175
·992	54	11 40	·911	1·021	15,402
1·292	63	12 51	·970	1·025	14,410
1·614	72	13 45	·997	1·029	13,962
1·936	81	14 18	·996	1·032	13,934
2·256	90	14 29	·968	1·033	14,324
2·560	99	14 18	·918	1·032	15,125
2·850	108	13 45	·850	1·029	16,389
3·108	117	12 51	·769	1·025	18,177
3·344	126	11 40	·673	1·021	20,850
3·542	135	10 11	·571	1·016	24,697
3·706	144	8 27	·463	1·011	30,606
3·838	153	6 31	·350	1·006	40,693
3·926	162	4 26	·235	1·003	60,695
3·982	171	2 14	·118	1·001	129,045
4·000	180	0 00	·000	1·000	

As an example of working the equations out, let A = 18°; then—

$$R = \frac{Rc}{\text{sine } (B + A), \text{ secant } B} = \frac{14{,}324}{{\cdot}382 \times 1{\cdot}003} = 37{,}399\text{lb.}$$

From a book of tables, we find—

When A = 18°; B = 4° 26′; cosine A = 0·951; cosine B = 0·997;

$$x = 10 - [8 \,.\, \text{cosine } B + 2 \,.\, \text{cos. } A] = 10 - [8 \times 0{\cdot}997 + 2 \times 0{\cdot}951] = 0{\cdot}122\text{ft.}$$

The sine of an angle is equal to the sine of its supplement, that is, to the sine of what it wants to make 180°; thus, when A = 135°, (A + B) = 145° 11′; sine 145° 11′ = sine (180° − 145° 11′) = sine 34° 49′ = 0·571. It is necessary to get at the value thus, because the tables do not give the sines beyond 90°.

In Fig. 2, *f g* represents the stroke of the piston, and on this are marked off to scale the distances *x* as shown, and at these distances ordinates representing the corresponding values of R are drawn at right angles to the straight line *f g*, and through the extremities of these ordinates is drawn the curve of resistance (reduced to the piston) as shown by *a*, *k*, *i*, *m*, *n*.

Upon this same base *f g*, the curve of steam pressure that shall give an amount of work equal to that of the resistance in one stroke is to be plotted.

The absolute initial pressure corresponding to a given absolute mean pressure is found from the formula—

$$P_1 = \frac{P m \,.\, r}{1 + \text{hyp. log. } r}$$

where P_1 = absolute initial pressure; $P m$ = absolute mean pressure; and r = rate of expansion. The mean pressure taken in our example is 50lb. per square inch; let the rate of expansion $r = 8$; the hyperbolic logarithm of 8 is 2·0794;

$$P_1 = \frac{50 \times 8}{1 + 2{\cdot}0794} = 130\text{lb. nearly.}$$

The steam is assumed to be moderately moist, so that the pressures will be inversely as the volumes during the stroke, in which case the pressures will be as given below for each ordinate drawn at distances from the commencement of the stroke advancing by tenth parts of the stroke. These pressures are to be set off on the dotted ordinates to the same scale as the resistances R, on the ordinates to the curve of resistance.

No. of Ordinate.	Pressure of Steam in pounds.
1	130·00
2	130·00
3	81·25
4	54·17
5	40·62
6	32·50
7	27·06
8	23·21
9	20·31
10	18·05
11	16·25

Through the ends of these ordinates is drawn the steam curve *e c i h*, and the whole amount of work is represented by the area *e c i h g f*, and also by the area *o o g f*, *o o* being the line of mean pressure.

The space *b k i c*, intercepted between the steam and resistance lines, represents the amount of excess of work to be stored in the flywheel, and again given off in every stroke of the piston. By dividing the area of *b k i c* by that of *o o g f*, we find a factor by which the value of E for a cut-off at ⅛th stroke is determined; in this case it is 0·358. The general formula for E will be as follows:

Let A = area of piston in square inches.
P = mean absolute pressure of steam in pounds per square inch.
S = stroke in feet.
C = Coefficient depending upon rate of expansion and ratio of connecting rod to crank.
E = A . *p* . S . *c*.

If the connecting-rod is four times the radius of the crank the values of *c* are:

Rate of expansion	2	3	4	5	6	7	8
Value of *c*	·266	·288	·313	·321	·327	·333	·358

By equation (1):

$$E = \frac{W}{2g} \,.\, [v_1^2 - v^2]; \quad \therefore \frac{W}{2g} \,.\, [v_1^2 - v^2] = A \,.\, p \,.\, S \,.\, c$$

$$W = \frac{2 \,.\, g \,.\, A \,.\, p \,.\, S \,.\, c.}{v^2_1 - v^2}$$

Let N = number of revolutions of flywheel per minute; and D = mean diameter of rim in feet; then $v = [3{\cdot}1416 \,.\, N \,.\, D] \div 60 = 0{\cdot}052 \,.\, N \,.\, D \,. - v^2 = 0{\cdot}0027 \,.\, N^2 \,.\, D^2$, and $v_1^2 = 0{\cdot}0027\ N_1^2 \,.\ D^2 \,.\ v_1^2 - v^2 = 0{\cdot}0027 \,.\, D^2 \,.\, [N^2 - N_1^2]$ Let N *o* = mean speed in revolutions per minute, and $\frac{N o}{n}$ the limit allowed for variation of speed. Then, if N_1 and N be respectively the maximum and minimum speeds, $N_1 = N o + \frac{N o}{2 n}$; and $N = N o - \frac{N o}{2 n}$. Then $[N_1^2 - N^2] = [N_1 - N] \,.\, [N_1 + N] = \frac{2 \,.\, N o^2}{n}$. If v = the variation allowed in percentage of N *o*, $n = \frac{100}{v}$, and $\frac{2 \,.\, N o^2}{n} = \frac{v \,.\, N o^2}{50}$. The weight of the rim of the flywheel in pounds will be:

$$W = \frac{1{,}192{,}600 \,.\, A \,.\, p \,.\, S \,.\, c}{V \,.\, D^2 \,.\, N^2}.$$

$$\text{In cwts. } W = \frac{10{,}648 \,.\, A \,.\, p \,.\, S \,.\, c}{V \,.\, D^2 \,.\, N^2}.$$

The curves from which our coefficients are taken were, of course, plotted to a much larger scale than our space here permits us to reproduce.

C.

THE ANALYSIS OF IRON AND STEEL.—II.*

By An Analyst and Assayer.

Total Carbon.

As is well known, the classification of the iron of commerce into cast iron, wrought iron, and steel depends mainly on the amount of carbon present, as also the conditions under which it exists. There are at least two conditions in which carbon may be present in iron and steel—viz., (1) in a state of chemical combination, or "combined carbon," as it is termed; and (2) in the free state, as "graphite" or graphitic carbon. Upon treating the metal containing these two varieties of carbon with hydrochloric acid, protochloride of iron is formed with the evolution of hydrogen gas, with which the combined carbon combines, with the formation of volatile hydrocarbons, while the graphitic carbon remains insoluble. If, however, solution be effected by a reagent, the base of which can be reduced or displaced, without the evolution of hydrogen, by the iron, *both* the combined and graphitic carbon are deposited in an insoluble form, and may be collected and subsequently subjected to combustion. Such is the principle upon which the methods of estimating the "total carbon" are based, which, as is evident, consist of two operations—(1) the separation of the carbon, (2) the combustion of the same.

The reagent generally employed for the separation of the carbon is a solution of the double chloride of ammonium and copper, prepared by dissolving 534 grammes of the salt in a litre and a half of water.

Five grammes of the iron or steel are weighed out into a beaker, 25 cubic centimètres of the chloride solution added, and beaker and contents gently warmed, but on no account allowed to get heated, with constant stirring, until complete disintegration has taken place. Should an insufficiency of the chloride have been employed, the liquid will become colourless, or nearly so, in which case further addition must be made. Protochloride of iron is formed while the combined

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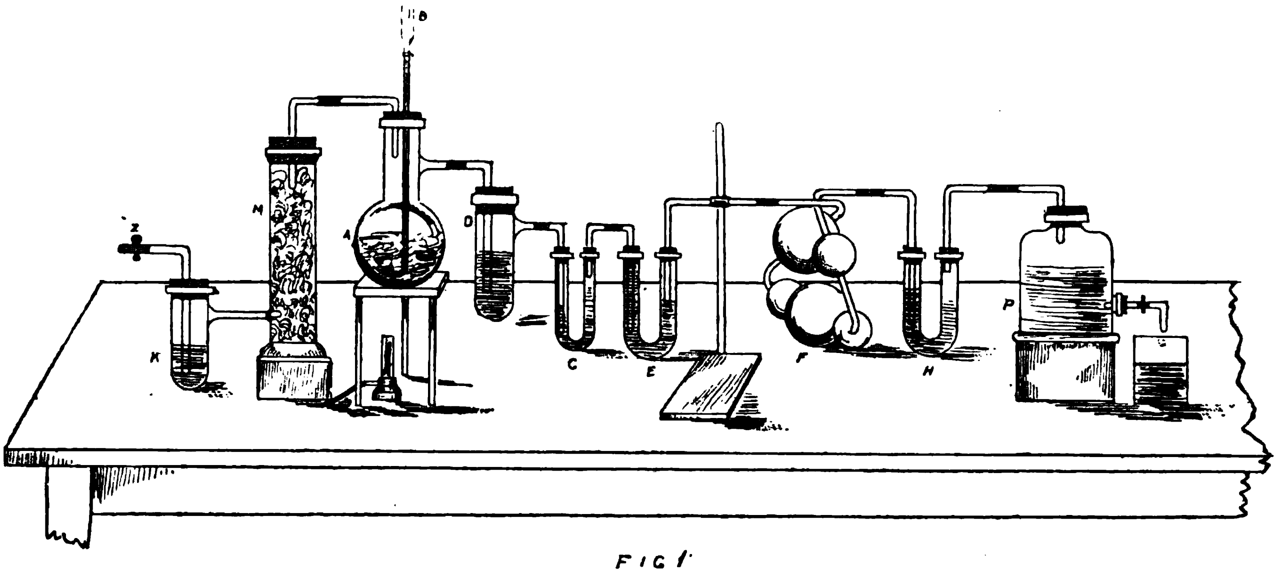

FIG 1

K, contains caustic potash solution; M, calcium chloride; A, generating flask; D, solution of silver sulphate in sulphuric acid; C, sulphuric acid; E, calcium chloride; F, tared caustic potash bulb; H, tared calcium chloride tube; P, aspirator.

and graphitic carbon remain insoluble, and are, together with a little metallic copper* deposited. To extract the latter, add a fresh portion of the chloride solution together with a little hydrochloric acid, and digest until it has dissolved; then filter through an asbestos filter constructed as follows:—Draw out one end of a piece of glass tubing about 8in. long and ¼in. diameter, and loosely plug up the narrowed portion with glass wool; on the top of this place a thin layer of fine asbestos fibre (previously ignited), and wash with water as long as any of the fibre continues to run through.

Wash the carbonaceous residue on the filter first with a dilute solution of hydrochloric acid, and subsequently with hot water, until a small portion of the washings, when acidified with nitric acid, give no opalescence with silver nitrate, upon the obtainment of which it is ready for combustion.

For the determination of the real amount of carbon contained in the crude carbonaceous residue obtained as above, either a dry or moist method of combustion may be employed. Among the latter methods is that of Ullgren's, the principle of which is that upon treating the carbonaceous residue with sulphuric and chromic acids, it is oxidised into carbonic acid (CO_2). The details of the method are as follows:—Rig up an apparatus similar to that shown in Fig. 1, and transfer the asbestos filter together with the carbonaceous residue to the flask A by inverting the filter tube in the neck, and gently blowing it out, rinsing in the particles adhering to the filter tube with the least possible quantity of water. Having closed the pinch-cock Z, and inserted the caoutchouc cork in the neck of the flask, add, through the acid funnel B, 60 cubic centimètres of strong sulphuric acid, and, after allowing to cool for a few minutes, ten grammes of chromic acid crystals dissolved in the least possible quantity of water. Gently heat the flask so as to maintain a regular evolution of gas, and as the operation proceeds increase until white fumes make their appearance in the body of the flask, which may be taken as an indication that the operation is at an end. The resulting carbonic acid gas CO_2—formed, as before stated, by the action of the chromic and sulphuric acids upon the carbonaceous residue—as it is evolved passes through the tube D, which retains any chlorine, and from thence through C and E, where it is dried, to the tared U tube F containing a solution of caustic potash—one part of the hydrate to two of water—by which it is absorbed. When the process is finished, remove the source of heat, release Z and aspirate a current of air—which in passing through K and M will be deprived of its carbonic acid and moisture—through the apparatus until it is cool. Finally, detach the U tube F and reweigh to determine increase due to the carbonic acid, which contains 27·27 per cent. of carbon.

The object of the tube H is to collect any water of the absorbing reagent, which may have been driven off by the heated gases. It is weighed before and after the operation, and any increase in weight deducted from the first weight of the tube F.

Graphitic Carbon or Graphite.

The accurate determination of the graphite can only be effected by subjecting the residue left on treating the metal with hydrochloric acid to combustion in a stream of oxygen gas and collecting the resulting carbonic acid gas. It is rarely, however, that this method is practised, either the one described in the determination of silicon, or the following being employed:—Weigh out into a beaker 4grm. of the sample, cover with dilute hydrochloric acid, and digest at a gentle heat, after which add a large volume of strong hydrochloric acid, and continue digestion. When the iron has completely dissolved, dilute the hydrochloric acid solution with hot water, and collect the insoluble portion—graphite—on a tared filter, which, together with contents, wash with water, dilute hydrochloric acid, repeatedly with a solution of caustic potash (to remove the silica), and finally with alcohol and ether. This being done, dry filter paper, &c., in the water-oven, and re-weigh, to determine the graphite obtained from 4grm. of the sample.

As the graphite thus obtained invariably contains small quantities of silica, after weighing it is transferred to a crucible, incinerated at a strong red heat for a considerable time, and when cool the weight of the residue, if any, determined and deducted from that of the graphite.

By deducting the amount of graphite from that of the total carbon, the amount of *combined* carbon is obtained.

Erratum.—Part I. p. 86, last par., lines 5 and 6, for "and also by titanium" read "and titanium."

(*To be continued.*)

EXTRA SENSITIVE COLLODION FILMS.

THE modern dry plates have almost driven the collodion photographic film out of the field; but it seems that Mr. R. Norris, of Aston, Birmingham, has devised a method of exalting the sensitiveness of collodion films, which he has protected by Letters Patent, and which is described as follows for the alkaline and acid bath and emulsion processes. For the alkaline bath process the silver salt is added to the collodion instead of impregnating the collodion, as is usual, with a soluble iodide, or bromide, or other haloid salt or salts, because by this method of procedure a greater range in the selection of the haloid salt or salts to be used as a bath is secured, for many of these salts are insoluble in a mixture of ether and alcohol, which is the menstruum in which guncotton (pyroxyline) is dissolved to make collodion. To make 1oz. of such a collodion, dissolve seven grains of pyroxyline, made at a temperature of about 200° Fahr., in a mixture of two drachms of ether and one drachm of alcohol. Then take twenty-six grains of very finely powdered silver nitrate and mix it in a test tube with eighty drops of glycerine, and stir it continuously with a glass rod till most or all of the silver nitrate is dissolved. Add gradually to this solution five drachms of absolute alcohol, and finally add by degrees the whole of this to the solution of pyroxyline. By the use of glycerine instead of alcohol for dissolving the silver salt the salt is most conveniently introduced into the collodion; alcohol may, however, be used for that purpose. Glass plates, paper, or other surfaces may be coated with the prepared collodion described and then submerged in or floated upon a solution of the soluble haloid salt or salts to form a film containing iodide, bromide, or chloride of silver, or mixtures of these. Having coated the plate with collodion charged with a salt of silver, nitrate of silver, for example (which collodion may be called "argentised collodion"), submerge the coated plate in a bath of iodide, bromide, chloride, or other compound haloid salt of potassium, sodium, ammonium, or the like, for a period varying from five to forty-five minutes. Films produced in such baths are much more sensitive after the bath has become charged with ether and alcohol, hence, in preparing the films, add ether and alcohol to the bath of haloid salts. A bath of potassium bromide, from thirty-five to seventy grains; distilled water, ½oz.; methylated alcohol of specific gravity ·830, ½oz.; methylated ether of specific gravity ·717, thirty-six minims answers well. The longer the plate or film remains in such a bath (within the limits, namely, from five to forty-five minutes) the more transparent and sensitive it will become. It will also undergo those well-known molecular changes which modify the tint of the silver haloid salt to transmitted light from ruby to blue and green. The temperature of the bath should be about 76° Fahr. The plate having remained a suitable time in the bath (according to the sensitiveness desired) it is withdrawn and washed with water, and submitted to the action of a dilute alkaline solution, such as a solution of potash, soda, ammonia, or the alkaline salts of these and allied bases. The method usually adopted is to dissolve 240 grains of caustic potash (hydrate) in 8oz. of distilled water as a stock solution; of this take forty minims and add it to 8oz. of water to make the alkaline bath. The plate is allowed to remain in this bath from ten to fifteen minutes, and is then transferred to a solution of gelatine containing, preferably, forty grains of dry gelatine to a pint of water, in which it may remain from fifteen to forty-five minutes; it is next passed into a dilute solution of a soluble iodide or bromide, such as iodide or bromide of potassium, ammonium, sodium, or the like, in which it may remain from ten to fifteen minutes. The iodide bath, which is preferable, may be thus prepared: Iodide of potassium, eight grains; water 8oz.; half a drachm of this solution is added to 8oz. of water to make the bath. The object of this last-described treatment is to convert the silver bromide, chloride, or chloro-bromide into corresponding compounds of iodo-bromide, iodo-chloride, and iodo-bromo-chloride of silver. These iodine compounds can only be successfully produced by this method of displacement, for if a soluble iodide is added to the bath resensitising with silver nitrate becomes necessary. The employment of the iodide, on the other hand, confers great advantages, both as to sensitiveness, freedom from fog, and susceptibility of development. The plate after the treatment described may be washed in water. Having at this stage acquired its full sensitiveness, it may either be used at once as a wet plate or be saturated with any of the well-known preservatives, such as gum, gelatine, dextrine, sugar, or analogous substances, and either be dried spontaneously or by the suitable application of heat. The preservation does not either exalt or diminish the sensitiveness. It is scarcely necessary to remark that all the processes described, as well as those hereinafter described, excepting the preparation of the collodion and solutions, must be conducted in a low non-actinic light.

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* If the proper proportion of the chloride solution has been employed this will not happen, the whole of the copper being retained in solution as sub-chloride. When such is the case, the subsequent addition of a fresh portion of the chloride solution, &c., is dispensed with, and the carbonaceous residue at once collected on the asbestos filter.

In another improvement, referred to as the acid bath process, the inventor makes collodion after the customary method—that is, charges it with iodides, bromides, or chlorides, or mixtures of these salts, soluble in alcohol and ether. Submerge the plate or surface coated with such prepared collodion for periods varying from five to forty-five minutes in a nitrate of silver bath charged with salts which are compounds of haloid silver salts with silver nitrate—that is, iodo-nitrate of silver, bromo-nitrate of silver, chloro-nitrate of silver, or compounds of these, such as iodo-bromo-nitrate of silver, iodo-chloro-nitrate of silver, and iodo-bromo-chloro-nitrate of silver. These salts in their crystalline state are added in quantities sufficient to saturate the silver solution used as a bath. The full sensitiveness conferred by baths of the kind last described is only obtained by the use of unusual proportions of nitric acid. From 40 to 100 minims of dilute nitric acid of specific gravity 1·101 to 1oz. of bath solution. A larger proportion confers higher sensitiveness, but it produces rottenness of the film. A bath of the kind referred to may have the composition, and may be prepared as follows: Silver nitrate, 560 grains: dilute nitric acid, 640 minims; distilled water, 8oz.; add the acid to the water and dissolve in it the silver nitrate; lastly, add iodo-bromo-silver-nitrate or allied compound silver salts to saturation. These compound salts of silver haloid and silver nitrate are prepared by adding silver iodide, bromide, or chloride, or silver iodo-bromide, or silver iodo-bromo-chloride to concentrated hot solutions of silver nitrate to saturation. When the solutions become quite cold the compound salts will be deposited, and may be collected and transferred to the silver solution prepared for the bath. This solution should then be kept in a warm place for several days and shaken or stirred at intervals to insure saturation. The film or plate on removal from the bath is washed with distilled water, and, as in the former process, passed through the gelatine and iodide baths, after which it may be washed in water and used as a wet plate or preserved, as in the manner hereinbefore described, dried, and used as a dry plate. In this process the alkaline bath is omitted. The ultimate sensitiveness of the photographic surface obtained will be related both to the length of time the film is in the bath and to the temperature of the latter, which may be used from 84° to 150° Fahr. These films progressively undergo the well-known molecular changes from ruby to blue by transmitted light while in the silver bath.

The invention further consists in the preparation of photographic plates or films by means of collodion emulsion, inasmuch as these emulsions, whether prepared with the soluble bromide or the silver nitrate in excess, may have exalted sensitiveness conferred upon them by the methods described in the foregoing bath processes. In an emulsion with soluble bromide in excess the emulsion or film is treated, after washing, with the alkaline bath or wash, and subsequently with the solutions of gelatine and alkaline iodide, and finally preserved and dried, as in the previously described processes In the case of an emulsion in which the silver nitrate is to remain in excess, the emulsion must be prepared in the first instance with a solution of silver nitrate saturated as in the acid bath process with iodo-nitrate of silver, iodo-bromide or chloride of silver, or mixtures or compounds of these salts. After washing the emulsion the film must be treated with solutions of gelatine and iodide and washed, dried, and preserved as in the preceding cases. In the preparation of an alkaline emulsion—that is, one with the soluble bromide in excess, the greatest sensitiveness is obtained by the use of the bromides of the alkalies rather than those of the earths and heavy metals. Plates or films prepared by any of the processes described are equal, if not superior, to gelatine plates in their sensitiveness to light. They may be readily developed with the ordinary chemical developers, such as ferrous oxalate of potash, or alkaline pyrogallic acid, or hydroquinone, and fixed either with solutions of hyposulphite of soda or cyanide of potassium. The exposing of plates treated according to this invention in the camera obscura, their development, fixing and drying, and complete preparation for printing from, may be effected in about a quarter of an hour.

IMPROVED UNIVERSAL CUTTER, INVENTED BY J. H. EVANS.

THE increased desire of amateur turners to produce works of a deep and elaborate character, necessitates the employment of instruments of a suitable form, embodying greater strength, stability, and power than those hitherto used, and it is for the purpose of enabling turners to carry out the desire for such work that the instrument under notice was constructed.

By reference to the engraving it will be seen that this instrument is not only supplied with the necessary gearing by which the speed and consequent power is obtained, but is also provided with a vertical slide adjustment, by which the tool can be moved above or below the centre of the lathe axis. This is obviously a great improvement, as it renders the adjustment of the instrument independent of the elevation or depression of the slide-rest, which, when once accurately set, the less it is altered the better. Such an instrument is often employed in either the vertical or horizontal positions, and by the main screw of the slide it is readily set to the central point, by the index on the slide.

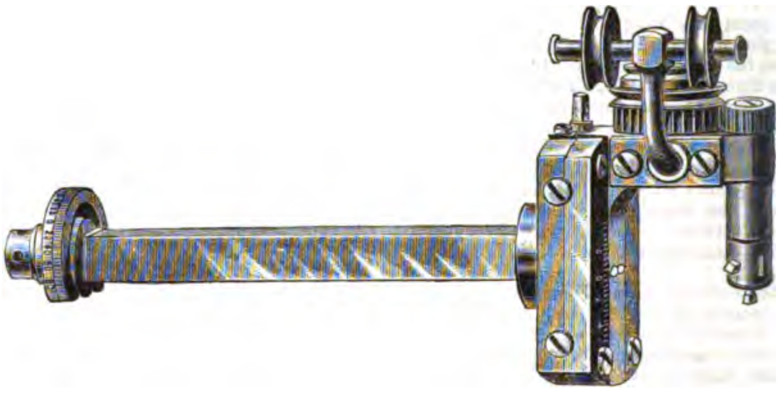


Fig. 122 in "Ornamental Turning" was the first design of this particular tool that was made, and finding that it answered beyond expectation, the further improvement of it was the next consideration, which has had an equally satisfactory result.

For the benefit of those who care to follow it out, a description of its manufacture may be of some service; at the same time it can but be considered a difficult piece of work to undertake.

The square stem with a circular flange has first of all a taper hole bored throughout its entire length, after which it is made perfectly true to the hole and to fit the tool-box of slide-rest; the flange at the front is also turned true to the square; the metal plate is then accurately surfaced and a taper recess turned at its centre. It is then carefully fitted by this to a corresponding projection on the front of the flange; the plate is then again recessed in the front to allow the head of the steel spindle which passes through the stem to be also well fitted. The spindle extends beyond the end of the square stem to receive a metal arc which carries the divisions necessary to obtain the various angles on either side from 0 to 90°, a binding screw fitting in the end of spindle and a smaller one passing through the semicircular slot in the arc.

The front metal plate should now have its surface corrected to an absolute right angle to the stem; this being a very essential point, and much of the ultimate perfection of the tool depends upon it. To the plate two single bevel steel side strips are fixed, one being provided with set screws; a metal slide with right angle arm and cylinder projection parallel to the plate is then fitted. The projection must be accurately bored out to receive a hardened steel collar, which is driven firmly into its place; the steel collar has a cone in the front end, and a hardened steel spindle is then fitted to it. The mortise through the spindle in which the tool is held must be made before the spindle is hardened, and when filing this out it must be so arranged that its centre is precisely opposite the axis of the square stem. On the opposite end of the spindle a metal pinion of twenty teeth is fitted, having a steel collar, and is held in its place by a steady pin and screw in the end of spindle, the head being recessed into the wheel.

A wheel of forty teeth is then fitted to a hardened steel stud fixed in the necessary position in the arm of the slide, and this must be so fixed that no backlash occurs between the two wheels. To the wheel of forty teeth is attached the driving pulley. To the side of the metal slide a steel arm is attached by two screws, and bent to such a curve that a cross spindle on which the guide pulleys are fitted conducts the band from the overhead to the driving pulley, and by this arrangement it matters not in what position the instrument is used; the band runs freely without the least tendency to run off the pulleys, and when a suitable overhead motion is employed, the usual band will answer in every respect.

The main screw of the slide must now be fitted, being carefully centred, a hole is bored throughout its entire length. The screw should be equal to all other screws used in such apparatus—viz., ten to the inch. A steel centre is arranged at the lower end, and a plate of the same material fitted to the opposite end to retain the screw in its place; the projecting end of the screw is then made square, and a small micrometer fitted to it; in the end of the steel spindle which holds the tool, a small screw is fitted by which the tool, after being removed for any particular purpose, may be returned to exactly the same place.

Having thus endeavoured to explain the manner in which such an instrument should be made, it will be well to point out the advantages to be obtained by its employment. In the first place, we have the facility of the adjustment vertically to the extent of 1in. either side of the centre; this may be usefully employed for other purposes than the mere setting of the tool to any particular point. Secondly, the geared wheels multiplying the speed give increased facilities for heavy and deep cutting. Thirdly, it will be seen that the absence of any projection of the driving pulley beyond the diameter of the spindle carrying the tool, enables the tool to be brought in close contact with the work without any interference on the part of the pulley, thus there is no limit to the length of the cut to be executed; also a small radius is obtained; this cannot possibly be when the pulley projects as in other instruments. Fourthly, there being no framework at the end of the spindle, the tool can be brought in close proximity to any work that may have a projecting shoulder. A number of these instruments are now in use, and are spoken very highly of by all who have them; it will be found when practically using such an instrument, that the tool will never pull up and stick fast, as is so often the case with the ordinary vertical or horizontal cutters. Any further information required will be cheerfully given upon this or other subjects. **J. H. Evans.**

MOULDING BEVEL GEAR.

THE method of moulding bevel gear and making teeth larger than pattern illustrated in the annexed engravings, was contributed to the *American Machinist.* It was a break-down job, the old wheel being broken and worn so badly that it was almost impossible to mould one off of it and make a good casting. After digging a hole in the floor to admit pattern and have sufficient room to properly bed it in, a spindle was put up, and a good solid and level bed swept up, as shown at A A, Fig. 1. A circle, the exact diameter of pattern at outside edge of teeth, was then struck, represented by dots B B, Fig. 1, the object of which will be seen before the job is completed. After removing the spindle and placing a piece of waste in seat *c* to prevent the sand from getting into it, the pattern was put down and levelled up, keeping it above the bed, as shown at *d d*, for tucking purposes, and keeping outside edge of teeth in line of circle B B. This is done by placing a carpenter's square on the bed, letting the corner rest at B, and placing pattern against it, as shown at *e*. This is done so as to have spindle seat *c* in the centre of the mould. After putting a weight on the pattern it was tucked (using facing) and rammed up, the cope lifted off, cores taken out, and pattern drawn. The centre of hub was then dug out and seat *c* perfectly cleaned to admit of replacing the spindle, after which sweep *f*, Fig. 2, was attached as shown, and the teeth swept off.

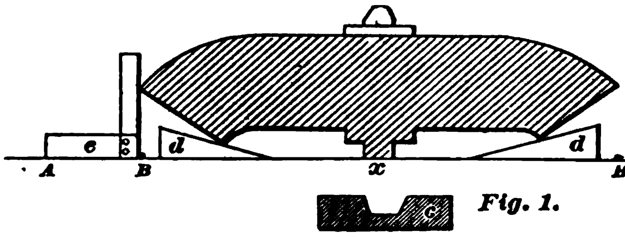


Fig. 1.

Fig. 5.

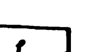


Fig. 4.

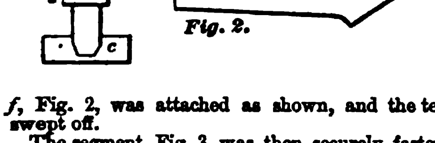


Fig. 3.

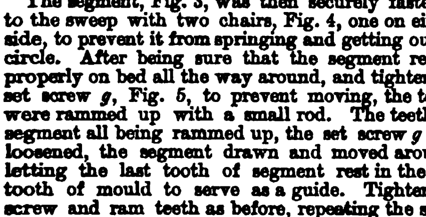


Fig. 2.

The segment, Fig. 3, was then securely fastened to the sweep with two chairs, Fig. 4, one on either side, to prevent it from springing and getting out of circle. After being sure that the segment rested properly on bed all the way around, and tightening set screw *g*, Fig. 5, to prevent moving, the teeth were rammed up with a small rod. The teeth on segment all being rammed up, the set screw *g* was loosened, the segment drawn and moved around, letting the last tooth of segment rest in the last tooth of mould to serve as a guide. Tighten set screw and ram teeth as before, repeating the same until entire circle of teeth are complete, after which the spindle is removed, mould dressed (using calipers to get core prints—Fig. 1—in centre) and closed.

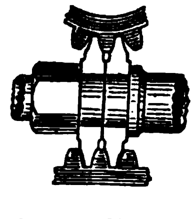
PHENOMENA OF THE STEAM JET.

THE following notes on the phenomena of the steam jet are contributed by Von Helmholtz to *Wiedemann's Annalen*. In the course of his experiments he noted that a jet of steam escaping from a hole of one or two millimètres diameter, lighted obliquely and observed upon a black background, is invisible at the lower extremity, and presents towards the top the well-known whitish appearance. This aspect may be modified in many ways. If an electrified point is brought near the steam, the jet immediately becomes azure blue, or, according to the power of the electrical machine, purple, red, yellow, green, &c. These tints are intimately connected with the dimensions of the liquid drops, and hence it follows that the electrical point has the power of provoking condensation of the supersaturated vapour which is found at the lower part of the jet. The same result is obtained by bringing near to the steam jet a platinum wire made incandescent by an electric current, or silver, iron, copper, or brass wires simply made red hot in a flame, or even glass-heated below the red, or an organic matter, wood, paper, &c., in a state of slow combustion. The products of any flame whatever, with the exception of the flame of pure alcohol, directed upon the jet steam by the aid of a chimney or by simply blowing, produce a very energetic effect. Finally, traces of certain chemical substances introduced into the steam jet cause the same modification. Among these are hydrochloric and nitric acid; but concentrated sulphuric acid especially shows the phenomenon. It is known that solid dust particles provoke the condensation of supersaturated vapours, but their presence cannot be invoked here to explain the preceding facts.

Helmholtz is of opinion that they may be attributed to a molecular concussion, the effect of which may be compared to that of mechanical concussion upon superheated or supersaturated liquids. A flame, for example, is the scene of closely approximated and extremely varied movements, and the chemical atoms which are incessantly passing in it from one combination to another are found in every kind of unstable condition. These movements and changeful states of equilibrium leave their traces in the products of combustion at a certain distance from the flame properly so called, and determine the observed phenomena. The luminous effect produced as the extremity of an electrified point and the presence of ozone in its vicinity show that this point is the cause of concussions comparable to those provoked by active combustion, and the analogy between the two phenomena is found again in the fact that they both furnish means for making electricity pass through gas. As to solid incandescent bodies, they can act either through the emission of solid particles from their surfaces or by the chemical concussions which they communicate to the surrounding gases.

CLOUGH'S DUPLEX GEAR CUTTER.

THIS duplex gear cutter is a new departure in the system of gear cutting; it cuts all gears of same pitch from sixteen teeth to a rack inclusive, taking the place of seven single cutters of the involute form of teeth. These cutters are so made that they can be ground on the face of the tooth and preserve their form. They are made reversible —that is, each cutter is made perfectly central and exactly alike, so that either side can go together, thus cutting the teeth perfectly central and true, and alike on both sides. The cutters can be made to cut two different pitches—for instance, six and eight pitch or twelve and sixteen. In shops where a variety of work is to be done with a view to economy of tools, this cutter cuts the tooth instead of the space as formerly practised by single-gear cutters. It has an improved clearance or relief to the cutter teeth, which enables it to cut freely, doing away with the friction and consequent heat, producing better and truer work, and the cutters thereby needing less grinding. The cost of these cutters is about one-third of what single cutters cost for involute form, and one-tenth of the epicycloidal form. The best tool steel is used. These cutters are in use by several manufacturers of machine tools and general machine work, and are giving good satisfaction. They were patented by Francis W. Clough in the United States, and are manufactured by R. M. Clough, of Meriden, Ct., from whom circulars and further information can be obtained.



THE SOUNDING ROCKS OF GUILDO.

NOT far from Dinan, on the banks of the Arguenon, one of those small torrential rivers which, in emptying into the sea, carve the coast of Brittany into capricious festoons, there is shown to the tourist a heap of greyish rocks known in the country under the name of the "sounding stones of Guildo."

In the crystalline texture of these rocks and their slaty colour we at once recognise that variety of stone known in mineralogy by the name of amphibole (complex silicate of iron, manganese, and lime). These stones, which, aside from their musical properties, possess no novelty, are situated in the midst of wonderful scenery. They occupy a small cove, that at rising tide is entirely covered, and which is overlooked by a high bank, upon which stands the little village of Guildo, formerly the centre of a celebrated pilgrimage. Opposite them, on the other side of the Arguenon, which at this place is no less than 980ft. wide, stand, sad and desolate, the ruins of the Castle of Guildo, still preserving in their massive structure something of a menacing aspect. Upon gazing at these proud witnesses of a so distant past, one involuntarily thinks of that stirring figure of Gilles de Bretagne, so often evoked in the legends of the country. It was within these walls, now mined on every side by a luxuriant vegetation, that passed the first scenes of that fractricidal tragedy which was to have its sorrowful epilogue in the Castle of Hardouinaie, near Rennes. Upstream widens out the pretty valley of the Arguenon, so dear to the Breton poets, and which is crossed by a new iron bridge. Downstream the river gradually widens out its estuary, and its right bank terminates in the curious peninsula of Saint Jacut, upon which rise, picturesquely, one above the other, the white houses of the market town, facing east and west. The left bank ascends more to the north and terminates in the point of St. Cast, a name that sounds well to the ears of the Breton patriots.

The stones of Guildo are not erratic blocks derived from the upper part of the valley. It is clearly seen that they have been detached from the bank itself, the strata of which are of rock of the same formation. They are huge boulders rolled and polished by the sea. When, at the rising of the tide, the *Norouet* wind blows in a tempest, the waves break over the points of Saint Jacut and ascend the river bed with irresistible force. Now, the sounding rocks stand at the very point where, in consequence of a slight bend in the course of the Arguenon, the fresh descending water comes into contact with the salt-ascending stream. Under the repeated stresses of these two opposite currents, the huge rocks clash against each other, wear away, and gradually become polished.

The sounding-stones are three in number. They are long prismatic blocks, lying side by side, at right angles with the shore, and because of their form, the inhabitants sometimes call them "the horses in the stable." The central stone more particularly exhibits the phenomenon. It is about 20ft. in length and 23ft. in circumference, thus giving it an approximate weight of 165,000lb. On the river side it ends in a sort of truncated spur. It is at this part that it is necessary to strike it with an iron instrument, or, better, with a stone of the same nature. Near this spur there are observed three or four points that are well marked by the wear produced by the repeated blows of visitors. These are the points at which the maximum of sonorousness is obtained.

Under a blow the stone emits a very clear, silvery sound, similar to that which would be obtained by striking a large bell with a mallet of soft wood. The sound, as far as a hurried examination allowed us to judge, corresponds to mi_2. The more one approaches the other end, in continuing the blows, the deader the sound becomes. Near the top the totality seems to increase a little. Finally, at certain points, which must be nodes of vibration, merely a dull sound is obtained. If, while striking, one presses his ear against the other extremity of the rock, the sound heard is extraordinarily intense, and, in measure as it dies out, the various harmonics are distinctly perceived. The two other stones emit nothing more than a muffled sound. It is asserted that this is due to the fact that they have been disturbed by the action of the sea. In fact, it is to be noted that the musical stone rests through a few points only upon the pebbles that support it, while the two others are now partially sunk in the subjacent earth.

We examined all the surrounding stones and found several that gave very varied sounds, without there seeming to be any relation between their size and the height of the pitch. At the end of the cove we more particularly remarked a horizontal stratum partially buried in the shore and divided into fragments, forming, as it were, something like the gigantic keys of a prehistoric piano. Three of these stones gave clearly the perfect major chord. While watching our researches with curiosity, a boy of the locality exclaimed now and then, previous to our experiments: "Will sound!" "Won't sound!" and, accustomed to make the singular stones speak, he soon showed us how, at the first glance, it was possible to recognise the musical stones. The rocks, in fact, exhibit two very different aspects.

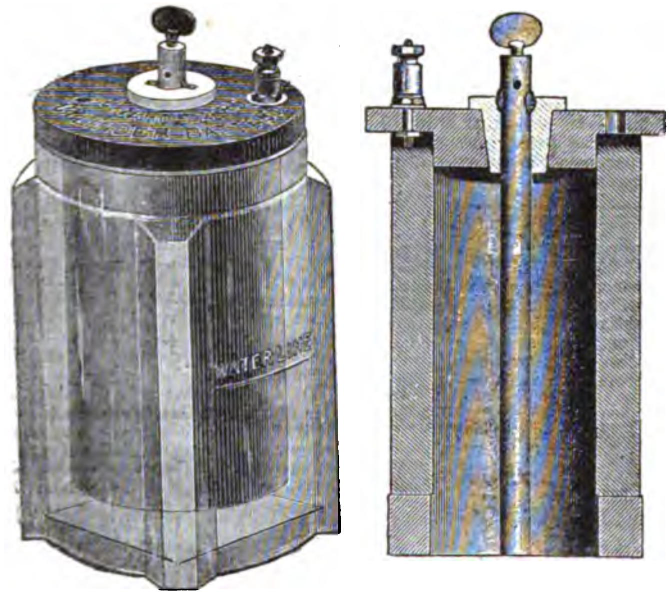
Those of a silvery grey, with a very fine texture, all render, even when broken, a very pure sound. Those of a darker colour and blotched with brown, through an excess of iron, are as if exfoliated, and emit no sound. The bank of diorite must have been traversed by a ferruginous vein, for at more than one point we found large rubble stones composed of the two kinds of rock.

Is there need of saying that the sounding rocks have more than once furnished their contingent to the already rich legendary of the Breton country? We were struck by one of these legends, for we found therein a *scenario* that has been exploited, with variants, more than once in the Armorican country. It is the story of a tailor (hump-backed, of course), who one fine evening obligingly assisted in completing the round of the fairies of Guildo, who were disconsolate over being in unequal numbers. As a reward, the fairies taught him to "sound the stone" in making a wish. At the call of the mysterious bell, there came from the depths of the earth gnomes and elves, who satisfied the fortunate tailor's wishes and began in the first place by ridding him of his hump. Then comes the usual counterpart: The artful and scoffing miller of the valley of the Arguenon wished to imitate the tailor, and succeeded only in making the fairies hostile. They avenged themselves on him by ridding themselves, at his expense, of the tailor's hump.

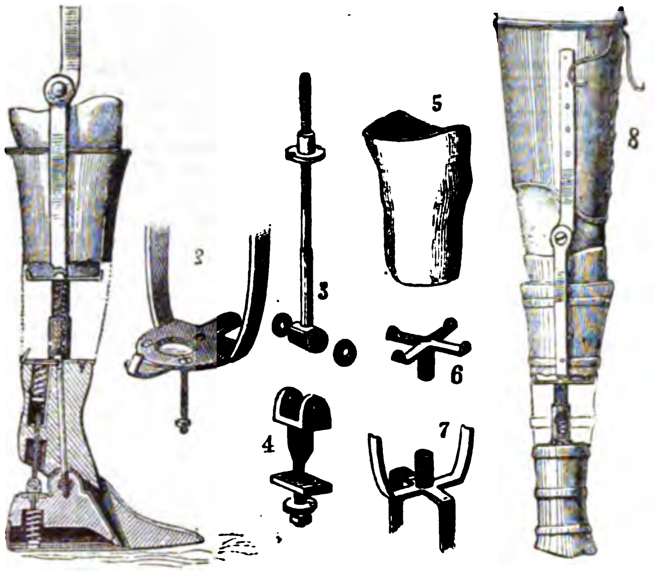
The sounding rocks of Guildo are scarcely known except in the country, and most authors who have written about Brittany do not even mention them.—*La Nature.*

THE HOLTZER CYLINDER BATTERY.

THE desire to obtain an open-circuit battery of large generating power, and one which should quickly recuperate, led to the construction of the



Holtzer cylinder battery of the Leclanché type, by Messrs. Holtzer and Cabot, of Boston, shown in perspective in Fig. 1 and in section in Fig. 2. As will be seen on referring to the cuts, the battery consists practically of two parts only, as the cylinder, zinc, and connecter form the first part, they being collectively united and forming one piece alone; the second part being the glass jar. The cylinder, resting on the top of the jar, forms by its weight a well-sealed joint, thus preventing evaporation. There are no fragile parts to be easily broken, but one strong heavy carbon of cylindrical form, having a binding post well secured to it and thoroughly protected from salts. The zinc is separated from the cylinder by a porcelain piece of wedge shape to secure a close fit. Thus is presented one of the simplest and most practicable forms of Leclanché battery obtainable.



AN IMPROVED ARTIFICIAL LEG.

AN artificial limb designed for use by a person whose leg has been amputated between the knee and foot, which will not chafe the stump of the wearer, forms the subject of two patents issued to Mr. Alexander Gault, of Medford, Minn., U.S.A. Figs. 1 and 8 show side elevations and a central vertical section through the ankle piece and foot, with parts broken away. Three sockets are employed, a thigh socket, a stump socket, and an outer socket for holding the stump socket, the outer socket being supported from the ankle or foot-piece by brace rods. The stump socket is shown in Fig. 5, and is composed of hard vulcanised rubber or other suitable material possessing the desired rigidity. The thigh-socket supporting arms are supported from the stump-supporting arms shown in Fig. 2, being hinged thereto, and forming upward extensions of a base-plate secured to the ankle-piece by bolts which pass downward at each side at the back. The ankle-bolt is of the ordinary form, but the joint is made of guttapercha or hard rubber. At the back of the ankle-piece is a vertical bore in which works a rod, shown in Fig. 3, designed as a practical substitute for the heel cord commonly employed, and also intended to obviate the necessity for a toe cord or an instep cord. That it may rock backwards and forwards, this heel-rod is hinged at its lower end to the upper end of the bolt or guidepost of a heel spring, shown in Fig. 4, the bolt extending downward to a plane with the ball of the foot, while below the head of the bolt is a rubber or elastic block socketed in the upper face of the heel of the foot. With the movement of the body in walking, the ankle piece rocks on its joint, the coiled spring on the heel rod aiding the wearer in bending the knee and lending a natural movement to the same, while, by means of the sole-plate and guide-bolt, with the heel-spring, the solid "wooden" sound, so noticeable with the ordinary artificial limb, is obviated.

STEEL AS AN ENGINEERING MATERIAL.

WHILST the growing use of steel as an engineering material testifies unmistakably to its superior suitability for general purposes, yet there are situations where it appears to be rejected in favour of iron, and these instances seem lately to have been on the increase. The greater liability of steel to corrosion is in many cases the cause of this preference for the older metal, especially in boilers where the feed-water is bad. Much has been said anent Thames mud; but it is doubtful whether it is worse than the ingredients of Staffordshire canal water; anyhow, the latter element is a serious nuisance to the steam user. This perhaps is why one sometimes hears of such cases as a Staffordshire steam user paying as much as £400 for a boiler 30ft. long by 8ft., and insisting, as one of his chief conditions, that it should not be made of steel. In many cases, however, steel is doubtless condemned unnecessarily. An ironmaster put steel in the bottom of his boilers and had to have them rebottomed before it had worn three months. He put in iron, and the iron continued very much longer. In a case like that there must, one would think, have been some serious defect somewhere. More often than steam users think, failures in boiler working arise from electrolytic action where various metals are in conjunction. A notable instance of this kind was mentioned at a meeting just held, of the South Staffordshire Institute of Iron and Steel Works Managers. A paper was read by Mr. G. H. Walkeden, entitled, "Notes on the Lancashire Boiler," and in the course of discussion, this topic of electrolytic action was touched on by Mr. A. E. Tucker, metallurgical chemist, of Smethwick. He knew, he said, of cases in that district in which boiler explosions had been clearly attributable to electrolytic action set up by the combination of iron and steel in the construction of the boiler, and by the presence of brass fittings. This action had sometimes been set up by the use of tie-rods of manganese bronze and phosphor bronze and similar materials. The intention had been to prevent corrosion, but the effect was just the reverse, for the electrolytic action had been very marked at both ends of the tie-rods, and the steel plates had been correspondingly corroded at those particular points. Doubtless, many instances of the kind adduced by Mr. Tucker could be recorded where the blame rests neither with bad feed water, nor with the quality of steel, but with unsuitable combinations of metals. —*The Engineer.*

Removal of Tattoo-marks.—The removal of tattoo-marks is a matter of no little difficulty, and many different methods have been tried (blistering, suction, thermo-cautery, counter-tattooing with white powder or milk, &c.). Criminals sometimes pour vitriol on their arms or hands, and letting it act for a few seconds, plunge the limb in water. The following method is recommended by M. Variot (in the *Revue Scientifique*):—The skin is first covered with a concentrated solution of tannin, and re-tattooed with this in the parts to be cleaned. Then an ordinary nitrate of silver crayon is rubbed over these parts, which become black by formation of tannate of silver in the superficial layer of the dermis. Tannin powder is sprinkled on the surface several times a day for some days to dry it. A dark crust forms, which loses colour in three or four days, and, in a fortnight or so, comes away, leaving a reddish scar, free of tattoo marks, and, in a few months, little noticeable. It is well to do the work in patches about the size of a five-franc piece at a time. The person can then go on with his usual occupation.

SCIENTIFIC NEWS.

WITH the great Lick telescope, Mr. Burnham has discovered that Alpha Ursæ Majoris is a close double, the companion being of the 11th mag. The following measures have been published:—1889·142 P. 327°; D. 0·96″. 1889·151 P. 325·9°; D. 0·83″. The companion could not be detected with the 12in., even when searched for after discovery under favourable conditions. Mr. Burnham also reports the discovery of small companions near several other bright stars in Ursa Major.

Barnard's comet, *e*, 1888, has the following ephemeris for Berlin, midnight, on May 8:—R.A., 23h. 20m. 54s.; N. Dec. 1° 54·1′. The position of his comet *f*, 1888, for same time is R.A., 9h. 36m. 36s.; N. Dec., 37° 30·4′.

In No. 2,888 of *Astronomische Nachrichten* there is a paper by M. Belopolsky, of Moscow, containing the results of several determinations of stellar parallax which he has deduced from a discussion of the meridian observations of the late Herr A. Wagner at Pulkowa. For the two stars of 61 Cygni he obtains parallaxes of 0·47″ and 0·55″ respectively; for Sirius, 0·43″; for the two stars of Eta Draconis, 0·32″ and 0·28″ respectively; for Nu Herculis, 0·40″; for Gamma Herculis, 0·11″; and for 10 Ursæ Majoris, 0·20″.

It is to be regretted that before he had time to complete the arrangements with the University of Cambridge in connection with the munificent offer of his great refractor and its accessories, Mr. Robert Stirling Newall, F.R.S., F.R.A.S., should have been "called away." He had reached the age of 77, however, and had done much useful work in his time. Born in Dundee in 1812 of an old and respected Scotch family, he entered a mercantile office, and afterwards came to London, where his talents found more genial employment under the late Mr. Robert M'Calmont in connection with experiments on the rapid production of steam. In 1840 Mr. Newall took out a patent for making wire rope: it was this invention that made submarine telegraphy possible. He established works at Gateshead, and his firm manufactured and laid the Dover and Calais cable in 1850, the Holyhead and Howth and Port Patrick in 1852, and the Dover and Ostend, the Firth of Forth, and the Holland cables in 1853. In November, 1854, Mr. Newall suggested a cable from Varna to Balaclava to the Duke of Newcastle, then Minister for War. The Black Sea cable was laid by Mr. Newall in 1855, and the Red Sea cable in 1859. He devoted much of his time to scientific work, and had a 25in. refracting telescope constructed by Cooke and Sons, which, just before his death he offered as a gift to the University of Cambridge. To local matters Mr. Newall devoted much of his time. He was twice Mayor of Gateshead, and he was unanimously asked to be mayor again this year when the British Association will visit Newcastle.

The death is announced of the Rev. J. H. Thompson, vicar of Cradley, who possessed an extensive and valuable collection of European plants, which he has bequeathed to the Worcestershire Naturalists' Museum.

Herr Joseph Werndl, the famous inventor of the rifle which bears his name, died on Monday. He was a self-made man, whose fortunes began to rise after the Austro-Prussian war of 1866, when he started a factory for the making of his breech-loaders at Steyr. That was subsequently converted into a joint-stock company, with Herr Werndl as director and principal shareholder, and at present is under contract to deliver no fewer than 450,000 rifles to the German Government.

The British Association, which has, by the extent of its donations, acquired the right to be represented on the Council of the Marine Biological Association, has selected as its representative Prof. Flower, the president elect.

Sir J. B. Lawes, F.R.S., who, by his experiments at Rothamsted, St. Alban's, has done so much to promote agriculture and our knowledge of plant life, announced some years ago his intention of bequeathing his laboratories and museum, with 50 acres of land and a sum of £100,000, in order that the field and laboratory experiments might be continued after his death. The property is vested in three trustees, and is to be administered by a committee of nine representatives of learned societies. During the past few months these have been nominated. They consist of four Fellows of the Royal Society, one Fellow of the Linnean Society, two members of the Council of the Royal Agricultural Society, one Fellow of the Chemical Society, and the owner of Rothamsted for the time being. These are appointed for five years, but the societies have full power to reappoint them. At the last ordinary meeting of the Council of the Royal Agricultural Society, Sir John Thorold and Mr. Charles Whitehead were appointed to represent that body on the committee.

The meeting of the Royal Geographical Society on May 12 will, it is said, be a Stanley field-night. The paper is by Mr. Werner, who has been making revelations concerning the Congo Free State. This will lead to a discussion of Mr. Stanley's letters, and among those who are expected to speak are Sir F. D. Winton, the Rev. Horace Waller, Colonel Grant, Mr. Joseph Thomson, and Mr. H. H. Johnston, who has returned from his mission to Lisbon.

At a recent meeting of the Physical Society some photographs of lightning taken by Mr. Shepherd, of Bayswater, were examined and discussed, and a paper was read by Mr. G. M. Whipple on the "Dark Flash" and on "Ribbon Lightning." A writer in the *Bayswater Chronicle* says, speaking from personal knowledge, that the "ribbon" lightning photograph was taken in the open air, and not through a window, and that the dark flash is not a reversion of any other flash shown in the same plate. The only theory which so far explains the curious phenomenon of a dark flash of lightning being seen amongst the ordinary white flashes in a photograph seems to be that which has been offered by Prof. Stokes, F.R.S., and Prof. Curtis, of Harvard University. Both these authorities arrived independently at the conclusion that the dark flash shown is really the path of a dead flash—that is, a vanished flash which has left a track of heavy nitrous oxide gas behind it in the atmosphere, impervious to the light of the flashes immediately following, and thus appearing opaque in the picture. We understand that Prof. Stokes's suggestion for charging a camera in the daytime during a thunderstorm, and taking off the cap just after a flash has disappeared, will be adopted, inasmuch as, according to the theory, a dead flash should certainly record itself on the plate under such circumstances.

The claim of the invention of the screw-propeller for the late Captain Ericsson—a claim he never made himself—having been shown to be without foundation, it has been asserted that he was not even the inventor of the *Monitor* type of fighting vessels, for a caveat was filed in the U.S. Patent Office by a Mr. T. R. Timby, of New York, in 1843, and this Mr. Timby was paid by the builders of the first monitor for the right to use his patent for the erection of revolving forts on the coast. Mr. Timby says he took the idea of the revolving plan for defensive works from the circular form of Castle William, on Governor's Island, when he first visited New York, and that he made a model of a marine turret, which he still has, in 1841. The truth seems to be that Ericsson was the "practical inventor," for he himself stated that the revolving platform, open or covered, was not novel, as a design for a floating revolving circular tower was published by Abraham Bloodgood in 1807, and the *Nautical Gazette* of 1805 contains an account of a "movable turning impregnable battery, invented by a Mr. Gillespie, a native of Scotland."

At the recent exhibition of the phonograph in Paris, M. Gounod said that if a tune were played and recorded on the cylinder, it might be transposed into different keys by turning the cylinder faster or slower. It is stated that this fact was demonstrated by means of a cornet played near the phonograph.

One of the Strong locomotives has, according to the *Railway World* (U.S.), been making high rates of speed on the New York, Lake Erie, and Western Railroad. The average rate, including stoppages, was only 29 miles an hour; "but on a bit of good road one mile was made in 48 seconds, another in 52, another in 56."

Some heavy locomotives have been put to work on the mountain division of the Philadelphia and Reading Railroad. The actual weight in working order of these engines is 153,040lb., 136,340lb. of which is on the driving wheels. The tractive force is 271lb. per pound of average pressure in the cylinders, which are 22in. in diameter by 28in. stroke. The driving wheels are 50in. in diameter, and the boiler is 13ft. 6in. long over the tube-plates. It contains 270 tubes of $2\frac{1}{4}$in. diameter. The firebox is 11ft. long by 42in. wide inside dimensions, and is placed above the frames instead of between them. The total heating surface is 2,345sq.ft., 185 of which are in the firebox. The engine is intended to burn anthracite.

The report of the Department of Mines of New South Wales for 1887 gives full statistical details and a number of reports, including some by Mr. Etheridge, jun., the palæontologist of the Geological Survey, on fossils. In the Inverell district it appears that as many as 23,000 diamonds were found, mostly very small.

Dr. R. A. F. Penrose contributes a valuable paper on "The Nature and Origin of Deposits of Phosphate of Lime" to the *Bulletins* (No. 46) of the U.S. Geological Survey. Prof. Shaler, in an introduction, explains that the paper is to be regarded as part of a wide inquiry into the subject of phosphatic manures, involving both chemical and geological questions, which can only be successfully carried out by the co-operation of the geological surveys with the experimental agricultural stations in the United States. It is, however, a comprehensive description of the occurrence of mineral phosphates in all parts of the world.

It is stated that Major Crichton, of Linn, Dalry, has left about £30,000 to the University of Edinburgh for the endowment of bursaries and scholarships.

Chicago will probably have the finest library in the world in the course of a few years. Mr W. L. Newberry, one of the earliest residents, left the sum of half a million sterling for the purpose, and a temporary building has been used for some time. It is now intended to erect a magnificent edifice capable of holding 300,000 volumes.

At the annual meeting of the Zoological Society on Monday it was stated that the number of members was 3,076, the total income for the past year was £24,025 (£13,284 received for admission fees), and the total expenditure £24,139. There have been 948 deaths of animals, but the additions numbered 1,121, of which 572 were presented, 143 purchased, and 158 were bred in the Gardens, the remainder being deposited. The total number of animals at the end of last year was 2,290.

Vegetation in the Congo.—From a report of the Belgian Consul-General in the Congo State, it appears that the effort made to introduce European vegetables and fruits in that district have been rewarded with very great success. The Government has imported tobacco seeds from Havana and Sumatra, which is cultivated in conjunction with native tobacco. The natives cultivate tobacco badly, but efforts are being made by the Government to teach them better methods. The inhabitants of the Lower Congo have been very successful in cultivating not only the usual African products, such as manioc, sweet potato, &c., but also sorghum, maize, and the "wandu" haricot, called "Boma" by the natives. The cotton plant grows in its wild state, and the natives manufacture from it hats, wallets, &c. No effort has yet been made to cultivative it for trade purposes.

Separating Minerals.—Mr. Carus-Wilson has devised an effective dry method for separating the denser minerals from sand. A piece of cardboard about 2ft. long is bent in the form of a shoot or trough (it must not be allowed to break), and held in this form by elastic bands at either end; this must then be held, or fixed, at an angle sufficiently inclined to allow the sand to travel slowly down the shoot on being gently tapped. A small quantity of the sand to be treated is now placed at the head of the trough, which is then tapped with the finger. When the trough is tapped, the sand travels slowly down, and in doing so the denser grains lag behind, forming a dark mass in the rear of the stream; this dark mass increases as the sand flows on, and must be collected and placed in a receptacle just the moment before the last tap would cause it to fall off the trough. When a sufficient quantity of this denser sand has been thus collected, it should be placed in the lid of a cardboard box (about 12in. by 6in.), and gently shaken to and fro at a slightly inclined angle, the mass being at the same time gently blown upon with the breath. The finer quartz grains will thus be blown away, and hardly any but the denser grains will remain.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knews no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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THE PHOTOGRAPHS OF THE ECLIPSE OF JANUARY 1st—THE LATE M. CHEVREUL — LOCKYER'S "ASTRONOMY" AND "F.R.A.S."—WALL SUNDIAL—CALCULATING R.A. OF THE MOON — THE CONSTELLATIONS — MEAN AND APPARENT TIME — HAGIOSCOPE—WORK AT HARVARD COLLEGE—THE LATE DR. DE LA RUE —THE MASS OF A BINARY STAR—CHEMISTRY, COMETS, AND CRAZES — HORN — CHEAP EQUATORIAL MOUNTING—INDICES OF REFRACTION—COMBINATION OF COLOURS.

[29881.]—By combining the various features exhibited in Mr. Barnard's fine series of negatives of the total solar eclipse of January 1st, Prof. Holden has produced a drawing of the sun's corona containing a perfectly marvellous wealth of detail. Among other notable results of his investigation is the discovery "that the so-called polar rays of the corona can be traced all round the sun's circumference, even at the equator; and thus that we must consider these polar rays (so-called) as a special typical form, quite different from the other class of rays which they resemble in appearance, but which are only to be found associated with the equatorial wings and extensions of the outer corona." And although as Prof. Holden remarks, no photograph of the corona traces the equatorial wings just spoken of beyond 50′ from the sun's centre, Mr. Barnard's exhibit faint extensions as far out as 1° 15′ of arc; and it is evident that the outer corona instead of quickly terminating, must extend far out into space: nay, in negatives taken by Messrs. Ireland and Lowden the outer corona is traceable with ease out to 1° 35′, and with greater difficulty to 2° 15′ and 2° 45′ respectively. It is evident that when the whole of the observations (visual, spectroscopic, and photographic) of this eclipse come to be discussed and summarised, a very valuable addition must be made to our knowledge of the physical constitution of the sun and his surroundings.

Perhaps in connection with your short biography of Chevreul on p. 151, I may invite attention to the large extent to which we are indebted to him for the present artistic decoration of our homes. Prior to the appearance of his famous book on Colour, the most violent, glaring, and inartistic combination of colours was as common, as it is happily now rare. Chevreul it was who first explained to us not only that blue and green, or green and yellow, in juxtaposition, are hideous, but why they are so. He it was who taught our art decorators the true principles of chromatic harmony and contrast, and purified our taste in the far from unimportant matter of painting our houses. Let us acknowledge our obligations in this respect, and testify our gratitude to the great French centenarian savant.

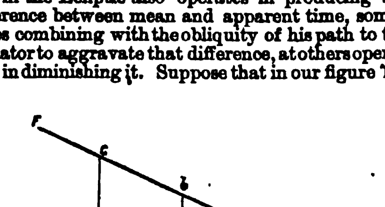
Learning, from what has recently appeared in these columns, that the picture of the lunar crater which forms the frontispiece to Lockyer's "Primer of Astronomy" is identical with one in his "Elementary Lessons," I now, of course, know that it is a reproduction of a photograph of Nasmyth's plaster model of Copernicus, taken, if I mistake not, from a plate which appeared some years since in one of De la Rue's Pocket-books. I have Noble's "Hours with a 3in. Telescope" before me as I write, and I notice that his sketch of Copernicus is simply that of the crater itself, and not of its surroundings, as shown in Nasmyth's model. It is drawn with too high a sun, and ought to have been taken when the shadows were longer; but the comparison instituted between Nasmyth's (or De la Rue's) engraving, made by "Veretatem Teneo" in letter 29838 (p. 153), is simply ridiculous, as he tells us that he himself examined Copernicus, probably at a favourable period of illumination, with an 8in. reflector, while Noble's drawing was made with a 3in. achromatic! To expect a little refractor like this to show one quarter of the detail visible in a reflector with a mirror of more than seven times its area, is to betray — well, let us say—inexperience, which certainly should disqualify him from any attempt to pose as an oracle, or to dogmatise as to the relative merits or demerits of pictures. With reference to the concluding portion of the letter of "Veretatem Teneo," I gravely doubt if there is such a thing as a good detailed drawing of Copernicus in any elementary book, or, in fact, in any astronomical book whatever. Some years ago there was a rather elaborate one, by Secchi, which appeared in the R.A.S. *Memoirs*; but I have not the volume here. There is also one from a terribly worn plate at the end of Sir John Herschel's "Outlines of Astronomy." Chambers has a purely fancy picture from Nasmyth in his "Descriptive Astronomy." As the aspect of a lunar formation varies exceedingly with change of illumination, your correspondent had better obtain the loan of Schmidt's great map, and try to trace out the features delineated there. Some of the drawings of lunar craters, by the way, of which engravings have appeared in these columns, have been as good and truthful as any that have yet been published.

Is not the beginning of reply 68282, on p. 159, rather likely to mislead the querist to whom it is addressed? Of course, if the gnomon of a dial be set up rigidly parallel to the earth's axis, the hours may be marked in by the aid of a chronometer, allowance being made for the equation of time; but even then refraction will prevent the graduation from being absolutely accurate. Where "longitude" comes in though—save in the case of the chronometer or clock marking Greenwich Mean Time, I do not quite see. Local time + or − the equation is what is required, and what, if the operation is to be performed by a beginner without a mistake, the chronometer ought to show.

I am wholly at a loss to conceive what "Ruric" means when he says (in query 68374, p. 161) that "Some time ago 'F.R.A.S.' said that the R.A. of the moon was not measured off on the terrestrial equator." On two occasions do I remember replying to questions concerning the position of the moon with reference to particular parts of the earth's surface—viz., in letter 23192, Vol. XXXIX. p. 583; and in letter 27751, Vol. XLV. p. 605. In neither of these letters does the wholly needless remark attributed to me occur. Why, of course, the moon's R.A. is measured on the *celestial* equator; but this is merely that great circle in the heavens cut out by the plane of the terrestrial equator produced. If "Ruric" will turn back to the two letters to which I have referred, he will find out how to determine at what part of the earth's surface the moon is in the zenith at any given instant, which, I take it, is all he requires.

"J. M." (query 68371, p. 161) will find a good commentary on Achilles' Shield in the concluding chapter of the first series of Proctor's "Light Science for Leisure Hours." Proctor's essay on "The Origin of the Constellation Figures" will be found in his "Myths and Marvels of Astronomy," and not in *Knowledge*. Incidental reference is made to the Shield of Hercules and its signification, in the essay referred to. Kurtz's book has never been translated into English. I do not know Lamb's translation of Aratus (which is presumably what is meant by "Arators"); but the *Φαινόμενα* and *Διοσημεῖα* have been translated over and over again. Macmillans published a very good rendering by Mr. Poste. Sir William Drummond's essay must have been out of print for ages. A high-class second-hand bookseller would be the man to apply to, to obtain his work, if now procurable at all.

In reply to "W. H. H." (query 68384, p. 162), Mr. W. F. Allen is substantially right in what he says, though, of course, the unequal motion of the Sun in the Ecliptic also operates in producing the difference between mean and apparent time, sometimes combining with the obliquity of his path to the Equator to aggravate that difference, at others operating in diminishing it. Suppose that in our figure ♈ E



represents the Equator, and ♈ F the Ecliptic, and let us imagine, for simplicity of explanation, that the Sun moves uniformly in the latter. Now set off equal intervals, ♈ A, A B, B C, and so on, on the equator. These we may suppose to be the arcs of R. A. described by the Sun in any supposed equal intervals. Again, let us set off intervals of identically the same length, ♈ *a*, *a b*, *b c*, and so on, on the Ecliptic, and drop perpendiculars from them on the Equator; then shall we see at once how little equal changes in Solar longitude correspond to the concurrent changes in Right Ascension (upon which, of course, the difference between apparent and mean time depends). For suppose a fictitious Sun to start from ♈, and travel on the Equator to A in a unit of time, while simultaneously the real Sun starts from ♈ and travels precisely the same distance to *a* on the ecliptic; then will this real Sun only have increased its Right Ascension by the arc ♈ *a′* instead of ♈ A; when it reaches *b* its R.A. will be only ♈ *b′* instead of ♈ B, and so on. My querist will find the whole subject intelligibly explained in Stubbs and Brünnow's edition of Brinkley's "Astronomy," published by Longmans and Co.

The hagioscope, concerning which "Question" puts query 68390, on p. 162, was a hole somewhere in the side of the chancel arch, through which lepers and others might obtain a peep at the altar during the performance of Mass.

That altogether admirable endowment, the Henry Draper Memorial Fund, continues to produce results of the highest scientific interest and of enduring value. From the Report recently issued by Prof. Pickering, it would seem that the photographic study of stellar spectra at Harvard is rapidly approaching completion. The photographs taken with the Bache telescope (which has an 8in. photographic doublet for an object-glass) cover the entire sky north of 115° N.P.D. About 28,000 spectra of 10,800 stars have been examined, including nearly all stars of the 7th magnitude and brighter, visible in latitude 42° 23′ N., and the catalogue is now almost ready for the printer. By a very ingenious process, the intensity of some 15,000 of the spectra has been measured. The telescope has now been sent to Peru, in order that the remaining southern portion of the heavens may be photographed in identically the same way as has produced such admirable results in this hemisphere. The 11in. refractor, with one, two, or four large prisms over the object-glass, has been employed in the detailed study of the spectra of the brighter stars, with some remarkable and interesting results. The sodium line D, for example, is shown double in photographs of Arcturus and Capella; while the components of β Cygni have spectra of different types. I may perhaps add that the Bache telescope has also been employed in making a photographic determination of the brightness of the stars, an elaborate memoir on which forms No. 7 of Vol. XVIII. of the "Annals of Harvard Observatory." Of this exhaustive monograph it is quite impossible to give a summary within the limits of a paragraph in a letter, and I must refer any of my brother readers interested in the matter to the paper itself, whence they may learn with what labour and painstaking ingenuity the photographic and photometric magnitudes of the objects observed have been compared, and what a foundation has been laid for the future detection of any changes which may occur in the stellar vault.

By the lamented death of Dr. Warren De la Rue, a familiar figure has fallen out of the ranks of English astronomers, and we have to deplore the loss of one who has done much to advance the interests of science in Great Britain. When we look upon the recent marvellous results attained in celestial photography by Messrs. Common, Henry Frères, and Isaac Roberts, we must never lose sight of the fact that the late Mr. De la Rue was the pioneer in the work in which such gigantic strides have been made of late years. He was sincerely and earnestly devoted to scientific pursuits, and his wealth furnished him with the means and opportunities of forwarding experiment and observation of which he was always ready to avail himself. Witness his generous gift to the Oxford University Observatory. To his genial and delightful manner all who ever came in contact with him will bear ready testimony. The only mischief that he ever did (innocently and unintentionally enough) was that involved in his unfortunate association with the Sunspot ring. The mere cadgers who were scheming to perpetrate (what Prof. Pritchard as accurately as expressively called) "that gigantic job" the "Solar Physical Observatory," for their own private pecuniary advantage, were but too fortunate—from their own point of view—in enlisting the sympathies and obtaining the advocacy of so transparently honest a man as Warren De la Rue. All the world knew that, unlike his associates in the matter, he had nothing whatever to gain by it, and so the unselfish co-operation of such a man misled many who would otherwise have seen through the whole contemptible scheme readily enough. He is gone. His pleasant face and delightful voice have disappeared from our meetings, and he will be sincerely mourned by the very large number of attached friends whom he leaves behind him.

As a rule, I studiously eschew any mere paradoxes or catch questions, and should have done so with query 68362 (p. 142), but that I observe that nobody has noticed "Finsbury" at all. In the first place, the formula quoted from Ball is devised to determine the relative masses of the central attracting bodies, those of their attendant planets or satellites bearing but an infinitesimal proportion to their own. In the next, I wonder if "Finsbury" has taken the trouble to reduce his second equation to figures. Let us try it out by the method given in the work whence he quotes (p. 336). The Earth at distance 1 revolves around the Sun in one year. Jupiter is 5·2028 times further off the Sun than we are, and his periodic time is 11·862 years. Now, if we take the square root of the cube of 5·2028 we shall find it come out 11·8674, so that we say $\left(\frac{11\cdot862}{11\cdot8674}\right)^2 = \frac{\text{Mass of Sun and Earth}}{\text{Mass of Sun and Jupiter}}$; or, in fact, that the mass of the Sun and Earth is some 0·99909 of that of the mass of the Sun and Jupiter—and this is substantially correct. The idea of the Sun revolving in an orbit round some other star is the veriest stuff and nonsense. A slight study of stellar proper motions would show "Finsbury" that they have nothing to do with the mutual gravitation of the stars. Mädler's craze about a "central sun" is as dead as a doornail.

Letter 29870 (p. 176) is a deliberate attempt to entrap me into a theological discussion, into which I absolutely refuse to enter. Texts are as utterly valueless in settling scientific questions as nursery rhymes. Surely in vain the net is spread in the sight of any bird. Anyone curious to see what I have called "crazy nonsense" can turn for himself to Newton's "Observations on the Prophecies of Daniel and the Apocalypse of St. John." The sole remark I shall add is that the honesty of "E. L. G.'s" method of quotation is on a par with his logic. By the omission of my words, "there is not the slightest proof that," before the words "does exist, or," he insidiously tries to impute a claim to omniscience to me, which I assuredly should be the last man in the world to advance.

Mr. Parfitt (query 68432, p. 184) should study pp. 121 to 126 of Vol. I. of Holtzapffel's "Turning and Mechanical Manipulation."

The mistake in the footnote on p. 9 of Webb's "Celestial Objects," referred to by "G. G. B." (in query 68436) on p. 184, lies in the substitution of Vol. XIV. of the *Astronomical Register* for Vol. II., that in which the description of Mr. Vallance's equatorial stand really did appear. The whole paper, illustrations, and all, was reproduced in the ENGLISH MECHANIC, on p. 394 of the second volume of which your correspondent will find it. The best way for him to divide his circles is by the aid of one of Holtzapffel's circular card protractors, remembering that 15° = 1 hour, 15′ = 1 minute, and 15″ = 1 second, and so on. The hours should be numbered right round from O (or XXIV.), from west to east. If the magnetic declination is accurately known, the equatoreal may be brought approximately into the meridian by the aid of a compass, and its adjustment (for which see Vol. XV. of the ENGLISH MECHANIC, pp. 551 and 629) subsequently perfected.

The calculation concerning which "J. L." puts query 68440 (p. 184) is as simple as possible. Given the refractive index—say between air and water, 1·336, and again between air and quartz, 1·548, what is the index of refraction between water and quartz? To find this, we simply divide the index of the medium *into* which the ray is supposed to pass, by the index of that from which it comes, thus: $\frac{1\cdot548}{1\cdot336} = 1\cdot159$.

"L." (query 68456, p. 184) puts his question very vaguely. If he wishes to know how to produce numerous different tints in water colours, he should get Barnard's "Theory and Practice of Landscape Painting in Water Colours," published by Hamilton, Adams, and Co. He will find a great deal of information, too, in Field's "Painters' Art, or Grammar of Colouring" in Weale's series.

A Fellow of the Royal Astronomical Society.

VENUS.

[29882.]—I WAS fortunate enough to-day, April 29, 1889, between 3 and 3.30 p.m., to make a successful observation of Venus when near inferior conjunction, though clouds were constantly passing. The thread-like arc was indescribably beautiful.

My instrument is a 6½in. Calver reflector, equatorially mounted, and I used a low-power eyepiece and a dark glass. **E. Brown.**

Further Barton, Cirencester, April 29.

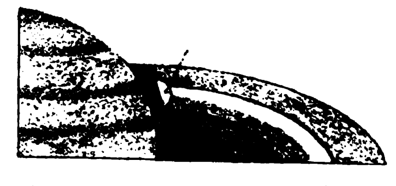
SOLAR HALO.

[29883.]—A LARGE and vivid solar halo was seen here on Saturday, April 27. It was fully 60° in diameter, and was edged with prismatic colour. A white vapour pervaded the sky except the interior space, which was nearly clear of vapour and of a dusky blue, presenting a very striking appearance in contrast with the surrounding vapour. Approximate duration from 11.45 to 12.20.

Portland. **W. R. Waugh.**

BRIGHT SPOT ON RINGS OF SATURN.

[29884.]—THE remarkable white spot, first seen by Dr. Terby on March 6, has been so conspicuous during the past week that it has doubtless been observed by a large number of your astronomical readers. I had a fine view of it on April 18, and again to-night. On both occasions it occupied the same position as shown in Dr. Terby's sketch ("E. M." p. 153). That portion of it on ring B appeared to be much brighter than that on ring A. Not the least remarkable feature in connection with it was its peculiarly pure white colour, which contrasted strongly with the other lines associated with the planet. Its following edge was clearly convex, and it appeared to be oval in shape. I could trace it from the inner edge of ring B, to a little beyond the inner edge of A. Cassini's division, which was beautifully defined on both evenings, could not be seen through the spot. I append a sketch made to-night with a power of 284 on my 8½in. Calver reflector. **Thos. Gwyn Elger.**



Kempston, Beds, April 20.

MEAN-TIME TRANSITS.

[29885.]—As some of our friends are evidently using a transit instrument with a mean-time clock, and as no transit tables are now forthcoming, perhaps it would not be inopportune to compare notes on the best way out of the difficulty. Before starting a sidereal clock, I felt the need of having the most concise method of getting the mean time of a star's transit, because when one has to compute it for every observation, the slightest economy in the figuring is worth attending to. Now, there is a table in Main's "Spherical Astronomy" which comes in very conveniently in this connection, having been devised by the ex-Astronomer Royal expressly for the purpose of computing mean time. It is formed by taking the ordinary retardations from certain fixed quantities. The tabular corrections thus resulting are applied additively, which may seem a trifle, but makes a good deal of difference practically, as one operation suffices instead of two, and fewer figures are also required. Mean time then = mean time of preceding transit of First Point of Aries (from p. III. *N.A.*) + sidereal time + correction for hours, minutes, and seconds − 4 minutes. The last quantity being an even amount can be taken off mentally, as the time of the transit of ♈ is extracted; but when the object is to find the mean time of star transits, a further economy is possible. For the R.A. of a star (except the close circumpolars) varying very little, and the correction varying very much less, no sensible error is involved if the latter is considered a fixed quantity. It is, therefore, convenient to run into one item the correction for the h. m. and s. of R.A., and enter it at the foot of the column belonging to the star in the *N.A.* With this can also be incorporated the small correction due to the observer's position in longitude calculated at the rate of 9·8565s. for each hour of longitude and considered + if station is East of Greenwich and − if West. Premising that this preparatory work is done, and it can be easily accomplished on one or two of those delicious evenings the British climate supplies in such rich abundance, when astronomical work can scarcely be furthered in any other way, then the absence of transit tables will hardly be felt at all. For all that remains to be done to get the mean time of a star's transit on any evening is to add together three items, all of which are in the *N.A.*, and two of which are on one page.

Thus, suppose the mean time of the transit of Arcturus on the evening of May 1st is required, at a station 4 min. W. long. The correction for Arcturus, which would come out from the tables as 1m. 40·65s., in this case would be reduced by ·65s., and would for an observer so placed be entered as 1m. 40·00s. Then the mean time of the preceding transit of First point of Aries, less 4m., = 21h. 18m. 0·86s. If to this be added the R.A. of Arcturus for the day—viz., 14h. 10m. 37·09s., and the correction as above, the sum 11h. 30m. 17·95s. is the time required. If transit tables had been available, their use would have involved almost as much trouble as this, as they must be arranged for some meridian, and if exactness be aimed at, a correction will be necessary to use them for any other; while, on the other hand, it is a great advantage to have all the suitable stars of the *N.A.* at our disposal by an expeditious method of computation. With regard to the tables above referred to, anyone interested will find them on p. 105 of the work mentioned; or should Mr. Main's book prove difficult of access, the quantities can be easily formed from the tables in the *N.A.*, p. 482, by the following formulæ: — Tabular correction for hours = 3m. 47s. + mean time equivalent − sidereal hours. Tabular correction for minutes = 10s. + mean time equiv. − sid. minutes. Tabular corr. for seconds = 3s. + mean time equiv. − sid. secs. It will be noted that these three constants added together are equal to the 4m. which is dropped when the table is used. It might perhaps be thought that, although this method gives very little work at the end, yet the preparatory work brings it to about the same thing. But this is far from being the case, because an observer may expect to observe the same star a considerable number of times in the course of the year. If he can contrive to make, therefore, any part of the computation applicable to *all* the observations, a palpable saving must result. This is just what the above plan does, and, thinking it might prove a useful suggestion to those who are taking transits in mean time, I have ventured to put it forward. **W. J. R.**

THE METEORITIC THEORY AND "F.R.A.S."

[29886.]—IN letter No. 29792 I asked "F.R.A.S." to be good enough to point out to me some of the inaccuracies in the meteoritic hypothesis. For "wanting to know" I am politely called a fool; whilst one who sympathises with "F.R.A.S." (letter 29815) wonders how much I know about the matter. It certainly looks as if both writers considered my letter a gross piece of presumption.

Now, in the same issue as that in which my letter appeared (April 5) "F.R.A.S." began his remarks with two references to Prof. Lockyer. He called attention to the fact that Dr. Huggins, who no doubt is one of the best living spectroscopists, had said in a paper to the Royal Society that the characteristic line in the *auroral* spectrum was not "the remnant of the brightest manganese fluting at a wave-length = 558." I note that your correspondent does not publish the wave-length which Dr. Huggins holds to be that of the auroral line—namely, λ 5571. I have no doubt that in due course Prof. Lockyer will reply to Dr. Huggins, if he has not done so already; but it seems to me, after all, but a very small matter, and either of the observers may be wrong to so slight an extent in their measures. Dr. Huggins takes Gyllenskiold's mean wave-length = 5570, as found by 30 different observers, as the true one. I fail to see how this could be devoid of error when such numbers as these are included in the list:—5552, measured by Struve in 1868; 5595, measured by Procter in 1870; 5680, measured by Lindsay in 1871.

The mean result may therefore certainly be wrong. Dr. Huggins's own result, after measuring the line in 1874, was λ 5571—a very different number from those quoted above. From what I know of the matter, the balance of evidence between the results of Huggins and Lockyer is about equal, with perhaps a little in the favour of the latter. I have just examined the spectrum of manganese, and find that on the more refrangible side of 558 there is a slight maximum in the fluting, which would give it a wave-length nearer to Dr. Huggins's value. A re-examination of the spectrum by Prof. Lockyer with better instruments than mine might show this edge more clearly, and thus demonstrate even to Dr. Huggins that the aurora line is after all the remnant of the first manganese fluting.

Regarding Prof. Young's "General Astronomy," it is a splendid work and worthy of all praise. The meteoric theory, however, is not spoken of very favourably in it, although the diagram on p. 484, copied from Prof. Lockyer's paper, explains stellar variability in a much clearer manner than any other noted. Prof. Young says: "The fundamental idea that the phenomena of the temporary stars may be due to collisions is not new. Newton long ago brought it out and to some extent discussed it; but *considering the probable diameter of the stars as compared with the distance between them*, it seems impossible that collisions could have been frequent enough to account for the number of temporary stars actually observed." The part in italics was omitted by "F.R.A.S." in his quotation. Now there is a vast difference between the hypotheses of Newton and Lockyer; in one case we are dealing with the direct collision of two compact bodies, in the other, with the collisions of two swarms of meteorites where there would be little direct impact. But Newton never proposed the collision theory to explain the variability of stars like Mira, but only to explain the creation of stars such as Tycho Brahe's Nova of 1572. He held that regular variables might be produced by the revolution on its axis of a fixed star having a dark and a light side. In the words of the Principia, "Stellæ fixæ quæ per vices apparent et evanescunt, quæque paulatim crescunt, videntur revolvendo *partem lucidam et partem obscuram* per vices ostendere."

Hence, Lockyer cannot be said to have copied Newton in his theories of temporary or variable stars. Newton's hypothetical Nova would have taken millions of years to cool. Lockyer's Nova, being due to grazings of meteorites more than anything else, would not be one mass raised to a very high temperature, but the increase of light wo be the integrated result from all the meteorites had collided, and the swarm would soon cool to its normal condition. Does not this theory the case of Novæ better than Newton's direct appulsion of two comets or dark bodies in space?

"A Sympathiser with 'F.R.A.S.'" makes most alarming statements in a very dispassionate manner indeed. He makes me say that I have only recently taken to learning astronomy, when I said nothing which could be construed into such a statement. I have worked with a 7in. achromatic for nearly twelve years, and have managed to gain a little knowledge of the beauties of the heavens in that time. I do not find anywhere that Prof. Lockyer attempts to make out that he is the author of the meteoritic theory. In the "Manchester lecture" he gives the honour to Tait, and in his latest paper on comets, he begins with Schiaparelli's and Tait's conclusions. I believe, however, Lockyer was the first to examine the matter spectroscopically, and since "F.R.A.S." acknowledges him to be an able spectroscopist, why disregard and pooh-pooh his conclusions and *original* observations contained in his papers to the Royal Society? But what matters it who was the originator of the hypothesis? All theories are subjects of evolution. The theories of cosmogony propounded by Kant and by Laplace, and Herschel and Proctor, are all very similar to that held by Tycho Brahe more than 300 years ago.

I could say much more, but fear that I have already trespassed too much upon your space. I cannot, therefore, reply to the other points contained in letter 29818, although a couple of them are very susceptible of attack. I must thank "F.R.A.S." for calling my attention to the paper read before the Liverpool Astronomical Society by Mr. Monck. I have ordered the *Journal*, and shall no doubt read it with interest. I do not pin my faith to any creed, and certainly to no man, so think I can view a question in an unbiased manner. If I injured the feelings of "F.R.A.S." by attributing personal motives, I am sorry; but it must be manifest to every reader of the "E.M." that he begins a review of the Professor's works with the thought, "Can any good come out of Lockyer?"

Richard Arman.

115, Rylston-road, Fulham.

DELUGES, FLOODS, CONFLAGRATIONS, STEAM COMETS, AND CATASTROPHES IN GENERAL.

[29887.]—"E. L. G.," letter 29870, on "Celestial Chemistry," according to "divine revelation," gives your readers some interesting information. Perhaps it may be consoling to those among them who are now living in threat of this impending "fervent heat" to consume our earth, to know what some "heathen" philosophers thought of these "prophecies" inspired or revealed. Aristotle ("De Meteor." lib. i. c. 14) says that the winter of the great cyclic year is a deluge, and its summer a conflagration. Volney, "Revolutions of Empires," page 229, says these deluges and floods in mythology are nothing more than the annual winter rains and floods, particularly those of the Nile, exactly as their pretended fires which are to destroy the world are the excessive heats of the summer of the deserts. Porphyry says of the Egyptians, from whom, no doubt, Moses derived greatest part of his mythology, employ every year a talisman in remembrance of the world; at the summer solstice they mark their houses, flocks, and trees with red, supposing that on that day the whole world had been set on fire. It was also on that day or period, that they celebrated the pyrrhic or the fire dance. As to floods, "E. L. G." puts his, as p. "watery comet," 50 centuries ago. The Chaldæans put theirs 15,000 years before the war of Troy; the Egyptians had theirs at another time, with their Ark of Osiris; the Greeks, theirs of Deucalion and Ogyges; the Indians theirs, Xisuthrus being like Noah saved in his ark. Does "E. L. G." invite us to imagine "special" (watery) comets for each and all of these floods, or a "fiery" one for each conflagration?

F. W. H.

FRESH EGGS.

[29888.]—In your issue of this week, page 175, is a paragraph on the subject of testing the freshness of eggs, by a Dr. Evans. I suppose the paragraph is really meant as a little joke. A better plan would be to at once break the egg and have a look at the inside, for surely violently shaking an egg in the manner suggested would break the yoke (*sic*.).

Now, Sir, "I know a trick worth two of that." I did not learn it from a doctor, but from an old woman, who assured me 35 years ago that Adam and Eve used this method before they boiled their eggs for breakfast.

Now, what is a fresh egg? Of course, all eggs offered for sale are very fresh. I take an egg to be fresh that still retains the germ of life.

Assuming this definition to be a correct one, I know of only one homely plan of ascertaining the existence of vitality in an egg, and, as this method is so infallible and simple, I have pleasure in giving it to my fellow-readers:

Press gently the broad end of the egg on to the tip of your tongue. If fresh, it will be distinctly warmer than the tongue; the small end will be icy cold. If the egg is not fresh, both ends are cold. An egg when both ends are hot has just been boiled.

Tuebor.

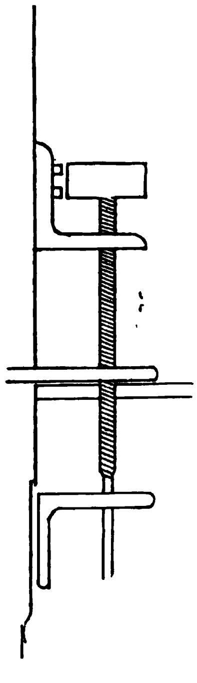
[29889.]—The discovery of a reliable test for the freshness of eggs which you credit Dr. Evans with has been in practical use in every farmyard for "generations," consequently it hardly deserves a place in your "scientific columns," where we usually expect something fresh.

To prove that this is universally known, if not prehistoric, let any reader give an egg to any ploughboy, and ask him if it is fresh or not, and he will at once put it to his ear and shake it; or ask any old egg-woman in our market. And perhaps your readers may be interested to know that if they put the base end of an egg against the tip of the tongue it will strike warm if quite fresh and good; but if it strikes cold it is "haddled," as the ploughboys call them—that is, the "germ" has lost its vitality.

Leicester. **W. C. Phipps.**

THE MOST USEFUL CONDENSER FOR MODERN OBJECTIVES.

[29890.]—I saw in last week's paper some notes on the substage condenser from the *American Monthly Microscopical Journal*. What a great number of microscopists want to know is what to buy as the most useful condenser for the modern objectives. Apparently there is no choice, because there are, so to speak, no wide angled 1·40 achromatic condensers.



I once thought we might have got wide-angled objectives made to answer both purposes; but on inquiry at Beck's about it, I was told that the condenser needed a different correction to an objective.

I had this last week a curious confirmation of that theory. I was trying a very badly corrected ⅛th, maker unknown—a glass I had been recommended to throw away as being worse than useless. I had a Reichert ½in. objective in the substage as a condenser, and to my surprise I found that the ⅛th was clear and entirely without fringes. That to my mind convinced me that for a condenser you wanted something differently corrected to an objective.

Reichert's price for a condenser of 1·20 or 1·40 aperture is £1 2s.; but if you want an English one you have to pay double or treble the money. Where is the difference? With the high-power objectives now in use you need a very fine adjustment, as they are so deficient in penetration that you have to do a lot of your work by means of the focussing; but in all the stands I have seen, you have no chance, as the range is so small that the slightest movement of the milled-head you are out of focus. What I want is to be able to trace slowly the different layers and their connection one with another.

I have thought that a number of the older stands with the front lever or side lever might easily be improved if you made use of the principle of differential screws. Suppose you had a piece of brass fixed to the tube tapped with a thread of 25 threads to the inch, and below the lever the milled-head tapped to 26 to the inch, and you had as near to the movable nose-piece as you can get a brass with a plain hole through it, you make your screw the upper part 25 threads to the inch, then 26 threads to the inch, and the lower end plain; you screw through the upper brass before you put the top milled-head on, and when fit up you would have a very fine adjustment 625th of an inch for one turn of the upper milled-head. One of one turn to the 26th of the inch by one turn of the lower milled-head. I inclose a rough sketch.

A Struggling Microscopist.

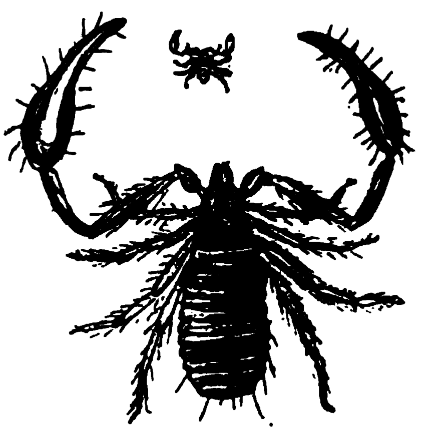
THE METRIC SYSTEM.

[29891.]—"Ponto" supposes, in letter 29875, p. 177, that the idea of percentages would be retained with tables not centesimal. But percentage is never even now applied to such things as Income-tax or the richness of ore. The former is always defined by pence in the pound; the latter (in the case of auriferous quartz) by ounces per ton. Even railway gradients are not expressed by percentage. With uniform meristic measures, weights, money, &c., there will be no shadow of motive for so clumsy a method as percentage.

E. L. G.

PSEUDOSCORPIONIDEA.

[29892.]—Perhaps a short note on the Pseudoscorpions (one of the orders of the Arachnida) may be interesting to those who take a delight in the study of nature. I shall confine my remarks more especially to the fam. Chernitidæ and the genus Chelifer. These little creatures (of which I send a drawing) are more simply organised than the true scorpions; the abdomen does not become narrow to form a post-abdomen, and there is no caudal spine and poison gland. They all possess spinning glands, and breathe by means of tracheæ. The genital opening is situate on the first sub-abdominal segmental plate. The alimentary canal is simple, and imbedded in a mass of substance, serving the function of a liver. There is nothing certain about the circulatory system, except that a simple vessel runs along beneath the dorsal plates. These creatures feed on podura principally; but will also eat mites and small insects. They live under decaying bark, moss, stones, in old books, herbaria, and some are said to be parasitic on the common fly itself. The pseudoscorpions possess only two or four ocelli, and the tracheæ open by means of two pairs of stigmata, situate on the second and third sub-abdominal segmental plates. The openings of the spinning glands lie around the stigmata.



Appendiculata.

PERSPECTIVE DRAWINGS—A SIMPLE RULE FOR FINDING THE VANISHING POINT.

[29893.]—In drawings involving many straight lines, such as interiors of rooms, &c., one of the first difficulties met with by a beginner is to determine the position of the vanishing point of any given line, such, for instance, as the edge of the ceiling, or the sides of a book, &c. Many special rules have been given—here is a very simple general one which I believe to be new:

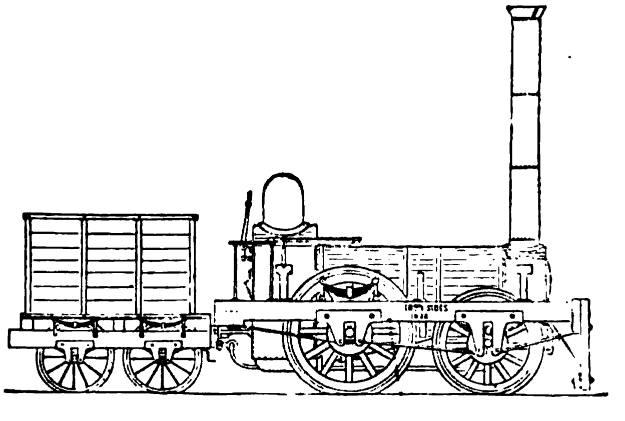
Hold your pencil *parallel* with the line you wish to draw, look along it, and the point where it would, if prolonged, strike the wall or other object in the room, is the vanishing point of all the lines to which the pencil is held parallel. This applies equally whether the line slopes up or down, and whether it is perpendicular to the plane of the picture or not.

Glatton.

THE HAYDON CUTTER BAR.

[29894.]—I should like to pat Mr. Carre on the back and call "Time!" The writer has a Haydon cutter bar, a perfect slide-rest, and a Tangye cutter bar. The first he is prepared to sell cheap, the last he won't part with. The first is an incentive to cursing and swearing (I hope Mr. Carre will forgive); the last is like the Waverley pen, a gift and a blessing to men.

Tuebor.



AN OLD AMERICAN LOCOMOTIVE.

[29895.]—RECENTLY I have obtained from America the annexed diagram of a locomotive engine named "Old Ironsides," built for the Philadelphia, Germantown, and Norristown Railroad Company.

It was the first railway locomotive constructed by Mr. Baldwin, of the now famous "Baldwin Locomotive Works," Philadelphia. It was completed and ran a trial trip on the 23rd of November, 1832.

It will be seen that the "Old Ironsides" was a four-wheeled engine modelled essentially on the English practice of that time, and was very similar to the "Planet" class introduced upon the Liverpool and Manchester Railway by George Stephenson in 1830.

The driving-wheels were 4ft. 6in. diameter, the cylinders 9½in. diameter, and the stroke 18in. The boiler was 2ft. 6in. diameter, and contained 72 copper tubes 7ft. long and 1½in. diameter. The valve motion was given by a single loose eccentric for each cylinder, and on the inside of the eccentric was a half-circular slot. A stop fastened to the axle terminated in a pin which projected into the slot; the engine being reversed by changing the position of the eccentric by means of a lever on the foot-plate. Weight of engine in working order about 5 tons. The tender ran upon four wheels, and contained an iron tank for water inclosed in a wooden casing, and with a coal space in front.

Clement E. Stretton,
Consulting Engineer, Asso. Soc. of Enginemen and Firemen.

Leicester.

LOCOMOTIVE CABS.

[29896.]—IN reply to "J. A.'s" invitation (p. 155) to railway men to give their ideas of the present form of cab, I send a few of mine. While thanking him very much for bringing this subject up, I must say that I don't think his plan would do. How would he provide (in the tender-engine pattern) for play in going round curves and over uneven roads? Also, how would he get to the tool-boxes on the top of tender? Now, what we want are doors at the side about 3ft. 6in. high, a sort of half-cab (the roof of this half to slide on to the top of engine cab when it was not raining in the summer) to fasten on to the tender, and thick canvas curtains to cover the space left, to fasten with small studs into eye-holes in the curtain, or any means which would secure it so that (in the event of a gauge-glass bursting, or anything happening which required the driver's or fireman's head outside) it could be easily undone. I can assure your readers that life on the foot-plate is not what many suppose it to be—viz., in summer time, a nice comfortable ride in fresh air, some nice scenery to look at, and nothing to do except look ahead occasionally for a signal, and put a bit of coal on now and again; in winter, a nice fire to keep you warm all day long. No, Sir; in summer, the scenery we see every day, and riding is hard work. They must remember the engine breaks the jolts for the passengers, and, besides, there is the throbbing of the machinery; in winter, there is the keen wind cutting across, and if you are running tender first, or have a double-cab tank-engine, it is, without exaggeration, "terrible."

Locomotive Fireman.

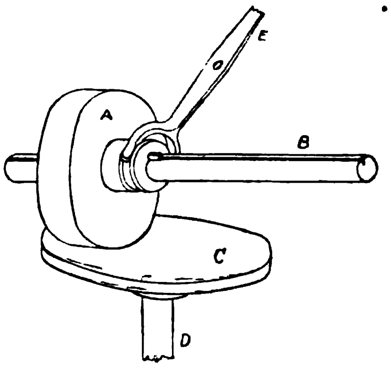
PORTABLE AND STANDARD CELLS.

[29897.]—"W. R." (letter 29857) seems to have misinterpreted my letter. It is true that it is, as he states, a bit sloppy; it is not so much on the portability that I lay stress, but on its being a reliable standard of 1 volt. The Latimer Clark, it is true, would be much cheaper, but I have found from practice that it gives rather above the average of 1 volt. The three silver-chloride cells that I mentioned 3½ by 1, and at the temp. of 90° F., gives an E.M.F. of 1 volt; also I may state that I have a set made of ebonite, which also give every satisfaction; so that "W. R." will see that they can be made of other materials besides glass. If "W. R." will advertise his address I think I can help him with a portable sealed standard (similar to the Leclanché).

F. W. Mason, Consulting Electrician.

WATER MOTORS.

[29898.]—A FEW days ago I saw an amateur turner's workshop driven by a Ramsbottom three-cylinder motor. There is a certain amount of shafting, say, 8 yards, and about 6 bearings, to drive, one at a time, several lathes. The quantity of water consumed is 800 gals. per hour, and this, I believe, must be the case even if the motor be running alone, since the cylinders must fill; throttling the water inlet may diminish the speed and the power, but, unless I am mistaken, the water per revolution will be the same. Will Messrs. Ramsbottom kindly correct me if I am wrong? I reckon 800 gals. per hour at 85lb. pressure equals 8,000lb. falling from a height of 160ft. equals 128,000ft.-lb. per hour or, say, 21,000ft.-lb. per minute. Supposing friction of shafting and motor, &c., to reduce this to one-half, we still have 10,500ft.-lb. effective for driving a lathe. Now, a man on a treadle cannot exert more than about 4,000ft.-lb.; here, therefore, my friend has a power of two and a half men available. Now, as the water costs 9d. per 1,000 gals., 800 gals. come to 7¼d. per hour, which, if I am right, will be expended even if the shafting or the motor be running alone, provided it runs at the normal speed; no water being saved by screwing down the tap. It appears to me that with a suitable arrangement half this expenditure of water might be saved, and I suggest the following:—A is a friction wheel, surrounded with indiarubber, or made up of discs of leather; its key slides in a long keyway on its shaft, which shaft, B, is supposed to be a continuation of the crank shaft of the motor; thus A turns continuously at a normal speed in one direction, the motor being incapable of reversing. C is a friction plate on shaft D, and it is pressed by a spring against A, so that it receives motion from A. The position of A upon the shaft B is controlled by the forked lever E, the handle end of which would be fitted with a notched quadrant, like the reversing lever of a link motion, and would be brought up within reach of the workman, so that by moving the handle he could drive his main shaft slowly with considerable force, or, by sliding A towards the centre of C, faster with less force; or, by moving A on to the centre of C the motor would be stopped; by moving it across the centre to the other side, the direction of revolution would be reversed, the handle E having a similar effect to the reversing lever of a locomotive, and, like it too, the arrangement would appear to permit of the full pressure due to the head of water being utilised without obliging it to expend half its force in passing through a throttled valve. Perhaps some correspondent will kindly criticise this plan, or say if there is a better one.



I have a small wheel-motor having an orifice $\frac{1}{16}$in. Will someone say what power it should give with a head of 100ft., and at what speed it should run? The wheel is about 12in. in diameter.

F. A. M.

ORGAN NOMENCLATURE.

[29899.]—I AM, in common, I feel sure, with all the readers of your journal who are interested in Organ matters, much obliged and indebted to "G. W. S." for the "little lesson in German" which he has given in his letter (29878). With reference to the term "Lieblich gedeckt" and its different spellings, I am free to admit that until very recently I submitted, in a thoughtless manner, to considerable confusion, born of the inaccuracies of nearly every writer on the organ, and of almost all the compilers of Organ specifications in this country. In Hopkins and Rimbault's work, two spellings are used—viz., "Lieblich gedact" and "Lieblich gedackt." To the best of my knowledge, the correct form of spelling does not once appear. In Carl Locher's work on "Organ Stops," translated by Mrs. Schauenburg, we find the following:—"Gedackt or Gedeckt (covered, stopped). Gedackts form one of the most important families of stops. The terms Lieblich, Sanft, Still, Gross, and Grob-gedackt depend upon the power of intonation and dimensions of the pipes." The term "Gedackt" is employed throughout the book. In Stainer and Barrett's "Dictionary of Musical Terms," we find these explanations:—"Lieblich (*Ger.*), lovely, sweet-toned; as *Lieblich gedackt*, lovely stopped diapason." "Gedackt (*Ger.*), covered or closed [Decke, § 2."] "Decke (*Ger.*) 1. Cover, an upper or lower plate of a resonance box. 2. The cover of stopped metal organ pipes—e.g., *lieblich gedeckt*, the sweet-toned stopped diapason." In Tolhausen's "Technological Dictionary," published by Tauchnitz, of Leipzig, this sentence occurs: "Stopped, covered with a lid (org.); *gedackt*, *gedeckt*; Jeu à tuyaux bouchés." In the great work by Helmholtz, "On the Sensations of Tone," we find the author, whilst speaking of large-scaled stopped pipes, using the term "weitgedackt." Now all this is a little confusing, and I, for one, would be greatly indebted to "G. W. S." for a further lesson on the subject. As may be seen by reference to my "Notes on the Concert-room Organ," I have settled in my mind that "gedeckt" is the correct and most desirable way of writing the word; but with such German authorities as Tolhausen and Helmholtz staring one in the face, one can only come to the conclusion that both "gedackt" and "gedeckt" are equally correct. Perhaps "G. W. S.," who is evidently a German scholar, will give his opinion on this question.

"G. W. S." concludes his letter with this remark: "I think this little lesson in German may help Mr. Audsley or Mr. Robinson in settling upon a word which shall at least mean *something*. Now this is a very severe "slap in the face" to all the German authors and organ builders who have used the terms under discussion with the conviction, I presume, that they "mean something"; but with such authors and organ builders I have little to do at present; they can take care of themselves and their language. I shall await with some impatience Mr. Robinson's ideas on the question, and I have no doubt that they will be, like all the hints he has already given in these pages, very valuable. As regards my own views anent the expedience of employing more or less inappropriate foreign names for our organ stops, they have already been given, in no timid words, in my "Suggestions for the Introduction of a Systematic Organ Stop Nomenclature." I may be wrong, but I flatter myself that I have practically covered the ground in relation to this matter in the following few words:—"In arranging a Stop Nomenclature which shall commend itself for general adoption, it is obvious that it must be formulated on a definite system. It is imperative that it should be capable of conveying to the mind a tolerably clear idea of the sounds produced by the respective stops: their quality, strength of tone, and their relationship to the fundamental unison sounds of the instrument. In the nomenclature we have nothing whatever to do with the *forms of the pipes* or any other expedients resorted to by the organ-builder to produce certain varieties of tone; it is with the *resultant sounds* we have to deal, and with them alone." In my remarks on the names of stops yielding FLUTE ORGAN TONE I say:—"The first step to be taken towards a more satisfactory nomenclature for this subdivision is to throw aside every name which has no reference to the *tones* produced by the respective registers. This weeding out must be done regardless of questions of nationality, or of the conceit of accredited inventors." In such names I include lieblich gedeckt, still gedeckt, sanft gedeckt, grob gedeckt, gross gedeckt, and "weit gedackt." I say in the article alluded to:—"Two facts assist in the simplificatio of the nomenclature. Firstly, that distincti qualities of ORGAN FLUTE TONE are very few number; and, secondly, that only two or three these are introduced in any one department, even of a large organ, at one time. Under these circumstances, it is unquestionably absurd to retain in use an embarrassing list of practically synonymous terms as that now obtaining. To arrive at the simplest result, I suggest adopting for all stops producing *Organ Flute Tone* the single term FLUTE, qualifying it, as required, to clearly indicate their position in, and relation to, the general tonal structure." Such remains my view of the matter.

Devon Nook, Chiswick. **G. A. Audsley.**

ORGAN MATTERS—TONE COLOURING IN RELATION TO GENERAL DESIGN.

[29900.]—I THOUGHT that my letter under the above heading was written on sufficiently broad and liberal lines to have made personal attack impossible. I am sorry to find that Mr. Audsley, who is laying himself out to act as an unprejudiced and disinterested adviser, should resent fair criticism and descend to personalities. A reply from me he now enforces.

Roosevelt, of New York, is pre-eminently the representative of a school of *huge* organ building; his specifications are gigantic, and display perfect forests of stops of all imaginable and unimaginable names (from a "Contrabumblebee" to the "Last Trump" transmitted by telephone!) The prevailing feature in all these designs is endless duplication of stops in every manual.

Mr. Audsley, in acknowledging and adopting this school, follows Roosevelt's lead, and his pet Concert Organ scheme displays the same characteristics and the same faults as those of his great prototype, and would be, if carried out, to use his own expression, "an Organ of the first magnitude." Mr. Audsley's "Notes on the Concert Organ" serve him as the one and only authority, which he quotes to all would-be inquirers.

I have dared to question their value, dealing only, it must be observed, on the broad principle of general design, and lo! the bolt from heaven has fallen. Jupiter tonet!

I revert to my original standpoint once more, and say that these huge instruments are unnecessary and inartistic, because the ends in view can be attained by simpler means. For, if with distinctive colours and a few skilful touches of the brush on the canvas greater effect can be produced than by the elaboration which Roosevelt and Mr. Audsley advocate, the simpler process, possessing as it does immense advantages, must be the more artistic. And this is more obvious in a tone picture than in a painting, because the colours once present are capable of endless shades and variety in combination, so that duplications are unnecessary.

Mr. Audsley reminds me of the would-be critic in the picture-gallery, who cannot help admitting the excellence of a picture which everyone admires; but the artist has unwittingly jostled him, so his expression of approval is confined to the beauty of the colours employed, and not upon the artistic skill of the conception!

Mr. Audsley very much admires my means; he says the colours are fine, and, forsooth, the framework, too! Indeed, he is right. Neither have as yet, I believe, been excelled; but having passed the stagy remark that he did not care the value of the pen in his hand for my opinion, he could, of course, hardly admit that he had written, which he has done, that one at least of my pictures is the finest he has ever criticised!

But here lies the grievance. If, with very moderate outlay, much finer results can be obtained upon the simplified system than upon the old one of multiplication, Mr. Audsley will not succeed as an amateur in persuading intending buyers to pay the increased cost which his ideas involve, beside the commission which he disinterestedly charges for his advice, when they can go direct to professional experts and manufacturers and save both charges with better results.

I think it was Lord Dundreary whose musical reputation was based upon the fact of his possessing a cousin who played the German flute! Mr. Audsley's connection with the St. Barnabas organ is almost as absurdly amusing! He has a friend—a very able musician, too—who was once organist of the church; that is the only connection! Any knowledge of the organ—past, present, or in its intended future—on the part of Mr. Audsley is—well, "[illegible]"!

Carlton C. Michell.

[illegible], London, April 29.

[29901.]—At p. 154 Mr. G. Dixon says: "Alas! how many English builders could be relied on to make any [illegible]," &c. Allow me to point out that there are plenty of English organ builders who would do the work if they are paid for it; but probably they would not care about it for the price it is expected at. Pay the price, and you can have the work.

[illegible] (p. 161), may be informed that gedackt is the correct term to use with Lieblich Gedackt. The word is probably obsolete in German, but it remains in technical terminology, and means "covered with lids." Gedackt is accompanied by gedeckt in the technological dictionaries, and always refers to "covered with a lid."

Organon.

THE REFLECTING TELESCOPE.

[29902.]—IN reply to Mr. Davis, on page 176, I would briefly say that if the rays fall perpendicularly upon the entering face of the prism, no refraction or chromatic dispersion can take place, provided that surface of the prism is flat; but if convex or concave, then these phenomena commence immediately, and extend in proportion more or less as the curved or tilted surface departs from or approaches to a plane one. Therefore, in using a total reflection prism, in which this surface is flat and the apex of the prism is a right angle, no disturbance takes place if the other faces of the prism are flat also.

In reply to our esteemed optical correspondent, "A. S. L.," I may tell him the general figure of the Cassegrain 15in. mirror was very good, about one-fourth corrected towards the parabolic curve, therefore somewhat elliptical; it was exceedingly mottled from extensive tarnish, and was repolished so as to preserve the original figure as much as possible. The shadow and tonal tests alone were used, no repolishing of the two secondary mirrors was allowed, and owing to some defects in the mounting, no star testing could be satisfactorily carried out.

There was a metal plane mirror allowing the instrument to be used as a Newtonian; but I found this to be very convex indeed, and remedied this defect to a very great extent.

"A. S. L." may know that a true plane cannot be obtained on any other surface than that of a circular disc, and that the old opticians were in the habit of making these metal planes by forming the metal to the proper shape, cementing it into a suitable cavity in a circular disc of speculum metal, and grinding and polishing the lot together. My own observations have led me to believe that the older opticians could often work a surface with a very good approach to a spherical curve, and that then the secondary mirror of concave or convex form was worked in varying modes till a good result was obtained. It is to be regretted that we have no means of knowing strictly what these curves were.

Further, no amount of care taken with a grinding tool will necessarily produce a truly spherical curve on a concave surface; this perfection must be obtained with the polisher alone, and I feel I may claim that the same remarks will apply to a convex surface produced by a concave tool.

J. C. Linscott.

RATTLESNAKES AND STINGS OF BEES.

[29903.]—As to the exact meaning of the paragraph quoted from the *St. James's Gazette*, I am at one with "W. G. P." (letter 29847, page 155); but on reading his subsequent remarks I find myself somewhat in the dark as to what he desires to establish, unless it be the position of a pre-conceived idea having determined the present aspects of life on the earth, which has exercised an arbitrary influence on development. The "view" whose acceptance by the majority he asserts in his concluding paragraph, seems to justify this conclusion on my part. But if he considers every form is developed in such a way as to "perform a given part in the world," he must give up natural selection as a method of development at once, or, at all events, limit its action by the unnatural arbitrary influences fitting the form for its given part in such a way as to render it uncertain and futile as a working hypothesis. But he does not seem to desire to renounce natural selection, for it appears that he takes it for granted as the cause of some organs and functions, such as the rattlesnake's tail. Now, Darwin ("Origin of Species," edition vi. page 162) deals with this case as an objection to his theory of natural selection, and concludes that it probably frightens its enemies just as the hen ruffles her feathers for a like purpose, and on the next page shows that if the bee's sting is used as a sting there may be destroyed a few individuals, but the *race* of bees is vastly benefited by the dead insect's mates being left alone. In a sense we do here "strike a balance"; but "W. G. P." is wrong in narrowing "the species" to mean one particular being, and not all those included with it as a species. Then as to horses and the larger cats. Why has not "the preconceived plan" which I understand he would have us believe in, provided some protection or habit whereby they were protected from the lasso and rifles of the animal in particular which has happened to beat them in the race of life—viz., man? Then what does he mean by the Whig and Tory case he cites? Surely here we have two species typically at war. It is clear that if all animals agreed on "united action," half of them would very soon starve, as they could not eat the other half. Where would be the advantage? Whigs and Tories do not exist for the purpose of only "checking," but actually of overcoming, each other, and therefore becoming supreme. Does not any Opposition throw out any Government when it can?

But least of all do I grasp his introduction of the consideration of consciousness. Is it not obvious that the "good" gained by a surviving form is simply its mere existence to a later period than other forms in the great struggle? Is he really trying to show that unless the animal or plant can actually congratulate itself on surviving, that such survival is impossible? Natural selection fails us at once if we admit that animals and plants have developed to benefit each other as well as themselves (such cases as the symbiosis of simple algæ with the Radiolarian Thallassicolla are undoubtedly cases of private as well as mutual advantage), for what then regulates survival? In the place of one simple, all-embracing hypothesis for the understanding of why such and such forms survive, "W. G. P." would relegate us to arbitrary influences working on arbitrary lines and not in any way to be comprehended. Like his "philosopher," we must be satisfied with the "half-truth" which is not a truth at all.

As to habits, many are, of course, disadvantageous; but here still natural selection holds. Does not a race—say, of drunkards—soon become extinct?

Uttoxeter. **N. S. B.**

A NOTE FOR NATURALISTS.

[29904]—THE following is unique in my experience, and I venture to think would prove so to most. At a country house I have lately visited three young chickens were, owing to the death of their mother hen, put into a drawer, to which a cat about to kitten was attracted. For a short time before and after her kittens were born, the cat lay on the chickens, and persisted in doing so for a considerable period. Two of the chickens by accident died; but the third—now fairly grown—is strongly attached to the cat, and the cat to the fowl. During the time of nursing the chickens might have been the cat's own family for all the affection and attention bestowed on them.

C. H. Harbett.

USEFUL AND SCIENTIFIC NOTES.

◆◆◆

Indian Ink.—Mr. B. Piffard says, in the *Chemical News*, I find that a colour apparently identical to Indian ink can be produced by the action of sulphuric acid on camphor. An excess of camphor should remain some 24 hours in strong sulphuric acid; it then results in a gelatinous mass of a slightly reddish colour. This, when heated, effervesces, gives off fumes of sulphurous acid, and turns intensely black. By evaporation the superfluous sulphuric acid and camphor (for there remains an excess of both, the weakened acid not acting on the camphor) can be driven off. The remainder, when applied to paper as a paint, appears, to my unartistic eye, to be Indian ink. When dissolved in water, it remains an indefinite time without precipitating. It appears to be dissolved, not held in suspension.

Asbestos Joints.—A permanent and durable joint can, it is said, be made between rough, cast-iron surfaces by the use of asbestos with sufficient mixed white lead to make a very stiff putty. This will resist any amount of heat, and is unaffected by steam or water. It has been used for mending or closing cracks in cast-iron retorts that were used for the distillation of oil and gas from cannel coal. The heat being applied to the bottom of retorts and the temperature of iron maintained at a bright red heat, after a time the bottom of the retort would crack, the larger portion of the crack being downward towards the fire. The method employed was to prepare the mixture, and place on top a brick, then place the brick on a bar of iron or shovel and press the cement upward to fill the crack in the iron, holding it for some time until it had penetrated the cavity, and somewhat set. Of course, during this operation, the cap was removed from the retort, so that no pressure of gas or oil forced the cement outward until set.

THE new Calais mail steamer which has been built for the London, Chatham, and Dover Company, and which will be placed on the service next month, has been named the *Calais-Douvres*, the name having been taken after the popular twin ship, which is now to be finally withdrawn from the service. The new vessel is built entirely of steel, and to insure additional safety in case of collision, has been divided into nine different watertight compartments. The dimensions of the vessel are as follows: Length between perpendiculars, 325ft.; breadth, 36ft.; depth, 21ft. 6in. It is calculated she will be the fastest cross-Channel steamer afloat, and will make the passage between the English and French coasts easily in an hour. She will be lighted by incandescent electric lamps, and has been provided with embarkation arc lights.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67832.]—**Distribution of Load.**—Thanks to "T. C., Bristol," for his kindly remark. I always read queries and replies appearing in these columns which have anything to do with mathematics or mechanics. In the present case it appeared to me that the problem is indeterminate, if the various parts are considered rigid. I was reminded of a problem I saw somewhere to illustrate the subject of indeterminate problems. A gate or door is hung in the usual way on two hinges, given weight of door, position of hinges, &c., to find the vertical pressure on each hinge. It is evident that however good the workmanship might be, a few strokes with a file would throw all the weight on one hinge or on the other. If the various parts in our problem are not rigid but capable of bending, then we have that difficult subject "resilience" to deal with, which is too abstruse for these columns.

Bath. M.I.C.E.

[67862.]—**Distribution of Weight.**—It is easy to find infinite varieties of distribution of W, which will result in a balance at point W, as BB_1 are really neutral; but the problem is to find the distribution when load is at W. Taking W at 60lb. (to avoid fractions), we have, for instance—

$$\begin{array}{ccccccccc} A & & BB_1 & & CC_1 & & D & & W \\ 9 & + & 47 & + & 3 & + & 1 & = & 60 \\ 18 & + & 34 & + & 6 & + & 2 & = & 60 \\ 27 & + & 21 & + & 9 & + & 3 & = & 60 \\ 36 & + & 8 & + & 12 & + & 4 & = & 60 \end{array}$$

all balancing by moments round W, round A, round D; or on lines parallel to AB_1 BC_1 CD. Of this series, it is evident, one must be a closer approximation than the rest. "Z.," like a Scotchman, answers by asking a similar question.

Liverpool. W. S.

[68011.]—**Medical Battery.**—Replying to "Nun. Dor." as to how the above battery is made up, I described it as well as I could at the time. It is made up of four separate tubes, 6in. long and ⅝in. diameter, with screw metal caps on ends, incased in morocco leather in pocket-book form, but to take it further apart would destroy its casing. The tubes seem to be filled, half-full, with some substance which has now become quite hard, but no doubt had formerly been in a plastic state. Could some liquid be put in to again soften and restore the electrical effect? Ignor.

[68042.]—**Slide-Rest.**—I should advise "P. S." not to trouble making his own patterns when he can buy so cheaply and ready planed, as the castings are not much use without they are planed. I have just fitted up a set I had from Gladstone, of Stafford (who advertises in these columns), and they are all that "P. S." could desire. They are as soft as brass, and very little trouble to fit up. The price for one for 3½in. centre compound rest is 10s. 6d., all planed, and if "P. S." likes he can get the screws, steel, square threads, and gunmetal boxes for 10s. 6d., so that he can get a slide-rest for 21s. minus his own labour, which is certainly cheap, and there is no question as to design and quality.

Preston. W. G. C.

[68054.]—**Diamond Cutting.**—I notice that "S." has kindly given a little of the information asked concerning the above. Would "S." be good enough to answer me the following question? What are the laps made of, and how are they first charged with diamond dust? Jagelon.

[68063.]—**Organ Pipes.**—"F. L." asks a question more easily put than replied to. In the first place, it may be pointed out that it is necessary for the production of a firm tone that a pipe, either of wood or metal, shall be of sufficient thickness of material to stand the vibrations of the column of air within it without any obvious trembling; beyond this it is just questionable if the thickness has any observable influence on the tone. In respect to wood pipes, there seems to be only a "rule of thumb" observed in the matter of thickness of material, for organ-builders vary very much in this detail. It has always seemed to me to depend chiefly on the cuttings or odd pieces of wood which may most conveniently come to hand, and the economy of labour in dressing them. I have seen many stops in which anything like a properly graduated thickness of wood was to be looked for in vain, and in which not a few pipes had each of their sides made of different thicknesses. Such stops, of course, must be classed as "cheap and nasty." It is an interesting fact that, in a wood pipe, the front (mouth side) and back do not seem to vibrate, whilst the lateral pieces are sensibly affected. This points, I think, to the importance of a careful study of the influence of the resisting powers of these sides on the tone of the pipe. I may just mention a matter that gave me some trouble at the time and set me thinking. In the lowest octave of an Open Diapason (metal, 8ft.) there was one pipe, the D D, which would wabble or slowly tremble in its speech, do what I would with its mouth and its supply of wind; and after continued attempts to overcome the too obvious impediment I gave up the matter as hopeless, and decided to have a new pipe. When I put my hands to lift the pipe, by its body, whilst speaking, to my surprise the tone became instantly steady; on removing my hands the trembling recommenced. Here was a new direction for my investigations; for I quickly found that a simple pressure of the hands on the two sides of the pipe or the permanent pressure of two felt-covered slips of wood perfectly cured the imperfection of the speech. I now carefully examined the body of the pipe, and found that it was oval and not circular, having been slightly crushed in carriage, and that the flatter sides offered insufficient resistance to the powerful vibrations of the internal air. I procured a round pole of wood and returned the pipe to a cylindrical form, effectually removing any imperfection in its speech. It is right to remark that, in my opinion, the oval form would hardly have been attended with so objectionable a result had the metal of the pipe been of greater thickness and of greater power of resistance. The lesson to be learnt from this is obvious. I have had no experience with wood Diapasons—that is, with them formed of wood throughout, voiced in imitation of the true Open Diapason, 8ft., of metal; but I may mention that the lowest octaves of the Open Diapasons in the organ of the parish church of Armley, near Leeds, are of wood, and their tones are quite equal to, if not better than, many of the finest metal ones known to me. These pipes were voiced by the late Edmund Schulze, of Paulenzelle, an artist of the first rank in his line. The tone of a wood pipe, in one direction at least, depends on the proportion its mouth bears to the sum of the widths of its four sides, internally measured: thus, the mouth of a square pipe is exactly one-fourth of the sum of its sides; whilst the mouth of a pipe of an oblong section may, when placed in a narrow side, be considerably less than one-fourth, and, when placed in a wide side, be considerably more than one-fourth. Beyond the greater or lesser volume of sound naturally produced by this matter of proportion, the art and taste of the voicer, and the amount and pressure of the organ wind are all-important factors in the production of tone. I trust these hasty remarks will prove sufficient for "F. L." G. A. Audsley.

[68113.]—**Basting Meat.**—My kitchen stove is one of the so-called Americans, but made at one of the numerous Glasgow foundries, and having an arrangement for top and bottom heat. When the roaster is hot, the joint is put in unbasted, so as to have a skin, scale, or coat formed on its surface by the high and dry temperature in order to prevent the moisture becoming evaporated. When the said impervious coating has been formed, then thin slices of beef or mutton suet are laid on the upper surface of the meat (bacon is used for fowls), whereby the process of self-acting basting is set in operation. Now, in the face of this most simple, most effective method, does A. Lloyd think a complicated mechanical lubricator likely to obtain favour with that class most ungifted of all others with mechanical genius and appreciation—i.e., English cooks? Much was expected (as to the capacities and attainments of the young female minds and hands) to result from the establishment of Board schools throughout the kingdom in producing better cooks for the well-to-do class, and better cooks, better mates for the operative class. Now, I would ask "our" readers, does their experience bear out these said expectations? Let the members of the Boards of School Management devote a little consideration to such matters so essential to the comfort and well-being of present and future generations, is a suggestion of

The Lydney Dispenser.

[68138.]—**Lapidary's Work.**—There is scarcely likely to be any book on lapidary work, for the simple reason that there would not be enough purchasers to pay for its production; but there are several articles in back volumes on the subject, and no doubt "Holtzapffel" has something on the subject. Lapidary's work is scarcely "turning," but the articles are pressed on his wheel, which runs horizontally, and are shaped by its aid. He uses discs of iron, lead, copper, &c., and various powders, including diamond dust, which cuts anything. J. T. M.

[68148.]—**Water Motor.**—I don't think sectional drawings of the Thirlmere water-motor are published; but why not write to Bailey and Co., Salford, for particulars? They are much too big people to decline to give information unless they think you are fishing for their patterns, and would certainly prefer to send the description privately to seeing it in print, provided they wish to keep the design something of a secret. W. M.

[68149.]—**Britannia Hot-Air Engines.**—These engines are, I think, the same as that illustrated in No. 1,008, and known as the Robinson.

S. T.

[68160.]—**Imitation Ivory or Celluloid.**—Celluloid would itself answer the purpose of this querist, so far as can be judged from what he says; but it is a patent, and has some years yet of monopoly, I believe. He will find all about it in back volumes. It can have a fine enamelled surface imparted to it by polishing its own substance. See an article in No. 1,143, and a letter in No. 847.

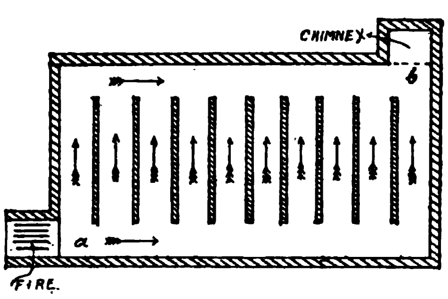
Nun. Dor.

[68161.]—**Chemical Gilding of Glass.**—I do not think that gold can be applied to glass from a liquid except by the aid of heat; but there are several recipes in back volumes, some of which may suit the querist. A process said to be due to Prof. Schwarzenbach, of Berne, consists in using a dilute solution of chloride of gold rendered alkaline by the addition of soda. To reduce the gold chloride alcohol saturated with marsh-gas and diluted is used; but as I have not tried it, I cannot say whether it is effective. Nun. Dor.

[68173.]—**Drying Floor.**—"Brier" should reflect that if the heated gases are compelled to traverse the flues one after the other, those which it passes through first will be raised to a higher temperature than the others, and I do not see how he can prevent it. Why not take the hot gases through all the flues simultaneously?

Nun. Dor.

[68173.]—**Drying Floor.**—To secure a uniform heat over the entire floor, construct the flues in the following manner:—Draught always takes the shortest cut, and as the distance from *a* to *b* through the flues in any direction is equal, it follows that the draught through the whole is uniform. Several years ago I constructed on this principle a hot plate for heating the workmen's coffee at a large factory with very satisfactory results. Baker.



[68176.]—**Welding Metals.**—"H. C." should be able to find all he can want to know about the electric method of welding in back volumes. Let him start by reading an article on the "Practical Applications of Electric Welding" in No. 1,220, and then refer to the illustrated article in No. 1,137.

J. T.

[68191.]—**Wounds.**—I have seen the interesting letter of Jules Orme in your number for April 5, No. 68191, on "Wounds," in which he mentions having seen a Polish lady who wore rings in her breasts. Of course he meant in the nipples, but he being a foreigner, the mistake was easy to make. My cousin Jack showed me the letter, and he is very desirous that I should have mine pierced and rings inserted. I laughed at the idea, and said I did not believe the thing was possible; but he showed me that he was then wearing himself in his nipples some gold rings which were inserted last summer by a jeweller in London. Now, I dearly love Jack, and am going to marry him next year; and I would not mind doing anything in reason to please him, so I have consented to do as he wishes. My younger sister, Mildred, has determined to have her breasts pierced also, if I have mine done. We have several pairs of fine large gold rings, such as are worn by the peasant women in Austria; they are smooth and thick, and about as large as a half-crown piece, and will answer the purpose very nicely. We are going to Paris shortly, to see the Exhibition; and on our return to London we shall call on the person who performed the operation for Jack, as we do not care to have anyone in our neighbourhood to do it for us. We have decided upon having our breasts pierced with an ear-piercer, instead of the method described by Jules Orme, as we would rather suffer considerable pain for the moment and have it more quickly over. We have little doubt that we shall have courage and endurance enough not to faint at the operation. What Millie and I want to know is, whether when we are married, if we have any children, the presence of the rings in our nipples would prevent us from nursing them ourselves. I am just turned eighteen, and shall not marry for more than a year, so that there would be abundant time for the wounds to heal. We hope one of your correspondents who is qualified will give us his opinion on this point. We have ordered the English Mechanic to be sent to us weekly while we are in Paris, so that we may see any answers which we may be favoured with. On our return, and after we have gone through the operation, I shall write again and let you know how it resulted. Constance.

[68192.]—**Hardening Bosses on Tricycle Crank-Shaft.**—Cast iron is usually hard enough, especially if chilled in the mould; but the querist can case-harden it by smearing it over with prussiate of potash while red hot, or by heating to a red while surrounded by dust of animal charcoal, or other carbonaceous matter. M.

[68199.]—**Hand-Painted Posters.**—Where does "Retsop" find any hand-painted (?) posters? Does he mean those which are coloured by means of stencils, instead of being printed in colours? S.

[68308.]—**Cement for Pushes.**—Will "Workshop," in his answer to this query, explain how to measure a half fluid ounce of magnesia carbonate, also same of plaster of Paris, and as to the one drachm of alum, is that drachm one of 60 grains apothecaries' weight or that of the 27 grains avoirdupois? The caution appended about recipe dealers not copying might have been omitted, since, as given, it is not practicable. F. G. Ll.

Woodlynch, Bonchurch, I.W., April 23.

[68319.]—**Battery for Medical Coil.**—Try chromic-acid ones. I have always obtained every satisfaction from them. F. W. Mason.

[68326.]—**Stove-Pipe Difficulties.**—Your pipe should not run horizontally. It should have a rise of at least 1ft. in every 6ft. Where the pipe enters chimney, put on a bend or elbow, so as to turn upwards. If you are not using the fire attached to chimney, block up the fireplace tightly with a board. Make all joints tight with fireclay.

Bristol. W. Ridler.

[68326.]—**Stove Pipe.**—Messrs. Andrews and Spokes, Tottenham-court-road, London, W., are the patentees and makers of the elbows inquired for. The products of combustion being at a low temperature, radiation of heat along the 27ft. of horizontal pipe still reducing it, then the difference in the specific gravity or weight in the column of air in the chimney and in that of the air entering chimney from stove is nominal; in addition to which, the calibre of the chimney is probably so large (proportionately) as to render the draught very slow, even when a draught has been started. The best specimen of a horizontal flue I ever examined was in the residence of the late Major Johnson, The Wind's Point, Malvern, near the British Camp, and which residence was purchased by Madame Goldsmith (Jenny Lind), chiefly on account of its romantic situation reminding her so forcibly of her beloved Sweden. Amongst the talented major's *penchants* was one for finding remedies for the numerous glaring defects in saddles, laminated steel saddles being his *beau ideal*, a specimen of which (when he had produced a perfect one) he promised to present to

The Lydney Dispenser.

[68331.]—**Coppering Carbons.**—Make up a solution of copper sulphate, 4oz.; sulphuric acid, 1oz.; water, 2 pints, and make carbon the cathode, and a copper plate the anode, and connect up to a pint Bunsen. F. W. Mason.

[68332.]—**Bichromate Battery.**—Expect you have elements touching somewhere in the cell; or else, perhaps, you use solution warm. Cannot say that I particularly like vulcanite for bichromate cells; try earthenware or glass. F. W. Mason.

[68343.]—**Blowpipe.**—In compliance with the wish expressed by "Lis Smith," I send a full description of an easily made and serviceable instrument, hoping it may prove interesting to some other readers. Two different sizes are given, the largest I have found to be most suitable for the purpose mentioned by the querist; the other is a convenient size for ordinary blowpipe work. To begin with, three pieces of light brass tubing of the following dimensions are required:—Outside tube *a* (Fig. 1) 6½—5¾in. long and ¾—½in. diameter, air-tube *b*, 8—7in. long and $\frac{5}{16}$—$\frac{3}{16}$in. diameter; gas tube *c*, 2¼—1½in. long and ½—⅜in. diameter. (Tubes measured from the outside.) Square off the ends of *a*, then at a point 2⅛—1⅛ from one end as a centre, file a hole the same size as the inside diameter of the side tube *c*, which is to be soldered hereon. One end of *c* is filed concave, so as to fit accurately on the convex surface of *a*; on this depends the neatness of the finished joint. Now pass a piece of string through *a* and tie *c* on its proper place, smear the joint with zinc chloride and solder. About an inch from one end of *b* three small holes are bored; into these are soldered short iron pins *e*, the object of which is to keep *b* in a central position; the joint at the other end between the two tubes is made with one or two short pieces of rubber-tubing, *d*; this makes a good joint, and leaves the inside tube adjustable. The support (Fig. 2), which is made of hard wood, consists of a circular base, *b*, about 3½in.—3in. dia. and ⅞in. thick, having a ⅜in. hole in its centre. Into this is wedged the reduced end of the pillar *a*, the size of which is about 5in.—4¼in. long and 1⅜in.—⅞in. thick, tapered. Near the top of *a* a hole somewhat smaller than the side-tube of the blowpipe is made; then a slit about 3in. long, as shown in the drawing. The sides may now be sprung open a little, and the tube pushed into the hole, in which it should turn rather stiffly. Polish up the tubes, fit together, and give the stand a coat of varnish; it will then have an appearance something like Fig. 3. R. McLaren.

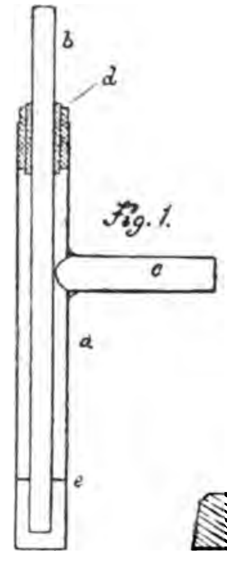


Fig. 1.

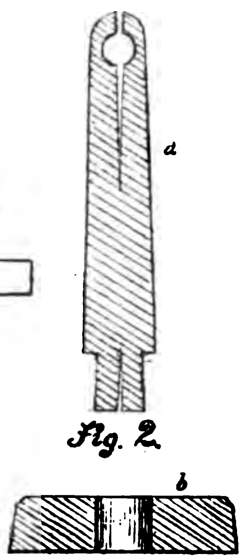
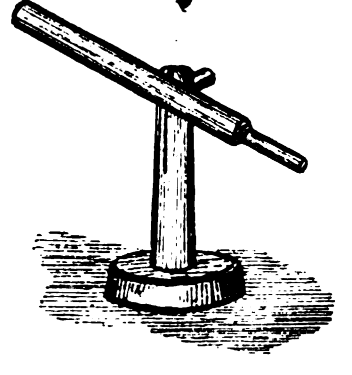


Fig. 2.

Fig. 3.



[68345.]—**Bisulphate of Potash in Leclanche Cell.**—I am perfectly aware that I quoted two different amounts of bisulphide; it was for this reason: the first was the average of some rough experiments, and the latter the average of the whole experiments and practical experience. Use the amount named in No. 67559.

F. W. Mason.

[68364.]—**Compound Condensing Engine Cylinders.**—The following is a table from actual practice giving the diameters of the high and low-pressure cylinders at different boiler pressures, the piston speed being taken at 420ft. per minute:—

Indicated horse-power.	Diam. L.P. cylinder.	Boiler pressure 45lb.	Boiler pressure 80lb.	Boiler pressure 125lb.
		Diam. H.P. cylinder.	Diam. H.P. cylinder.	Diam. H.P. cylinder.
10	7¼in.	4 in.	3⅝in.	3¼in.
20	10	5¼	5	4¼
25	11¼	6¼	5½	5⅛
30	12⅝	7⅝	6¼	5⅝
40	14¼	8¼	7⅝	6⅜
50	16	9¼	8	7¼
100	22¼	13	11¼	10⅝
150	27⅝	16	14	12⅜

Longsight. J. Stokes.

[68366.]—**Paint.**—Is it a wooden or metal water-tank you wish to paint? If it be metal, why not have a new one, as it will not repay the trouble of painting? However, if you give it a thick coat of red and white lead, mixed up with linseed oil and driers, you might do good; and if you fear poison, when the above has thoroughly dried and hardened, paint over with some enamel, such as Aspinall's or Chez-Lui, which will leave a firm, impenetrable face.

Bristol. W. Ridler.

[68366.]—**Paint.**—The querist does not say what kind of water tank he wants the paint for—it may be lead, black iron, or galvanised. If lead, coatings of limewash or fat and rosin (the latter applied hot) act as preservatives; if iron, I remember a cheap non-poisonous paint being recommended for this purpose by a chemist who had not only used it with good results but had analysed it to make certain as to its non-poisonous properties. It was called "Galvanite."

Whitehaven. D. B.

[68367.]—**Renovating Band Uniform.**—If "Baritone" will advertise his address in the "Sale" column, I will help him, and if within a reasonable distance from me I will pay him a visit and show him how to renovate his tunics at the cost of a few pence, being storeman for a regiment whose uniforms are the same as described. I have had considerable practice in renovating.

A. Smith.

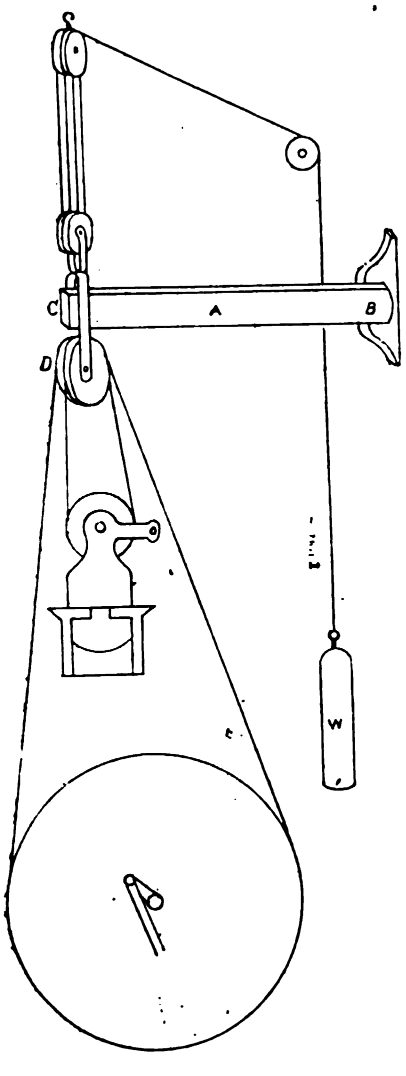
[68369.]—**Lawn Mowers.**—I have had twenty years' experience with these machines, and always resharpened the knives myself. 1. By reversing the cylinder—i.e., turning round, or end for end; the wearing of one edge tends to sharpen the other. Mine is a chain machine, and a cog on each end of shaft. 2. "Without taking them from their place." Remove chain or wheels, but leave knives—large and cylindrical as they are, and apply fine emery powder, and turn cylinder the reverse way from that when cutting, by fixing a temporary handle, say, 16 wire more or less would do, by cranking it. By this method all the knives are sharpened and fit, and, if necessary, may be screwed a shade nearer together. I place paper under my machine to catch the emery for use again.

W. Witton.

[68385.]—**Coil.**—The size of the wire for the primary coil of your shocking coil should be No. 16 gauge, and for the secondary coil it should be that known as No. 36. Quantity required for a primary coil would be nearly 1lb., what you have over will do for making connections with batteries and coil, &c. The quantity required for secondary coil will be 7oz., and then you will have some to spare, which may be used up as you think fit. It would do to make a coil for a galvanometer, which must be used in testing secondary wire. An Answerite.

[68386.]—**Slow Motion by Band.**—You can obtain the effect you desire, viz., more gripping surface on small driving pulley, by putting on a small pulley at any convenient point between the driving and driven pulley, and having two grooves in the driver. Said small pulley set angled sufficiently to take band direct from one groove and run it direct into the other. The angle of band to the large pulley driven will not affect its driving power to any considerable extent. The extra pulley can be suspended from lathe-bed, if for driving lathe, by a swivel, when it will adapt itself to the exact angle, or placed on lever to take up slack by spring or weight at its opposite end. When the small driving pulley is exactly above the large one driven, the extra pulley can easily be suspended on the band in the same manner as a clock weight with pulley, and effectually serve to take up slack, tension, and guide to band in one. Where there is sufficient distance between the pulleys you may even use more than two grooves in small pulley so long as the angle is not too great to the driven pulley. Those who have not back-gear please try this when your band slips, mount double-grooved pulley (large) on face-plate and try its effect for heavy work, and report result. H. Watson.

[68386.]—**Slow Motion by Band.**—A spiral groove will not do. You need several parallel grooves on the pulley for the several turns of the band, and a guide-pulley also with several grooves, over which the band should be led, so that it goes from the first groove to the second, and so on; or, if you put two or more grooves on both driving and driven pulleys, and lead the band round and round them both, a guide-pulley with only one groove will do to deliver the band from the last groove of the driver back to the first. (This single guide-pulley can also conveniently be made to tighten the whole system.) But the grooves on each individual pulley must be all of exactly the same diameter and depth, as otherwise one groove would be hauling on more band than another is giving off. The arrangement I have hit upon most successfully for getting a good grip on my lathe-cone may give "Antares" (and perhaps others) some useful hints, for I find that it combines many important advantages. The sketch partly explains itself. Above the headstock a wooden bar, A, is pivoted at B. Its end, C, is forcibly drawn up by a small block and tackle, to whose "fall" is attached a weight, W. Under the radial bar A is hung the pair of grooved guide-pulleys D, running freely on their axle. The band, made of ¼in. cotton lay cord, is put on with a "long splice," and never needs altering in length, for it suits all speeds and is always tight. It goes, as shown, round the foot-wheel, over one guide-pulley, under lathe spindle cone-pulley, up again to second guide-pulley, and then down to foot-wheel again. A rise and fall of only a few inches of the radial bar enables me to run the band on the 9in. speed or the 22in. of my treadle-wheel. I get rid of all "thud" of hook and eye going over small-speed pulley; I have never to "take up" my band; I have always a uniform strain on it (which I can increase, if I should wish it, by adding to the weight W); and I annihilate all jarring or infinitesimal jumping of the spindle, as the band is always pulling the spindle up, just as the tool is always tending to lift the work up, whereas in foot-lathes generally the spindle (especially if a trifle slack in the bearing) has a lively time of it, jumping up and down between the pull down of the gut-band and the lift up of the tool in taking off the cut. I also obtain a most powerful grip of the mandrel pulley by taking a greater circumferential hold of it, and by making the grooves strictly to a sharp, deep angle—namely, 45° This form (M) of groove gives immense holding and driving power, with an astonishingly slight tightness of belt, and the "lightest of running." T. F. S. T.

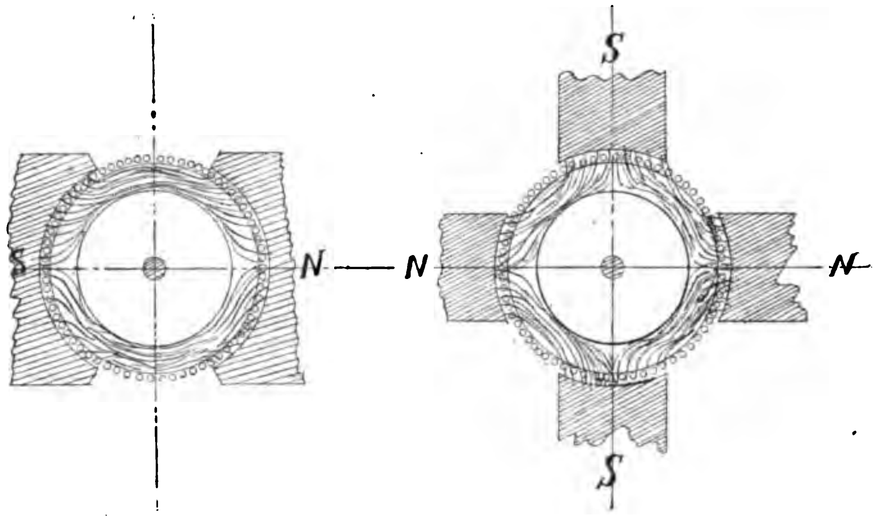


[68391.]—**Hot-Water Circulation.**—I have to thank "Skibo" for his reply. I have a soda-water machine by Barnet and Foster, where one of the block-tin pipes has to stand, if required, up to 200lb. per square inch, and it is only $\frac{1}{16}$in. thick by ⅜in. bore. Will not, therefore, a ⅜in. compo. gas-pipe continue to stand 70lb. with safety? It weighs 2½ft. to the pound, and its small bore surely renders it better able to withstand pressure. Also, is "Skibo" quite certain that the pipe C does not act as an expansion pipe as well as a supply pipe. The height of new pipe C is only 7ft. I find it has worked well for two months, but I am doubtful whether it should continue to do so. Perhaps "Skibo" or other correspondent will kindly reply.

Nemo.

[68391.]—**Hot-Water Circulation.**—There is no alternative but to continue existing expansion pipe either over cistern or through roof. If the sketch is a correct representation of pipes, the system is a modification of "Dyer's," one of the main features of which is the bringing of the cold water to boiler instead of through cylinder, the advantage gained—when system is carried out properly—being a quicker supply of hot water than usually obtainable by the old methods. An expansion pipe that will also act as an outlet for any air accumulating in pipes, is, however indispensable, and any attempt to do without this is not only risky, but sure to be followed by the annoyance and trouble always accompanying air-bound pipes. The ⅜in. compo. should be replaced by the ordinary lead pipe; it is neither safe nor workmanlike. I question whether pressure is so much as 65lb. Surely there is some mistake?

Whitehaven. D. B.



[68392.]—**Four-Pole Dynamo.**—Yes, the resistance is one-quarter that of 2-pole machine. Since there are now 4 circuits through A. instead of 2, the output of current is doubled, and the E.M.F. remains the same, or output under new conditions = 100 volts 60 ampères. Of course, this assumes that the "magnetic density" in the A. remains the same as in the 2-pole type; or, in other words, the field excitement is twice as strong as before. I send two sketches, which will illustrate the following:—Take the 2-pole type wound as a Gramme ring (inside coils not shown), and let N = number of complete coils on A. ring, n = number of revolutions per second, D = lines of force per unit area (i.e., "magnetic density"), A = area of armature core, 10^8 = number of abs. lines to be cut per sec. to induce 1 volt. E.M.F. Then

$$E = n \times \frac{N}{2} \times 4\,D \times a \times 10^{-8} = n \times N \times 2\,D \times a \times 10^{-8}.$$

The expression $4\,D \times a$ will be readily understood by reference to Fig. 1 (2-pole type). $D \times a$ = number of lines passing through one side of A.; therefore $2\,D \times a$ = total number of lines through A. which are cut twice in each revolution by any coil. But since in a Gramme A. there are two circuits in parallel, the terminal E.M.F. only equals that due to $\frac{N}{2}$ coils in series; and since $\frac{N}{2} \times 4\,D\,a = N \times 2\,D\,a$, we simply count all wires round outside of ring, and call the effective rate of cutting of lines = ½ actual. In the case of the 4-pole type, keeping the revolutions the same, it might appear that the terminal E.M.F. would be halved, which would be the case if the total induction from all the poles together were the same; but we assume that the quantity $D \times a$ = constant, which means double excitement from the whole field, and since the time occupied in passing any pole = ½ to 1 of 2-pole type, the rate of cutting is doubled, and each A. turn is twice as active as before; therefore the terminal E.M.F. remains the same as before. We also get an armature resistance = ¼ what it was in the 2-pole type (when cross-connected), so that the relative loss by heating armature coils $1 \times 1^2 = 1 : \frac{1}{4} \times 2^2 = 1$; or, in other words, the percentage of loss in A. is halved. This fact is the great advantage of the multipolar type. Hope the above will prove satisfactory.

Govan. Engineer.

[68392.]—**Four-Pole Dynamo.**—Noticing Mr. Bottone's reply to above, I wish to add to my previous reply that I supposed opposite collector bars to be coupled, thereby putting four sections in parallel. Mr. Bottone evidently intends to couple over a quadrant instead of a diameter; but, in that case, I fail to see how he lowers resistance, as he then has two sections in series, and two parallel, as in simple two-pole Gramme.

Govan. Engineer.

[68394.]—**Whip Joint.**—"H. E. H." can get instructions from any of the textbooks how to make a wiped or any other form of plumbing joint; but unless he practises or some little time, so as to gain a knowledge of the nature of solder, &c., he will not make much headway. I would advise him to take a lesson from someone who is a proficient joint-maker, so that after learning the elementary principles of soldering, he can go on with some chance of success. Solder he should buy at first, for although an easy mater to give approximate weights of tin and lead, so much depends upon having decent solder, that it is much better to get it where it is made by experienced hands.

Whitehaven. D. B.

[68394.]—**Wiped Joint.**—I suppose this is what querist means by "whip" joint. If "H. E. H." has to wipe a tap or boss in a lead pipe, and has never tried the game or seen it done, he had better let it out to a plumber, for no amount of reading will teach him the way to manage it. It requires a lot of showing and a deal of practice. If he writes to the Editor, and asks him to send him the numbers of "E. M." which contain Mr. Davis's "Instructions for Joint-making," he will obtain some information on the subject. I suppose by soft solder you mean fine or tinman's solder, and by hard solder plumber's solder. Fine solder contains equal parts lead and tin; plumber's solder, 2 lead, 1 tin—in the latter case both ingredients should be pure.

Bristol. W. Ridler.

[68397.]—**Shellac Solution.**—Filter it.

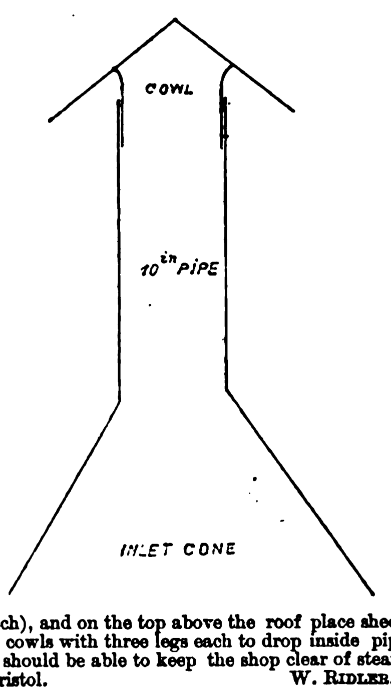
Sm.

[68397.]—**Shellac Solution.**—Add one part petroleum ether to three parts shellac solution, and shake well together. After standing a few minutes the liquid forms two layers. Remove the upper layer, which contains the colouring matter, and you will have left a clear yellowish-brown solution of shellac.

Bristol. W. Ridler.

[68399.]—**Ventilator.**—If you bring your 10in. pipes down as close as possible to the coppers, and fasten up to them large sheet-iron cones (as per sketch), and on the top above the roof place sheet-iron cowls with three legs each to drop inside pipe, you should be able to keep the shop clear of steam.

Bristol. W. Ridler.



[68399.]—**Ventilator.**—As proved by actual experiments, Boyle's and Buchan's are the best ventilators in the market—either of these forms would do what you require. The working power of any extractor can be greatly augmented by providing for a good supply of cold, and, therefore, heavy air, into the building at a moderately low level, so that a current can be set up and sustained through the ventilators.

Whitehaven. D. B.

[68409.]—**Tracing Paper.**—Take some good thin printing-paper, say like that on which our "E.M." is printed, and brush it over on one side with a solution consisting of one part, by measure, of castor-oil in two parts of meth. spirit; blot off and hang up to dry. You can trace by pencil or ink on this. I have tried it and done it.

F. G. LL.

[68416.]—**Paraffin Pump.**—Apparently a small centrifugal pump. SM.

[68418.]—**Celluloid Films.**—I have used both Carbutt's and Fry's celluloid films. They appear exactly alike, but Fry's are much more reasonable in price. Results as good as with glass plates can be obtained, the manipulation is the same as with glass. They can be cut with a sharp knife or scissors. They need no backing, the surface coated with the emulsion being like ground glass. Two dozen films would, I should think, be about ⅛in. thick. H. G. M. CONYBEARE.

[68419.] — **Decomposition of Water by Electricity.**—We must begin by stating that the least practically useful voltage that will decompose water (acidulated) is 3 volts. Now, ½H.P. = 373 watts. Dividing this by 3 (the number of volts required) gives 126½ ampères as the theoretical output of a dynamo driven by a ½H.P. engine, say 126 ampères at 3 volts pressure. Now, each ampère liberates 0·583 grain of hydrogen per hour, so that 126 ampères would liberate about 73½ grains of hydrogen per hour, or about 3163·4c.in. And this is really the highest output in hydrogen that a dynamo worked by a ½H.P. engine can be expected to give.

S. BOTTONE.

[68419.]—**Electrolysis.**—The amount of hydrogen liberated would depend on the number of ampères given by the dynamo; however, supposing the dynamo to be built so as to give the best number of volts and ampères, the answer would be as follows:—The current would give the best results at a pressure of about 4 volts. Now, ½ H.P. = 373 Watts, and as we want 4 volts the number of ampères will be $\frac{373}{4}$ = 93·25. A current of 93·25 ampères will liberate 93·25 × ·000010352 gramme of hydrogen per second, ·000010352 being the electro-chemical equivalent of hydrogen, from which we get ·000965324 grammes of H per second. Multiplying this by 3,600, we get the amount liberated in one hour, the number being 3·4751664.

F. C. LEES, O.L.

[68421.] — **Bicycle Head.** — "Manchester" might make a tolerably strong job by sawing to bottom of crack, neatly fitting a strip of iron in the notch, and then braze. SIMPLEX.

[68421.]—**Bicycle Head.**—The query is somewhat vague. If the crack is in the head or neck of an ordinary high machine, a renewal of the faulty part is most advisable. Some of the brazing may have given way, in which case it may be rebrazed.

JOSELENE.

[68422.]—**Voice Lozenge.**—The following is a good formula; but you cannot expect any lozenge to be a cure for all kinds of sore throats. A sweet or melodious voice is only obtainable by cultivation; but this recipe will give the voice clearness and full tone. Extract of eucalyptus, 120; confection of roses, 78; glycerine, 30; mucilage, 40; finely-powdered cayenne, 1; chlorate of potash, 1; triple extract of rose, 20; tincture of eucalyptus, 10; powdered refined sugar, 700 parts; mix. Judging from your signature, it will not be necessary to give the *modus operandi.*

FREDERICK DAVIS.

[68423.]—**Cleaning Grand Piano by Collard and Collard.**—The information given by Mr. W. H. Davies refers to an old square piano, in which the action and key frames are in two parts. In the treble part of the piano there are about 20 keys on a separate frame, which are shifted into what is called the box, and this part must be taken out first. You say your piano is a grand piano. In that case there is only one frame, which is kept in its place by two blocks, one on each side. Unscrew them, and then pull the whole out. But it appears to me from your query that it is a square piano. In that case you have to raise one or two keys, under which you find the screws; bend the keys a little sideways, to enable you to take the screws out of the front, and also of the centre part of the frame. Then replace the keys, and try with a chisel or knife to lift the frame a bit, to see that all the screws are out. Take care that nothing is lying on the keys, and that the hammers are in their resting place. Then take hold of the knobs, and pull the keys and action bodily out. J. H. SCHUCHT.

[68424.]—**Reversing Model Locomotive.**—This may be accomplished in two ways at least. The object is to reverse the steam inlet and exhaust. Interposed between the cylinder and the block is a disc, having the steam and exhaust ports communicating respectively, with two grooves turned at the back. One of these groves covers the steam entrance, the other the exhaust in all positions, so that a half-revolution brings the supply port where the exhaust was, and reverses the engine. Another more satisfactory method is to mount a steam-chest containing a slide-valve moved by the reversing lever, and making communication with one port and exhaust, according to the direction desired.

JOSELENE.

[68428.]—**Problems.**—The information desired by "H. M." is given in Dawson Clark's "Trigonometry" (Rivingtons); also in Hooker's "Trigonometry" (Elijah Johnson), and in several other textbooks of the same character, as the questions are pet ones with certain examiners.

C. W. BOURNE.

[68429.—**Problem.**—We have given:

$$x + y\sqrt{-1} = (\alpha + \beta\sqrt{-1})^n$$

Taking differentials, we get—

$$dx + \sqrt{-1}\,dy = n\,(\alpha + \beta\sqrt{-1})^{n-1}\,(d\alpha + \sqrt{-1}\,d\beta)$$

—i.e. $(dx + \sqrt{-1}\,dy)\,(\alpha + \beta\sqrt{-1})$

$$= n\,(x + y\sqrt{-1})\,(d\alpha + \sqrt{-1}\,d\beta).$$

Equating real and imaginary parts, we obtain at once—

$$\alpha\,dx - \beta\,dy = n\,(x\,d\alpha - y\,d\beta)$$
$$\beta\,dx + \alpha\,dy = n\,(x\,d\beta + y\,d\alpha)$$

Squaring each equation as it stands, and adding corresponding sides, we have—

$$(\alpha^2 + \beta^2)\,(dx^2 + dy^2) = n^2\,(x^2 + y^2)\,(d\alpha^2 + d\beta^2);$$

or— $$\frac{dx^2 + dy^2}{x^2 + y^2} = \frac{d\alpha^2 + d\beta^2}{\alpha^2 + \beta^2}.$$

There is a mistake somewhere in the question as it stands. QUIVIS.

[68429.]—**Problem.**—I have not got "Williamson" to refer to, but there appears to be a superfluous d in the denominator of the right-hand of the last equation: both sides of the equation are evidently intended to be symmetrical. As it would take too much space to give a general solution, I think it will suffice if we make $n = 2$, as the same process will answer for higher numbers. We are given—

$$x + y\sqrt{-1} = (\alpha + \beta\sqrt{-1})^2 = \alpha^2 + 2\,\alpha\beta\sqrt{-1} - \beta^2$$

Now equate possible and impossible quantities, and we get—

$$x = \alpha^2 - \beta^2;\ y = 2\,\alpha\,\beta.$$

Now differentiate, and we get—

$$dx = 2\,\alpha\,d\alpha - 2\beta\,d\beta$$
$$dy = 2\,\alpha\,d\beta + 2\beta\,d\alpha$$

Square and add, then—

$$dx^2 + dy^2 = 4\,(\alpha^2 + \beta^2)\,(d\alpha^2 + d\beta^2)$$

Again, $x^2 + y^2$ will be found after reduction to be equal to $(\alpha^2 + \beta^2)^2$. Now divide the former result by this last, and we get—

$$\frac{dx^2 + dy^2}{x^2 + y^2} = 4\,\frac{d\alpha^2 + d\beta^2}{\alpha^2 + \beta^2}$$

—Q. E. D.

Bath. M.I.C.E.

[68429.]—**Problem.** — Take the logarithm of both sides of the given equation; then differentiate, and we have:

$$\frac{dx + dy\sqrt{-1}}{x + y\sqrt{-1}} = n.\ \frac{d\alpha + d\beta\sqrt{-1}}{\alpha + \beta\sqrt{-1}}.$$

Multiplying up gives us an equation composed of real and imaginary quantities. Now, in order that the equality may be possible, the algebraical sums of the real and imaginary terms must each equal zero. Hence we deduce:

$$\alpha\,dx - \beta\,dy = n\,(x\,d\alpha - y\,d\beta)\,\ldots\ldots\ldots\ (1).$$
$$\beta\,dx + \alpha\,dy = n\,(x\,d\beta + y\,d\alpha)\,\ldots\ldots\ldots\ (2).$$

Square (1) and (2), and add together the results, and we get:

$$(\alpha^2 + \beta^2)\,(dx^2 + dy^2) = n^2\,(x^2 + y^2)\,(d\alpha^2 + d\beta^2).$$

whence—

$$\frac{dx^2 = dy^2}{x^2 + y^2} = n^2.\ \frac{d\alpha^2 + d\beta^2}{\alpha^2 + \beta^2},$$

which is the result required. In the printing of the question a d has been accidentally inserted in the denominator of the term on the right, which is an error, as can be seen by referring to Williamson's treatise on the "Differential Calculus."

Charing. J. R. C.

[68431.]—**Beams.**—Rankine says the "modulus of rupture" is determined by experiment to be 33,000 to 43,500lb., and that this modulus is "18 times the load required to break a bar 1in. square and 12in. long between bearings and loaded in centre," and so agrees with your figures. Where the tensile and compressive strength of materials vary, I think the neutral axis is not the centre of gravity of section, but varies, so as to give an area above and below which, multiplied by the leverage and strengths, are nearly equal.

Bristol. T. C.

[68431.]—**Strength of Beams.**—"Student's" calculations are right enough; but as regards the breaking strain of cast iron when in tension, I will quote a few lines from Rankine's "Applied Mechanics":—The values of the modulus of rupture for cast iron require special remark. It had for some time been known that while the direct tenacity of cast iron (as determined by Mr. Hodgkinson) is on an average 16,500lb. per square inch, the modulus of rupture of rectangular cast-iron beams is on an average about 40,000lb. per square inch, or two and a half times as great. This was supposed to be accounted for by the assumption that the stress on a cross-section of a cast-iron beam is not a uniformly varying stress, and that the neutral axis does not traverse the centre of gravity of the section. But in 1855 Mr. W. H. Barlow, by experiments, showed, in the first place, that the stress is a uniformly varying stress, and that the neutral axis, in symmetrical sections at all events, traverses the centre of gravity of the section; and, in the second place, that the modulus of rupture has various values ranging from the mere direct tenacity of the iron up to about two and a third times that tenacity, according to the figure of the cross-section of the beam." Now 40,000lb. is just about the 18 tons calculated by "Student," so that, according to the above, his bar would about bear the weight of one ton in the centre of the bar; whereas, if we make use of the mere direct tenacity of the iron (which is only some 7 or 8 tons per square inch) in our calculations, the result would make it appear that the bar would break with less than half a ton suspended from the centre. This shows that cast iron is a very difficult material to deal with, when calculating strains; but, fortunately, it is not much used now for girders.

Bath. M.I.C.E.

[68433.]—**Bacteria.**—The difficulty is to prevent bacteria getting into anything. I do not see how I can assist you in determining the kind of fungus without personal observation. Have you not got any books? SM.

[68433.]—**Bacterium.** — The fungus is probably either "Penicillium mucor," or perchance it may be "Aspergillus." It is a known fact that "torulæ" appear in the mycelium of these fungi; but a debatable point as to whether they are the same as the "torulæ" of yeast. With reference to the oscillating motion of the bacterium, possibly you have not the particular species given to this motion, for, you must remember, there are several kinds—for instance, the Spiræolæ, having corkscrew motion; the Vibriones, having a wavy motion. You must be careful, however, to distinguish these motions from the "Brownian movements." Your latter question opens up the question of "spontaneous generation." I am inclined to think the germs must be carried in by the atmosphere. Boiling will not kill all kinds of bacteria. FREDERICK DAVIS.

[68434 and 68437.]—**Air-Pump and Blowpipe.**—You can very easily, with a slight knowledge of glass-blowing, make yourself a Sprengel pump which will answer all your requirements. A good supply of mercury is convenient, but you can manage very well with two or three pounds only. A water-pump is out of the question unless you happen to have special facilities, and even then you would not get so good a vacuum as the Sprengel will give. You can also construct your blowpipes and blowers very cheaply. I will send next week a detailed description of apparatus specially suited for amateur work.

Leicester. E. E. B.

[68435.] — **Screw-Cutting.** —I do not quite understand your difficulty. If the threads of screw being cut are a multiple of the lead screw the nut will drop in right anywhere. If not a multiple, make a chalk mark on bed, and always draw saddle back to that for starting, also put a chalk on face-plate and on wheel on leading screw when you first put clasp nut in gear, and always start with the marks in the same position for each cut. You can use a block of wood between saddle and loose headstock, instead of the chalk mark, if you prefer it.

Bristol. T. C.

[68435.]—**Screw-Cutting.**—When the number of threads per inch to be cut is divisible by the number of threads per inch of leading screw, the saddle will gear right with any part of the leading screw. When the number is not divisible the method usually adopted by workmen is as follows:—Run the saddle against the poppet head or other convenient stop. Then turn mandrel slowly round by hand until clasp nut drops freely into gear; now make a bold chalk mark on face plate (any convenient position will do), and opposite this mark chalk another on lathe bed. Chalk also two or three teeth on wheel of leading screw, and opposite these marked teeth chalk yet another place on lathe bed. Now, with nut in gear, start lathe and take a cut along screw blank. Then unclasp nut and run saddle back against poppet head or stop. Again turn lathe slowly round until the chalk marks on face plate and wheel come into their original positions—viz., opposite marks on lathe bed. The clasp nut will again gear with leading screw and the tool follow in its former path.

AN ENGLISH MECHANIC.

Newcastle-on-Tyne.

[68436.]—**Equatorial Telescope.**—The reference alluded to in Webb's book is a misprint for "II. 35." L.

[68436.]—**Equatorial Telescope.**—The description of cheap equatorial stand is in No. 14, page 35, of Vol. II., 1864, "Astronomical Register," with an illustration. SIGBEE.

[68436.]—**Equatorial Telescope.**—This is a misprint, for No. XIV. p. 35, and the description will be found at p. 35 of the volume for 1864. Having at one time been puzzled in the same way as "G. G. B.," I hunted up the correct reference and noted it in my copy of Webb's work. E. D.

[68436.]—**Equatorial Telescope Stand.**—In reply to "G. G. B." (p. 184), there is an error in Webb's "Celestial Objects" respecting the volume in the "Astronomical Register," in which there is the description of the cheap equatorial stand referred to. The Volume is II., and not XIV.; but the number containing this description is No. 14, for February, 1864. The illustration accompanying the particulars of the stand is by an old contributor to the "E. M.," Mr. Philip Vallance, who also describes an ingenious contrivance attached to the mounting for giving motion to the telescope by an air-bladder, the escape of the air being regulated by a stop-cock immersed in a vessel containing water. I fancy it is also described in a back number of the "E. M." LINEA.

[68438.]—**Spirits of Camphor.**—Presuming that the spirits of camphor was taken in a dilute form (that is, mixed with water), you may be quite sure that your wife's low state of health does not depend on a single dose of such a mild medicament. Even supposing that she had taken it neat, it would certainly not produce any worse effect than that produced by a quartern of good Irish whiskey neat. Of this I am quite certain, having had personally a good deal of experience with the administration of spirits of camphor. S. BOTTONE.

[68438.]—**Spirits of Camphor.**—Spirits of camphor of the B.P. strength should be 1 in 10—i.e., one ounce of camphor to nine ounces of spirit, and if your wife took a teaspoonful (1 drachm) of this preparation in water, it is not an excessive dose; but if she took a teaspoonful of Rubinie's spirit of camphor, it would be an excessive dose, this preparation being a saturated solution. The dose of camphor is from 5 to 10 grains, and should be given in the form of an emulsion—that is, suspended in aqueous solution by gum acaciæ or something of emulsifying properties, because when camphor is taken in the form of a pill, it floats upon the top of the stomach, and frequently produces nausea or a form of indigestion; the same applies to taking camphor in the form of spirits, because immediately the spirits of camphor comes in contact with the gastric fluids, or with water, the camphor is thrown out of solution. Camphor given in this way frequently causes pain at the upper orifice of the stomach. The best thing your wife can do is, take an aperient, say, fluid extract of cascara sagrada 1 drachm, fasting in the morning, and drink warm milk and water for a day or two, refraining from tea, coffee, &c. Should this treatment not remove the uneasiness, consult a medical man. FREDERICK DAVIS.

[68438.]—**Spirits of Camphor.**—I should think the wife of "N." was suffering from an over-dose of spirits of camphor. There are substances which are perfectly wholesome when taken in moderate quantities, which, however, may cause death when taken in excess; and the same substance may be taken in the same proportion by two persons: in one it produces no effect, but in the other considerable inconvenience and, perhaps, very serious results. If a person drinks largely of cold water when the body is over-heated, effects may be produced which may resemble poisoning, and even death may ensue. Substances which are in common use, such as table salt and sulphate of magnesia, have been known to cause death, when the quantity taken has been excessive. Some time ago, a man in London took a quantity of salt in a pint of ale, and died within twenty-four hours. Another case, a girl died in consequence of taking a quantity of salt as a vermifuge. About two years ago, a lad, 18 years of age, whom I knew at Tunbridge Wells, died in great agony owing to taking an over-dose of pure sulphate of magnesia. It appears, then, that the state of the person taking a substance, or the quantity in which it is administered, may very seriously influence the effects produced. If the dose taken be hardly sufficient to cause death, or if from treatment its effects have been mitigated, still it often leaves behind an impaired digestion, and other disarrangements of the system, which may last through life. J. WEBB.

[68439.]—**Gas-Works.**—"Gas-Man" should have given the size and length of his retorts, whether of iron or clay, and the distance his dip-pipes are apart in the hydraulic main, as without these particulars (at the least) it will be impossible to give him any definite sketches. He may also give the width of the arch of oven inside, and the height from floor level. If his retorts are of the size usual in small works, he ought to make easily 10,000c.ft. per diem, if they were set properly, and have no difficulty about getting up heats. Richards's "Gas Manufacture," published by Spons, London, is a good work; also King's "Treatise," a large and rather expensive work in several volumes. If, however, "Gas-Man" will send me the particulars named, I will post him a tracing that will enable him to get his retorts set properly. See Address Column. GAS ENGINEER.

[68439.]—**Gas-Works.**—Your present setting of retorts must be a very bad one, as with a setting of four you ought, at least, to turn out 10,000 cubic feet of gas per working day. The quantity of coal you use (1 ton) is a great deal more than would be necessary were your setting a good one. In setting retorts the great thing is to have plenty of fuel room, good dampers, and plenty of draught, which can easily be regulated by the dampers. It would be impossible for me to give you sketches, showing sections of settings, as it would take up too much space, and would be also very vague, and there is no good work on the subject that I know of, the various works in publication at present dealing chiefly with theory and not with practice, and are noted for their high price, which I think in many cases are not warranted. If you will publish your address in the Address Column, I will write you and give you all information in my power, and will also give you sketches of the kind of setting required. I may say that with a setting of retorts (three in a bed) 12½in. by 12½in. by 8ft., I have been able to produce 11,000c.ft. per working day, and that with a pressure of 4½in. in the retorts, which I think you will agree with me is good work. The height of chimney in your case need not be more than 25ft., and diameter 14in. by 16in. would be amply sufficient for your works, which has, I take it, a bed of four, and a bed of two with a production of about a million and a quarter cubic feet per year.

FRED. J. WARD.

[68443.]—**Telescope.**—Remove your eyepiece, and try the o.g. with another eyepiece, if possible. This will, at least, show where the haziness originates—i.e., whether in the eyepiece or object-glass. SIMPLEX.

[68444.]—**Ventilation.**—If you fix a good-sized zinc outlet, say, 6in. diameter from ceiling, immediately over gas-fittings, but not necessarily so, and finish off outside with a good exhaust ventilator, providing at the same time for the delivery into the apartment of fresh air; you will have no difficulty in getting rid of gas fumes. The first consideration is to get a decent exhaust ventilator, the poorer forms not always preventing a blow-down. This blow-down is the cause of your failures, and no arrangement will work satisfactorily until it is stopped. You can bring the fresh-air in by means of an aperture through wall, with cast-iron grating outside, and tube or wooden box inside, delivering in an upward direction, to obviate draughts. Top should not be less than 5ft. 9in. from floor. This arrangement works well, a strong upward current through outlet being constant.

Whitehaven. D. B.

[68446.]—**Flat-Bottomed Canoe.**—I should advise "Rhenus" to have a keel hinged to the bottom of the boat in the centre, with two stout hinges at each end; the keel to be about 6in. deep and 1in. wide, with a line to pull the keel flat to the bottom when not in use. The best sail to be used is a small lug-sail. The sail can be used with a fair wind without keel. W. H. KNIGHT.

[68448.]—**Horizontal Engine.**—Cut-off will be about two-thirds in each cylinder. You had better make a full-size drawing yourself. Valve rods, ⅜in. full and $\frac{3}{16}$in.; eccentric rods each, say, ¼in.; and connecting rods, ⅝in., and $\frac{7}{16}$in. at middle; length of latter, 7½in. Cast bosses on bed, and make them what distance you like. Cannot you settle such a matter as that?

Bristol. T. C.

[68452.]—**Electric Light.**—The E.M.F. of the Bunsen cell, whatever be its capacity, is very nearly 2 volts—say 1·90. The E.M.F. of three cells in series is therefore about 5·7 volts. As the internal resistance in a quart cell is small, it would be possible to light a 4 or 5-volt lamp with three cells for perhaps ten or twelve hours. But remember to place the battery out of doors, because of the poisonous fumes. S. BOTTONE.

[68455.]—**Electric Light Carbons.**—The Globe Co., in their catalogue, say: "Carbons for steady burning, being quite free from flicker and noise when burnt, are a coned rod in top holder and solid one in bottom." Two coned carbons are consumed for one solid. In Joel system O.G.P. carbons are used; these are coned and solid, forming "a good crater at the positive and a clean cone at the negative." The cone or negative is usually the bottom one, the positive or crater being uppermost. The querist would do well to refer to the *Journal* of Society of Arts for March 8th, Prof. Silvanus Thompson's grand lecture on "Arc Light Mechanisms." He there says: "The resistance of carbon pencils may be materially reduced by a thin coating of copper. Carbons used in commerce 11 to 15 millimètres in diameter vary from 0·15 to 0·2 ohm per foot if plain, and from 0·001 to 0·09 if coppered. Cored carbons have a higher resistance than uncored. Carbons cut from solid gas coke have from 5 to 20 times the resistance of those made by the usual modern processes."

A. I. E. E.

[68457.]—**Dynamo for Arc and Incandescent Lighting.**—To MR. BOTTONE OR OTHERS.—As you do not say whether your dynamo is series or shunt wound, it is rather difficult to advise. First of all, see replies 67339, at pp. 424, 463, Vol. XLVIII. "E. M." You will find the Brockie Pell a very good lamp. A compound-wound dynamo can be used for accumulator charging; but it is better to throw the series coils out of circuit while charging. Presuming you wish to make a series-wound dynamo to feed ten arc lights, each of 1,000c.p., having a resistance of 25 ohms, and taking 20 ampères each, you will need an armature 12in. in diameter, 12in. deep, Pacinotti ring pattern, wound with 20lb. of No. 14 wire. The field-magnets may be either A Gramme or Manchester type, 4in. diameter, 12in. long, wound with 32lb. of No. 16 wire, coupled in parallel, so as to bring the F.M. resistance to 0·42 of an ohm.

S. BOTTONE.

[68460.]—**Coil.**—To MR. BOTTONE.—Make a bundle of iron wires about $\frac{3}{16}$in. in diameter, 2¼in. long. Fix a piece of brass triblet tubing that will just slip over this bundle, with a button at one end. Now make a brown-paper tube to fit closely round the brass tube, the same as a rocket-case is made. This must be the same length as the coil is desired to be, including the head. Fit two circular wooden heads to this tube, each 1¼in. diameter, and about $\frac{3}{16}$in. thick, with a central aperture in each to take the paper tube, to which they must be glued, one at each end. One end of the iron bundle must be tightly wrapped for about ½in. of its length with stout brown paper, and glued inside the paper tube, so that the ends of the iron wire are almost flush with the level of the wooden head. At the other end the iron bundle is left free, so that the brass tube can be slipped on and off, so as to serve as a strength regulator. To work with a single Leclanché, the coil should be wound with about 4oz. No. 25 silk-covered copper wire, each layer being carefully paraffined and insulated from its neighbour by means of a turn of "Bank post" paper, previously soaked in melted paraffin. It will not be necessary to use a "secondary" with this coil, but take the shock from two terminals in connection with each end of the coiled wires. Of course, a contact-breaker will be wanted in this as in all other coils. See my "Elect. Test. for Amateurs."

S. BOTTONE.

[68461.]—**Wotton Tramway.**—In answer to "W. E. C. B.," the length is six miles from Quainton-road (on the Aylesbury and Buckingham Railway) to Brill. This so-called railway is a disgrace to everybody connected with it, as the rails are in a fearful state. Rails of the bridge section 22ft. long, laid on long baulks of pine 30ft. long, with cross-ties every 20ft. There are no signals, no bridges; gates at level crossings which the stoker has to open. The stations are a heap of clay whetted up to form the platforms. The rolling stock consists of three engines of the contractor class, two with the motion on the top of boiler, the other a loco. pattern, all 4-wheeled. Two tram-cars—one seats 20, the other 30 passengers; the time occupied is about an hour and forty minutes. One can walk quicker, as it has to call at the neighbouring pond for water. It belonged to the late Duke of Buckingham. The Flying Duke it is called about here. D. E. WADDESDON.

[68463.]—**Small Dynamo.**—To MR. BOTTONE.—If, as you say, the insulation is all right, and you have followed my directions exactly, it is just possible that your brushes are coupled wrongly to terminals and to field-magnet wires. You can easily ascertain this by reversing the direction of driving. If the dynamo now gives current, you will have to reverse the connection to get it to give current when driving in the old way.

S. BOTTONE.

[68465.]—**Induction.**—With a resistance of about 70 to 75 ohms in the circuit comprising the telephones, it is usual to employ a primary having a resistance of about 1·5 ohm, and a secondary of about 150 ohms. These results can be secured by using about 2oz. No. 24 for primary, and 2oz. No. 40 for secondary, both being silk-covered copper; 1 or 2 Leclanchés will give good results.

S. BOTTONE.

[68465.]—**Induction Coil for Microphone.**—The coil used with the modern form of Blake transmitter, so says Mr. Miller in *The Telephone* for April 15, has a primary coil of ·5 resistance and the secondary 250 ohms; but Mr. Bruce in his new book remarks it is a great question if so high a resistance produces best results. Mr. Franks, who performed many experiments with a microphonic transmitter, in Vol. XXXIII. "E. M.," p. 92, April 1, 1881, got excellent results from a primary coil of three layers of No. 24 and a secondary of ¼oz. of No. 40 wound on a wire core 3in. long and ⅜ diameter. He used one Leclanché cell with this, but found a small bichromate make the articulation much louder.

A. I. E. E.

[68467.]—**Coach Painting.**—1. Dark greens for coach painting are made with dark Brunswick green (ground) and adding drop black till the shade required is obtained. 2. A small drop of boiled oil in the colour for lining makes it work free, but care must be taken not to smear with the fingers, &c. 3. A sable brush carries the colour better and does not double when wet as the camel hair. 4. Powdered pumice stone is used by placing in saucer or box, and damping afterwards a piece of old cloth, is just rubbed on pumice in box, and you have all that is wanted for flatting. Care must be taken to wash all clean off coach after flatting, and well dry with chamois leather. 5. It is not usual to give a coat of varnish, but a little of the ground colour is kept and varnish mixed with it to form a coloured glaze, then it is ready for flatting, washing, and afterwards lining, &c. Dark browns are made with Indian red and drop black, mixed according to shade required. Brushes, work, &c., must be kept perfectly clean and free from dust or allowed to get hard; all paint brushes kept in water, and varnish brushes in linseed oil.

Corris. Chas. R. Chaplin.

[68467.]—**Coach Painting.**—"A Poor Blacksmith" can make dark greens as follows:—Mix together chrome and blue, which will be green. If he uses lemon chrome and celestial blue, the result will be a bright green, which can be easily darkened by the addition of black (N.B.—I find the best drop ivory black ground in turps as good as any); but it is impossible to tell anyone how to match a colour without seeing it, especially green, as there are so many sorts of greens. For coach-painting, your colours should dry as quickly as possible, with the exception of the first coat, which should be composed of equal quantities of oil (either raw, linseed, or boiled) and turps, with patent driers, white lead, and lampblack or vegetable black, mixed together to a rather dark-lead colour. For a brown, mix red and black. The following colours, I think, will suit you both for greens and browns. Greens—Prussian blue and yellow ochre, ditto and lemon chrome, celestial blue and yellow ochre, ditto and lemon chrome, ultramarine blue and raw sienna, Prussian blue and burnt sienna. Browns—Red ochre and black; red ochre, vermilion, and black; burnt sienna and lemon chrome; raw umber, red ochre, and black. Experiment on the above. Always add the black last, and cautiously, until it is as dark as you require. To dry quickly, mix with gold size and turps (not too much of the latter—just enough to thin it), or varnish, terebene, and turps. To mix your colour for picking out, you may use gold size and turps, and a little boiled oil, but not much; if you are a quick hand, use none at all. A sable pencil or liner is better than camel-hair, simply because it is stiffer; but I prefer hog-hair. Your last coat of paint should contain plenty of varnish, which, of course, will dry off glossy, and lines will not "take" on a shiny ground; therefore, it must be flattened down as follows:—Put a little ground pumice-stone into a saucer, or anything convenient, and wet with a little water; then rub this over your glossy paint with a piece of rag until it is "dead." I never heard of varnishing before picking out. Walter J. Parker.

[68471.]—**Circular Saw.**—Most likely the cause of your saw "rolling" will be found in the saw itself. If the spindle has end-play, it had better be made right; but I suspect that your saw-plate has become slack at the outside; if this is so, you will require to get it hammered: it will work best a little slack at the centre. Also see that it is well trimmed, or there is no hope of good work. If your belt is in good working order, being pliable and somewhat adhesive, it will have most power with the polished pulley, for the simple reason that it has more contact with the pulley surface. If your drive is arranged with the tension side of the belt uppermost, you may look for trouble from belt slipping. Sandy Dunn.

[68473.]—**Gauge of Wire on Armature.**—I had correctly read the gauge as No. 19, and as such had sent it in the reply; but it got transmogrified, so I have no qualification to make to my former statement. S. Bottone.

[68474.]—**Connecting Dissimilar Batteries.**—When dissimilar cells are connected together in series the E.M.F. is additive; for instance, a cell giving 2 volts and another giving 1 volt, will combined give 3 volts; but the current will in all cases be limited by the resistance of the worst cell. Hence, while on a short circuit a chromic-acid battery, having plates 4in. by 4in., can give as many as 25 ampères owing to the low resistance, a Leclanché can only give about 1 ampère, the resistance being so much higher. Two such coupled together would actually give little more current than the Leclanché alone, and much less than the chromic cell alone. S. Bottone.

[68475.]—**Winding Electro-Magnets.**—To Mr. Bottone.—In winding all horseshoe electro-magnets, unless it is specially intended that they should have both poles N., or both poles S., the wire in passing from one limb to the other must form coils like the letter ∽. In the motor in question, the same mode of winding must be followed for each electro-magnet; but it is absolutely indifferent which way the winding is begun—whether both magnets are the same, thus: ∽ ∽; or whether they are different, thus: ∽ ∾. And there is no advantage in extending the winding to the bend of the horseshoe, provided the due amount of wire be got on. The easiest way of testing insulation is to connect one pole of a freshly-charged chromic-acid battery with one end of the coiled wire of the electro-magnet, and then draw the other pole against and across the bright iron core of the electro-magnet. If it sparks, it leaks badly. S. Bottone.

UNANSWERED QUERIES.

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The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

67856. Roulette Turning, p. 527.
67857. Commutators, 527.
67868. Gas Tube, 527.
67900. Clasp Nut, 528.
67909. Electrical, 528.
67915. Linesman's Duties, 528.
67918. Electric Motor, 528.

68136. Turbine for Lathe, p. 79.
68142. Permanent Way, 79.
68152. L. and S. W. R. Old Passenger Locos., 79.
68164. Lever Bicycle, 80.
68178. Coefficient of H, 80.
68180. Fret-saw, 80.
68182. Stamps on Pewter, 80.
68187. Model.

USEFUL AND SCIENTIFIC NOTES.

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New Silkworms.—In Germany, for some years past, efforts have been made, and with considerable success, to acclimatise the oak silkworms of China and Japan—*Attacus Pernyi* and *Attacus Yama-mai*. They have been raised in the open air, protected from the attacks of birds by nets of gauze or wire, changed from place to place as the oak leaves are consumed. Late frosts and excessively dry weather have been injurious in depriving the worms of food. In California a new wild silk moth, before unknown, has been found thriving on the poisonous species of *Rhamnus Californicus* or *R. Purshianus*. It produces a silk as good as that of the domesticated Bombyx. Owing to the favourable nature of the climate, without the frosts or rains of China or Japan, great hopes are obtained of propagating this species. In Yucatan a wild moth has also been met with, somewhat allied to the mulberry worm, which produces silk of a bluish tint, but the gum which envelops it is difficult to remove. Mr. John MacIntyre, a recent traveller in Manchuria, records having met with several new species of silkworm, which he describes in the *Chinese Times*. One wild worm feeds on the *Pinus chinensis*. It forms handsome cocoons, which yield a strong silk, but they are so mixed up with the needle-like leaves of the pine, that the winding off the silk would be difficult. On the walnuts he found another, which forms a reticulated cocoon, like a Chinese lantern. He also met with two other species of mulberry worms, one very hardy, which could be fed on lettuce or dandelion leaves, and remains stationary, the other which moves easily from branch to branch in search of food. The rearing of *Attacus orizaba* of Mexico is to be attempted in France.

It is announced that the French Government proposes to resume the trials of machinery and appliances for cleaning ramie fibre, and a section of the Universal Exhibition to be opened shortly at Paris will be devoted to this purpose in Group VII. (Agriculture). The actual trials of machinery and methods are to take place during the month of August, and it has been decided to grow quantities of ramie stems ready for the trials which will take place, as last year, under the control of the French Ministry of Agriculture.

QUERIES.

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[68476.]—**Marine Boiler.**—I have made a model saloon paddle steamer, 6ft. 6in. long, 12in. beam, 9in. deep (keel to deck), 18in. deep (keel to saloon deck, which runs from amidships to 2⅜in. from sternpost), diam. of paddle-wheels 11in., eight floats, 2½in. by 5in., on each wheel, driven by double-engine cylinders, 1⅜in. diam., 2⅞in. stroke. I wish a copper boiler, about 11in. long by 8½in. diam., and to burn coal or coke (the former preferred). Furnace at fore end of boiler, funnel at other. Will some one please show me how to arrange tubes—if tubes are necessary, giving sizes—to gain the best steam-raising qualities, and to supply plenty of steam to drive engines 100 or more revs. per min.? What thickness of copper to stand pressure of 60lb. to 60lb. without danger? What size of furnace? A rough sketch would assist greatly.—Sardonyx.

[68477.]—**Induction Coil.**—I have just finished an induction coil, 1in. size, as described by Mr. Mason in No. 1245. I used two layers of No. 18 B.W.G. for primary, and 1lb. No. 34 for secondary. The wire is well paraffined, and all the connections are right. However, I can get no spark to speak of. With three bichromate cells, exposing 30sq.in. of negative surface, the longest spark I got was about 1-32in. I find that after about a minute the platinum connections get burnt, and the armature stops vibrating. How can I prevent this? I wound the wire on a lathe, and fancy I felt a kink or two slip through my fingers. Could that have anything to do with it? It seems to me that with a very small battery power the shock is just as powerful as when I use three cells freshly charged. I noticed that on connecting the secondary terminals, the armature vibrated quite differently. I should be much obliged if some one would kindly help me.—No Induc.

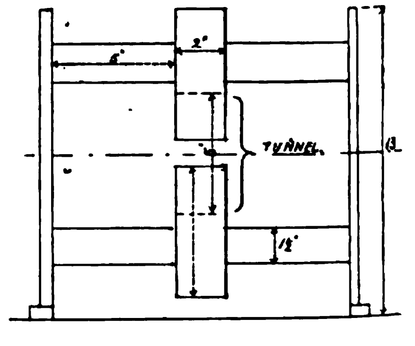
[68478.]—**Long Distance Thermometers.**—A correspondent in the *Standard*, referring to the exceeding value of these appliances for the detection of fire in dwelling-houses, says that the apparatus can be set to give the alarm at any given temperature, say in winter at 75° Fahr., in summer a little higher; and further, that if fitted up, as they should be, in every apartment, closet, attic, passage, or elsewhere in the house, the alarm upon the gong and the dial-plate indicate unfailingly the locality of the fire. Would any reader practically acquainted with the matter give full particulars of the instruments, and the mode of fixing, for the benefit of others besides—Pyro.

[68479.]—**Routing Machine.**—Would any reader kindly describe a routing machine, such as used to clear away the superfluous zinc in a zinco block?—O. G. B. Jones.

[68480.]—**Dull Black for Sheet Zinc.**—Can any reader tell me how to get a dull black, or as dark a brown or chocolate as possible, on sheet zinc? It must be thoroughly adherent, and should be a natural bronze.—Designer.

[68481.]—**Division Plate for 9in. Lathe.**—Could any reader tell me the way to make a division plate for a 9in. lathe.—G. L. C.

[68482.]—**Gramme Dynamo.**—Would Mr. Bottone or other electrical correspondent tell me how much wire to put on F.M.'s and armature to connect as a compound dynamo? Also the size of wire. How many sections should there be on the armature, and speed? How many volts and ampères.—Electron.



[68483.]—**German Yeast.**—Would some kind reader tell me how to use the above, and how to make bread for home consumption—say, 14lb. flour at one time?—D. Roberts.

[68484.]—**Ammeter.**—To Mr. Bottone.—What size cardboard boxes, and what quantity of wire, size, and cost, should I get to make an ammeter to read to 5 ampères and 10 ampères? Also size box and size and cost of wire for a voltmeter to read to 20 volts; also size of [illegible] needles.—D. Roberts.

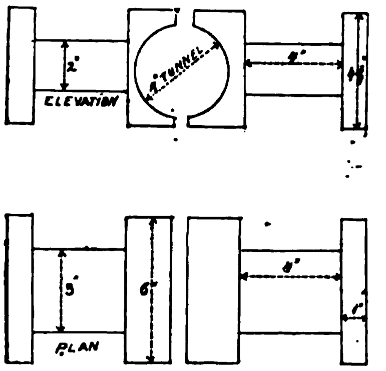
[68485.]—**Winding.**—A weight that requires two men to draw at the rate of two miles an hour. I shall be glad to have dimensions of steam-engine that would wind it at the rate of four miles an hour, supposing it makes [illegible] revs. per min. with 45lb. steam pressure, and what diam. should the drum be?—Demon.

[68486.]—**Soldering Fluid.**—Will the correspondent who, a short time since gave the recipe—viz., lactic acid, glycerine, and water—say what should be done with the mixture to make it usable for soldering? I have already mixed the ingredients, but find the stuff useless for purpose suggested.—Busy Bob.

[68487.]—**Size of Boiler.**—What size boiler would suit a horizontal engine, 2in. bore, 3½in. stroke, to do real work, and work up to 60lb.? Also state thickness of plates necessary.—Rolyat.

[68488.]—**Plaster Casts.**—I have some plaster casts that have been painted once. Would putting them in a hot solution of washing-soda soften the plaster? If so, how could I get the paint off without damaging the plaster?—ELEKTRON.

[68489.]—**Electro-Motor.**—Would Mr. Bottone tell me the quantity and size (B.W.G.) of d.c.c. wire for above?

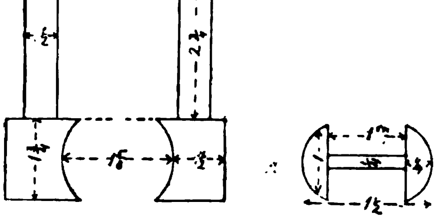


What current would it need to drive it? What H.P. would it give?—ELEKTRON.

[68490.]—**Electric Scarf-Pin.**—To MR. BOTTONE.—A friend of mine has a small scarf-pin, which he wants to light up. Will you kindly give me details of a small battery which can be carried in the pocket? I am sorry I cannot give particulars of the size of the lamp; it is very small. Details of battery will oblige.—VERY MUCH AN AMATEUR.

[68491.]—**Screw Threads.**—Are the same standard threads in steam and copper and brass tube, screwing dies and taps used in the United States of America, as here? I have from ½in. upwards, and intend going there. Shall I have to pay any duty on such tools that have been in use, or does that not matter?—W. MARSHALL.

[68492.]—**To Mr. Bottone.**—Will you kindly give me the best quantity and size of wire for dynamo in sketch?



Is it possible to make one so small? How many volts will it give? Please give quantity of wire in mètres, and size in millimètres. Armature is 1in. deep.—A. R. B. MERAN.

[68493.]—**Wind Vane.**—Will some one please describe how to make and fix a wind vane for showing the direction of the wind; if it could be made to indicate the same on a dial in the house, supposing it was fixed to a chimney, or if on a pole in the garden, how the direction might be seen by a near-sighted person? Would a piece of looking-glass fixed round the pole to show the reflection of vane do? Also please state how far out of the north the magnetic needle points at Croydon?—T. HEATH.

[68494.]—**Boot Repairing.**—Will any reader kindly inform me what shape to cut the leather for toe-capels, and also of putting on the same? Besides that I should like to know the best way of finishing off the edge of the heels and soles.—LEARNER.

[68495.]—**Quick-Drying Gum.**—I have to gum the back of bookbinder's cloth, so that when dry and cut into strips it can be applied by simply moistening with the finger dipped in water. I have tried the best gum-arabic very thick, but find that, in drying, the moisture soaks through and spoils the surface; the cloth also buckles. Can any reader assist me?—J. B. S.

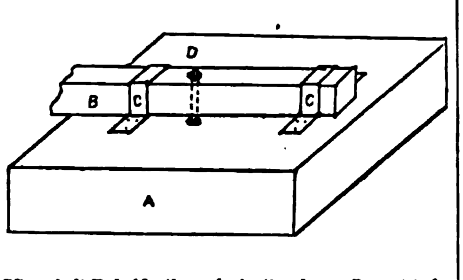
[68496.]—**Velocity in Elliptic Orbit.**—In the ENGLISH MECHANIC of Dec. 14, 1888, "F.R.A.S." gives a formula for the velocity at any point of an elliptic orbit, which seems to me incorrect. From this formula we have $vN = (1 + e) A V$, or $v : V :: (1 + e) A : N$. But as the velocities are inversely proportional to perpendiculars on the tangents at each point (I) we have $v : V :: (1 - e) A : N$ and therefore $v = \frac{(1-e) A}{N} V$. (V being the velocity at perihelion). Will "F.R.A.S." kindly explain?—LIGHT.

[68497.]—**Daguerreotype Photo. Process.**—Can any of our friends oblige with a sketch of the necessary photo apparatus required for the above process? Wanted, likewise, a sketch of interior of a daguerreotype studio. Full particulars will oblige.—BICHROMATE.

[68498.]—**Gaiffe's Pocket Medical Chloride of Silver Battery.**—Would some of our electrical correspondents kindly supply the information how the above battery should be charged, giving full particulars?—G. W. VALENTINE.

[68499.]—**Problem.**—Will some one kindly show how the following problem is worked out?—A mixture of soda and potash dissolved in 2,540 grains of water, took up 980 grains of aqueous sulphuric acid, and the weight of the compound solution was 4,285 grains. Find how much potash, and how much soda the mixture contained, assuming that aqueous sulphuric acid unites with soda in the proportion of 49 grains to 32, and with potash in the proportion of 49 to 48.—ALFRED.

[68500.]—**Removing Pole.**—Can any reader help me out of this difficulty? I have a box A floating on water, and a pole B across it, held down by two staples CC.; a bolt D holds the pole in its place. I want to be able to remove the pole frequently, but if I unscrew the nut the bolt will drop down into the box. I want to know some way of removing the pole without taking the box to pieces, or taking off the staples.—DOUBLE B.



[68501.]—**Judson Cell.**—What in ampères and volts is the output of a Judson corrugated carbon cell, porous pot and zinc in pot? And what size outer cell (both square and round outer cell), please Mr. Bottone. Porous pot round, and zinc and carbon to make up a cell with the same output as Judson's cell; inner measure of carbon corrugated cell 2¾ diameter, by 6½in., porous pot 7 by 2in., zinc 7 by ½in., diameter; a rod to use with your new depolariser; a Fuller, I believe, is your choice.—D. ROBERTS.

[68502.]—**Pocket Coil.**—To MR. BOTTONE.—Will you be kind enough to give me the sizes of a bobbin for a small pocket shocking-coil, to be unbearable, sizes, and length of wires? What size cell should I use, carbon and zinc, and what sort of acid for cell?—D. D. TAYLOR, JUN.

[68503.]—**Photography.**—1st. In photographing animals out-doors should it be in sunshine or shade? 2nd. Wishing to try the flash light in photography, can any reader recommend me a good flash lamp that would give a good detail in exposure, and whether a screen should be placed between lamp and sitter, and how worked when exposing? Having to use it in the evenings, should I leave the light (a lamp) I focus by, burning at the same time, or not? Any information on the subject would oblige—AN AMATEUR.

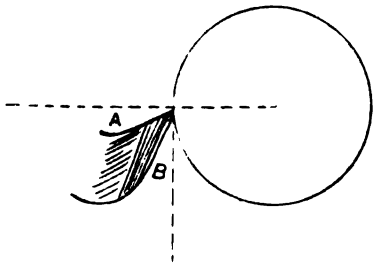
[68504.]—**Piston Rings.**—Could any of your numerous readers give me the dimensions for the thickness of piston rings similar to those of "Buckley" or "Lancaster" for cylinders up to, say, 100in. dia. I cannot find any rule for such details, or for distance between flange of piston and junk-ring.—STEAM.

[68505.]—**Brass Casting.**—As I intend to try and construct a locomotive from the instructions now being published, I would be thankful for some information on brass casting. I have tried several times, only once with success. Why did half the thickness of the bottom and one side of my crucible split off in the fire? I used an ordinary smith's fire and coke. Was the heat too great? Does the mould require any preparation after the pattern is withdrawn? Should I put anything in the crucible along with the brass? Should the crucible be covered over in the fire? Any other information will be thankfully received.—NOVICE.

[68506.]—**Cold Air.**—I want to keep a larder supplied with fresh cold air during the hot weather. Can any of "ours" give me an idea how to do it? Thought of having a fan or blower to drive a current of air through a zinc pipe coiled in a tank of cold water. Would this answer? The room is about 6ft. square.—J. W. W.

[68507.]—**Safety Clutch for Pit Cage.**—Would any of "ours" inform me which is the best apparatus for attaching to a pit cage to prevent over-winding? A sketch of same would greatly oblige.—MINER.

[68508.]—**Angles for Lathe Tools.**—Will some reader furnish me with the following information concerning the proper angles for lathe tools?—(1) Angles A and B for cast-iron; (2) angles A and B for wrought-iron; (3) angles for A and B for brass.—MYSTIFIED.



[68509.]—**Battery.**—To MR. BOTTONE.—I have purchased a battery of 12 cells. Each cell is made of carbon (corrugated) with porous pot, and zinc rod inside porous pot. Each cell has a capacity of about 1½ pint. Would you please tell me how I should charge it, and what c.p. lamp it would light? Also is it necessary to amalgamate the zinc rods, and how long would it run with one charge?—W. T. R.

[68510.]—**Anticatelephor.**—In an old book ("Science and Art," 1830) I have found a "Prospectus of the Anticatelephor" an engine for the instantaneous conveyance of intelligence to any distance, by the inventor, 'T. W. C. Edwards, M.A., Homerton, Middlesex." In the prospectus it states that the instrument is altogether different from every kind of telegraph or semaphore, and that its action requires neither electricity nor magnetism. Can any of our readers give any account of this engine, or the means by which it was supposed to act?—J. W. HORTON, Brayford Wharf, Lincoln.

[68511.]—**Dynamo.**—I have a dynamo of the Edison-Pacinotti type, cog armature 7½in. dia., 3in. wide, 1in. thick, with 12 cogs cast iron, and wound with 2½lb. of no. 18 cc. wire; the field magnets are cast iron, the pole pieces are 8½in high, by 3in. wide, and the cores are wrought-iron, 7in. high, 2in. dia., and wound with 10lb. no. 16 c.c. wire in series. Will such a dynamo light about 8 lamps of 10c.p. and 25 volts pressure, and at what speed should the dynamo be driven?—ENGINE GREASER.

[68512.]—**Engraving on Steel.**—I want to engrave certain designs on steel plates; the depth of the marking to be 1-16in. Will some of your kind correspondents help me out of the difficulty? I want to transfer the design on to the steel plate after drawing it out on paper. What composition must I use to cover portions of plate not to be marked, and what for transferring from paper to plate? The lines must be true, and not ragged. Must the plate be polished first, or not? Also, what acids to use, and how?—F. A.

[68513.]—**Engine Query.**—I have a mill requiring 24H.P. to work it, and have two 12-horse boilers and 12-horse double-cylinder horizontal engines. I want to couple the two boilers and have one steam pipe connected with the two engines, running belting from each engine to countershaft of mill. Will this arrangement work satisfactorily, or can a better arrangement be suggested? ZUID AFRIKA.

[68514.]—**Albatross Breast.**—Have a fine large albatross breast, and being a present and desirous of having it cured, will some reader kindly give me some suggestion?—ALBATROS.

[68515.]—**Sensitive Plant.**—Will some of your readers kindly give the name of any hardy plants commonly met with in English gardens, any part of which moves with more or less rapidity when touched? The yellow berberis and the mimulus are the only ones I know.—GLATTON.

[68516.]—**Scarecrow.**—Wanted a scarecrow, unobjectionable to human beings, but terrifying to birds, especially London sparrows.—GLATTON.

[68517.]—**G.E.R. Doncaster Express Engines.**—What is the working pressure and average speed of these engines? I have been told that they would run to 67 miles per hour. Is this correct?—J. C. S.

[68518.]—**Compressed Air.**—For refrigerating (eventually also for power) purposes, I want 10c.ft. of air per minute at a pressure of 45lb. (59·7lb. absolute) per square inch, and beg to ask as follows:—What initial quantity of atmospheric air of 14·7lb. absolute pressure, and at a temperature of 60° Fahr. (521° degrees absolute) will yield this quantity of compressed air, and what will be the ratio of compression, neglecting losses from clearances, leakages, &c., and what will be the final temperature? Supposing the compression pump to be jacketed, what quantity of water of 40° temperature will be required to pass the jacket per minute to cool this quantity of compressed air to the initial temperature of 60°, and what will be the temperature of the escaping water, and will the air be increased or decreased in pressure and volume by thus cooling? What is the mechanical work done in compressing the air independently of friction of pump? In re-expanding the compressed and cooled air to its original volume and pressure, what will be its temperature after complete expansion, supposing it to escape freely from the pressure vessel into a receiver of a capacity of 200c.ft. or twenty times that of the compressed volume, and will it be the same, or higher or lower, at the exhaust if used expansively in the production of power through an engine placed between the pressure vessel and the receiver, assuming, of course, in both cases that the receiver causes no back or counter pressure, the air escaping freely as fast as it enters at end from opposite points? As the case may require modifications, I should be obliged for rules applicable to the several points under inquiry, embracing as little of mathematical formula as possible. —M.

[68519.]—**Scalding by Hot Tea.**—I have often heard the remark made, and my own experience seems to lead to the same conclusion, that the palate and throat are more frequently scalded by tea when made with water which has not quite boiled than when the water did boil. Is there any scientific reason for this?—GLATTON.

[68520.]—**Tea, Sugar, and Milk.**—After tea is poured out, provided the sugar is put in the cups before the milk, it will generally be found that in those cups without sugar the milk mixes at once, requiring no stirring. In those with sugar the milk appears to remain at the bottom for a minute or more, so that until the tea is stirred it looks browner than those with no sugar. Why is this? It is easy to pick out in this way those cups with and without sugar.—GLATTON.

[68521.]—**Dynamo.**—To S. BOTTONE.—What power will the motor, Fig. 20, you are at present describing in these pages have? Also how many batteries, size, and kind will it require? Will it drive a sewing machine? Also, if used as a dynamo, what power lamp will it light? Also would the batteries that work the motor light the same lamp?—W. W. E.

[68522.]—**Engine.**—I wish to know the horse-power of my engine, cylinder bore 15in., length of stroke 36in., boiler pressure 40lb. per square inch, revolutions per minute 45, steam cut-off at ¾ stroke.—V. W. X.

[68523.]—**Flywheel.**—I have a gas-engine which works rather irregularly, the flywheel being, I think, deficient in weight, as it is a light one. Would it answer the purpose to make a wood rim, bore it with equidistant holes, fill up with lead, then bolt to the wheel; or would it be better to have a ring of metal cast on? Should be glad of advice as to any method. I do not drive off the wheel, so it would not matter if it had not a true smooth surface. —J. C. S.

[68524.]—**The Planet Mars.**—Will any reader be so kind as to give me the following information, viz:—How is it that the diameter of the planet Mars varies so much, that is, from 4,070 miles to 5,000 that is, I find, given in many recent works of astronomy. Taking 8·848" for the true value of the horizontal parallax of the earth at mean distance from the sun, now in the *Nautical Almanac* the semi-dia. of Mars at that distance is 5·55″ of arc, which, according to my calculation, is about 4,970 miles. Will any reader tell me if I am right, and how it is that there is an error of over 900 miles in so small a planet?—TOM MOORE.

[68525.]—**Movable Stereoscopic Pictures.**—Will any reader give a little information as to how I can produce movable stereoscopic pictures, such as a boat moving on the water, the rise and fall of the sea waves, &c., as I understand that it is possible to produce that effect. I have a stereoscope, and a lot of stereoscopic pictures, if they are of any use.—STEREO.

[68526.]—**Int.B.Sc. London.** — Can any reader kindly advise the best course for a resident in London to pursue, in order to get up the practical work included under biology and chemistry for the above exam., and what time would be necessary for these subjects alone, economy being the chief consideration?—ENGINEER.

[68527.]—**Paper Organ Pipes.**—Will some reader that knows kindly inform one that does not the reason of stopped pipes sounding higher than the open ones of same size? Ought they not to sound an octave lower?—F. W. D.

[68528.]—**Chemical Change of Colours by Heat.**—I wish to coat pieces of linen in a chemical solution, which will then be a pink colour, but which, if held to the fire, will be changed by the heat to blue. What chemical must I use?—W. F. HARVEY.

[68529.]—**Glass Gauge.**—Can any reader give me thicknesses of sheet glass, weighing respectively 16, 21, 26, 32, 36, and 42oz. per square foot? I am making a gauge for a friend, and would like correct sizes to ·001 (thousandth) of an inch. Also any other information about gauges used by glass-makers thankfully received by—AN ENGLISH MECHANIC, Newcastle-on-Tyne.

[68530.]—**Great Western Broad Gauge Engines.**—Would some of your readers favour me with the names of the engines now working the passenger and goods trains on the broad gauge, with the locomotive sheds at which they are stationed? I should like also to have the dates when the broad gauge was changed to narrow on the various sections. The South Wales section was changed in May, 1872, and the Bristol to New Passage line on August 8th, 1873, but these are the only dates I have. What were the names of the engines working the Trowbridge, Hungerford, and Reading section, between the years 1869 and 1873?—WOOTTON RIVERS.

[68531.]—**Brighton Railway Engines.**—When did Mr. Stroudley commence to name the engines on the L.B. and S.C.R., and what were the names and numbers of those which have been "scrapped" in his time? I know nearly all the engines that are now running, but wish to make up the original list of those which Mr. Stroudley first named, but are now worn out. I suppose such engines as Newport, Norwood, and Southsea were running the expresses 15 years ago.—WOOTTON RIVERS.

[68532.]—**Railway Mileage.**—What is the mileage at the various stations between March and Doncaster—the Sleaford loop—and the Bath and Bournemouth lines?—W. R.

[68533.]—**Cleaning off Old Lacquer.**—I shall feel obliged if anyone will tell me how to clean lacquer off of brass ornaments on iron bedsteads, which have turned black? I have tried oxalic acid; also hot water and soda.—T. W. C.

[68534.]—**Telephone Connections.** — Will some reader give proper connections for a pair of telephones, with sketch, showing arrangement for switching out induction coil, to use with microphone only? Also for the weight of telephone hanging on lever to break battery circuit when not in use. I have searched the last 16 volumes, but cannot find anything suitable.—A. R. H.

[68535.]—**Bicycle.**—Will any reader say how I can repair bicycle backbone? It has broken off about 8in. from the fork of little wheel, and I want to know how to make a good job of it, so it will stand knocking about.—WAT.

[68536.]—**Photographic Studio.**—Being anxious to make a studio this spring, I should be glad if some of your experienced readers would inform me which is the cheapest, &c., wood, corrugated iron, or Willesden paper, and how does this act in a wet mountain district. I have space about 25ft. by 9ft. Also should be glad of sketch of the position of lights, &c., and how much light would be sufficient, and what would be the rough cost, without labour.—CHAS. R. CHAPLIN.

[68537.]—**Solubility of Hypo.** — Required the solubility of sodium thiosulphate. The books only say "very soluble."—PRINCIPIA.

[68538.]—**Pink Paper.**—What is the pink paper coloured with, which is used for tickets, showcards, &c.? The light has a great effect on the kind I mean.—PRINCIPIA.

[68539.]—**Nessler's Solution.** — Will any correspondent give the best proportions, qualitative and quantitative (metric), and what it is applicable to? Does it discover only free NH_4, or also in combination?—PRINCIPIA.

[68540.]—**Fehling's Solution.**—Will any of "ours" give the proportions for this test?—PRINCIPIA.

[68541.]—**To Mr. Bottone.**—I have been following out your directions in making a linesman's detector, as given in the "Electrical Plant." By mistake I have wound on each side of the central aperture (sections A and B) one layer of No. 22 d.s.c., and over each layer about 2½oz. of No. 36. I have jewelled the bearings of the needle. I find that one layer of No. 22 takes nowhere near 8oz. as you state. Kindly let me know if I had better unwind it, or can I connect it, so as it will answer. All the wires are wound in the same direction.—M. A. C.

[68542.]—**Silver Waste.**—Can an amateur photographer recover the silver profitably from spent hypo. baths? Processes have often been described in back numbers for treating nitrate and chloride of silver, but I can find no mention of hyposulphite.—C. W.

[68543.]—**Heating.**—Can any reader say approximately what size tubular boiler, working at, say, 60lb., would be required to heat three lengths of 4in. pipe, each 240ft. long? Condensed steam returned to boiler. Contents of pipes are 60c.ft. How many cubic feet per minute must pass through to keep heated?—HEAT.

[68544.]—**Electric Fog-Horn.**—I should be much obliged if Mr. Bottone could kindly tell me the way to make an electric fog-horn, and give a rough sketch?—AMATEUR.

[68545.]—**Keyless Watches: Dangers of.**—To CHRISTIAN LANGE.—Some time ago you spoke of a plan or device for preventing the bow being wrenched off keyless watches. As I cannot find any details, will you kindly say what it was?—VOOGHT.

[68546.]—**Microscope Exhibition.** — Am constructing a travelling microscope exhibition, and would like to show "the flea chained by the neck." How is this accomplished? Any hints as to the most interesting objects to the general public would also greatly oblige.—SHOWMAN IN EMBRYO.

[68547.]—**Clock Gong.**—I have a steel gong fitted to a drum French marble clock, and it does not sound clearly. It is fixed on a pedestal of soft wood. It seems all right, and I cannot make out where the fault lies. One of the bends in the 3-16in. brass wire which supports gong is slightly cracked at the elbow, and there is a little soft solder on the upper check-screw, fixing the wire to the board. Would some correspondent kindly advise what to do?—NEMO.

[68548.]—**Leaning Tower of Pisa.** — Wanted dimensions. All I can learn from guide books is the height.—R. G.

[68549.]—**Steam Pressure and Plate Glass.**—Will any of our readers kindly inform me what pressure of steam a large basin, made of plate-glass and fitted with a jacket, will stand?—20 YEARS' READER.

[68550.]—**Gas.**—Is the Gas Light and Coke Co., under the Act of Parliament, bound to supply ordinary coal-gas if required to do so? I reside in St. James's-place, S.W., and on demanding to be supplied with ordinary gas, I am informed that they have only one main, and that is employed for cannel coal gas. This latter is unsuitable for my requirements, and about 25 per cent. dearer than the ordinary. What is the remedy?—DIAMONDS.

[68551.]—**Ventilation.**—Will someone kindly state (1) the amount of air required for the combustion of 1c.ft. of coal-gas, and the increase of temperature to that mass of air occasioned thereby? 2. The formula for finding the velocity of air in tubes due to the difference of temperature between the external air and that of the building to be ventilated. 3. Molesworth gives 8c.ft. as about the quantity of air passed per minute by an ordinary window. How is this result arrived at, and is there no more definite information to be had? 4. To what principle do inlet and extract cowls owe their action?—S. A. B.

[68552.]—**Maxima and Minima.**—This subject has always had a great attraction for me, especially if I invent the problems for myself! The following is original and, I think, very elegant, and I should like any of the correspondents—"J. R. C.," "T. C., &c.—to try it, as I am not quite sure of the result. Call one of the faces of a cube the base, draw a diagonal from edge to edge of the cube parallel to the base, at a height of one half of the cube, and suppose a plane to revolve round this as an axis, cutting the sides and top and bottom planes; what angle must this plane make with the vertical in order that the perimeter may be a minimum, and show that at the same angle the area of the plane will be a maximum, at least, a local maximum, if one may so call it—that is, the area will be greater than other sections taken close to it, although not so great as when the plane is vertical? This is the only case I know of where the perimeter and the area are both at maximum, for the same value of the variable. I make the angle one whose sine is $\frac{1}{\surd 3}$. A sketch solution will oblige.—M.I.C.E., Bath.

[68553.] — **Problem.** — Would some mathematical reader solve the following problem, set in the Honours paper at a recent Science and Art Examination? Show that in any plane triangle—

$$(s - a)^2 \sin. A + (\sin. - b)^2 \sin. B + (s - c)^2 \sin. C = 2\,S\left(\sin.^2 \frac{A}{2} + \sin.^2 \frac{B}{2} + \sin.^2 \frac{C}{2}\right)$$

where S denotes the area of the triangle.—TRIAL.

[68554.]—**Railway Accidents.**—Would some one help me to compile a list of the names of engines which have been in famous railway accidents? The ones I particularly wish to know about are the Harrow, Wigan, and Abergele accidents on the L. and N.W.R.—the Rednal—Bullo Pill, and Wilton accidents on the Great Western—and the Bishopstoke (cattle train, 1870), and Guildford accidents on the South-Western. Any particulars on the subject, in reference to accidents, other than those mentioned, would doubtless be of interest to other readers besides myself.—WOOTTON RIVERS.

[68555.]—**Dynamo.**—I have the carcase of a dynamo; the two wire spaces are 2in. by 3½in. by 4¾in. long; the armature is to be 3in. diameter by 4in. long. Will you kindly tell me the best kind of armature, and the size of wire on it, also the size of wire on the coils, in order to light 8 lamps of 10 or 16c.p.—G. H. HEYWOOD.

[68556.]—**Gramme.**—Will Mr. Bottone kindly give me sizes for castings for a 20c.p. Gramme dynamo—A type—thickness of standards, diameter and length of iron cores, diameter and width of armature; also size and weight of wires for ditto shunt? Should the castings be all malleable iron? What size lead should I use?—A NOVICE.

[68557.]—**Carbon Rods, &c.**—Will any electrical friend tell me how to make carbon cylinders and rods? I have tried pitch, coke, and sugar compressed in a piece of iron gaspipe, with ends plugged, exposed to a white heat, which, when taken out of mould, was very coarse, soft, and cracked. Have tried coal and coke in equal parts, which was much more compact, but cracked in small pieces. I wish to make them myself.—SHAMROCK.

[68558.]—**Chiming Clock.**—I have an eight-day English long case clock. I should like to make it chime Cambridge chimes. Is it possible to be made from an eight-day striking frame, fixed on the side of the other works, and geared with the minute wheel? What sized barrel shall I require, and what pins shall I require in it? How should I fix the hammers to strike the bells, and what bells shall I require—and tones?—O.

[68559.]—**Preserving Dead Baits.**—Could any of your readers give me the name of the spirit used for preserving small fish for dead baits, or is anything added to attract the fish, as far as scent is concerned?—WALTONIAN.

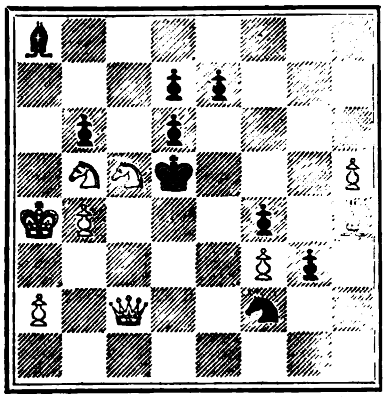
[68560.]—**Clothes.**—Could one of your readers give us directions for measuring and making men's clothes?—C. and T.

CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Uplyme, Devon."

PROBLEM MCXLVII.—BY F. C. COOK.

Black.



White. [9 + 9

White to play and mate in three moves.

SOLUTION TO 1,145.

White.	*Black.*
1. R-R 3.	1. K takes P (*a*).
2. Q-K 3.	2. Anything.
3. Q, R, or P mates.	
	(*a*) 1. P takes Kt (*b*).
2. R-R 5, &c.	
	(*b*) 1. P takes R.
2. Q-K Kt 3, &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,145 by J. Kistruck, Muzio (triple if 1. $\overline{\text{P-Kt 6}}$), W. Gleave (ditto), W. L. Martin (ditto), J. Bryden (ditto), F. Fernando, A. W., J. G. Hankin, J. E. Price, Mendelssohn, A. Dean (triple, but no mate if 1. $\overline{\text{P-K Kt 6}}$, 2. $\frac{\text{Q-Q B 3}}{\text{P takes Kt}}$), J. W. Read, Janus (dual), and T. A. Pringle; to 1,144 by J. E. J. Smith, Bernard Green, Janus, R. T. Hood, and H. G. Walsh (but Q 3 for K 3).

HENSING.—Thanks for your note. We receive the *Tri-Weekly Gleaner* regularly, and have noted the review. Sorry to hear that Mr. Blackburne's health is not good in the severe contest at which he has maintained the lead.

MUZIO, J. BRYDEN AND OTHERS.—There was an error in ascribing a triple to 1,143 after 1. $\overline{\text{Kt-R 3}}$. There are two duals arising from the defences, 1. $\overline{\text{K-Kt 4}}$, or B-B 3, and 1. $\overline{\text{B-Kt 2}}$, or B takes P. The same duals occur also from 1. $\overline{\text{K-K 4}}$, 1. $\overline{\text{Kt-K 2}}$, 1. $\overline{\text{B-R 2}}$, 1. $\overline{\text{B-Kt 4}}$, and 1. $\overline{\text{Kt-R 3}}$, two extra points therefore are scored for complete solution.

MENDELSSOHN.—To what problem do you refer? Please give the number.

C. A. WALBROTH.—If in 1,143, 1 P-KB 4, P takes P (*en passant*).

J. W. READ.—See notice to H. Warren in E.M., April 26; also to Muzio in present number.

Copying Drawings, &c.—Any kind of opaque drawing paper in ordinary use may be employed for this purpose, stretched in the usual way over the drawing to be copied or traced. Then, by the aid of a cotton pad, the paper is soaked with benzine. The pad causes the benzine to enter the pores of the paper, rendering the latter more transparent than the finest tracing paper. The most delicate lines and tints show through the paper so treated and may be copied with the greatest ease, for pencil, Indian ink, or water-colours take equally well on the benzinised surface. The paper is neither creased nor torn, remaining whole and supple. Indeed, pencil marks and water-colour tinting last better upon paper treated in this way than on any other kind of tracing paper, the former being rather difficult to remove by rubber. When large drawings are to be dealt with, the benzine treatment is only applied in parts at a time, thus keeping pace with the rapidity of the advancement of the work. When the copy is completed, the benzine rapidly evaporates, and the paper resumes its original white and opaque appearance without betraying the faintest trace of the benzine. If it is desired to fix lead-pencil marks on ordinary drawing or tracing paper, this may be done by wetting it with milk and drying in the air.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 1, and unacknowledged elsewhere :—

Capt. Saunders.—T. Clarke.—E. Brien.—F. J. Pine.—B. S.—G. Landell.—W. F.—B. R. W.—E. Hines.—Inexperienced.—R.—G. Parry Jenkins.—D. B.—Westwood.—Mark Moores.—Electro-Magnet.—H. L. Wraith. W. W.—Country Clock Dresser.—Bazaar.—David Fergusson.—Ion.—Amateur Bath-maker.—Scotia.—W. H. Tunley.—F. W.—F. W. Mason.—F. C. Allsop.—Technical.—Gas Engineer.—M.I.C.E.—W. Durtnall.—Shelford Bidwell.

Sufferer. (A suitable battery for your purpose can be made up of pieces of copper and zinc, the zinc of one cell being connected to the copper of the next, and so on, the terminal wires being attached to sponges for tracing over the nerves or the seat of the pain. The exciting liquid may be of vinegar or salt and water; but if necessary a dilute solution of sulphuric acid can be used. If, as you say, you are "robust" and have a good appetite, it would be advisable to consult a physician, as the symptoms described are peculiar, and their cause is to be discovered only by examination of the patient.)—One in a Fix. (Why seek to convert a good motor into an indifferent dynamo? Why not make a dynamo from any of the directions given in this paper? Look up your recent back numbers for information on the subject, and if you want any more particulars write again.)—Locomotive. (No, it is doubtful if a description of the lead tree has appeared recently, because it is now so familiar, and the method of making it is published in all the textbooks and playbooks of chemistry. The white powder is acetate of lead, commonly known as sugar of lead. The water should have as much as it will dissolve, and more may be added as the lead tree grows.)—Analyst. (Is not the information recently given sufficient, or what is it you wish to know? Is it only one pint bichromate, and you desire to know how small quantities you need buy, or what? The method of making the solution has been given many times, and those who use it keep it made up, and replenish or add to the cell as required.)—New Reader. (Apply to Mr. Britten, Horological Institute, Northampton-square, London, W.C.)—Young Tait. (The method of sharpening lawn-mowers was actually given last week, p. 182, and has previously formed the subject of several replies. Why put them into a lathe unless it is necessary to turn up the parts?)—J. Langdon. (Pneumatic bells, when properly fitted, work very well indeed. Procure the pamphlet of Gent and Co., Leicester, advertised on front page, and endeavour to comprehend the mechanism yourself, then you will be able to understand whether the workman has done the work properly.)—F. J. G. (How can anyone do more than guess, unless you say what kind of red ink? If aniline, try vinegar or ammonia; if the ordinary red ink, try oxalic acid; but really there are plenty of recipes for removing stains of all kinds to be found in back volumes.)—Electro. (Do you mean a solution to "wash" on, or for use with the battery? Whichever you mean, you will find it fully described many times in back volumes—even in recent back numbers.)—W. M. B., Leith. (You can use either a spirit varnish, as pale shellac dissolved in methylated alcohol, or a pale copal, such as coachmakers use. The latter is the more durable; but whichever you use, apply it in a warm room, or wait until summer.)—Driver. (Such questions cannot be inserted. Nor can we answer them, except by recommending inquirers to procure the catalogues of makers, and judge or choose for themselves. No doubt many of our readers would advise as to the purchase of a traction-engine and threshing machine; but to mention names in the "Reply" column would be a gratuitous and very valuable advertisement; besides which, the other makers, who were not mentioned, would protest, and assert that their machines were the best. If you are unable to form an opinion yourself, advertise for help in the "Wanted" column.)—E. Newbery. (Which gas-lighter do you mean—the one worked by a chloride of silver battery, or that which is worked by a little influence machine? Both have been illustrated and fully described, and you can see the volumes of the "E. M." at the Patent Office Library, or find the blue book copies of the specifications in which all the details are given. The back numbers are out of print.)—Gouty. (Very full directions for constructing home-made vapour, hot-air, or Turkish baths were given in Vol. XXXV.; but a very simple one can be easily made by knocking up out of rough boards a sort of cupboard, with a hole for the head to project out of, or by sitting on a chair with a large blanket round you. A spirit-lamp will give sufficient heat.)—Tanner. (We have no further information about Hauff's improvements in tanning than we gave on p. 146. The No. of the specification is 18,306, 1888, price 6d.)—J. Byfield. (We do not care for examination questions unless they present some special feature of interest to many readers.)—Geo. S. MacIlwain. (We cannot undertake to recommend anyone in particular; but in the "Wanted" column you will find the addresses of those who undertake work of the kind.)—L'Ignorance. (Please see what has been said in previous volumes.)—Robt. Allen. (Calvert's *Mechanics' Almanac* contains something about it; but the subject has been fully described in back volumes. Holden's work on the "Manipulation of the Screw" is useful; also Martin's, and Greenwood's. Any bookseller will procure them.)—Light. (You will find an answer to your query in many back numbers, even recent ones.)—J. T. (What do you mean? You must either advertise that you have a son who wishes to be apprenticed to the fitting, or go round to the engineering shops and ask if they want an apprentice.)—J. Y. (We have frequently given the recipe for dissolving indiarubber to make fabrics waterproof. It is to shred the light-coloured bottle rubber into bisulphide of carbon or mineral naphtha. You can buy as much of it as you want.)—C. J. (You will find several lanterns for showing opaque objects by projection in the back volumes, and in the catalogues of any of the makers.)—W. R. K. (Black lines on white ground would generally be done by the photographic process, or, if many copies were wanted, by photo-lithography, or by a process block. Give some idea of what it is you want to do, and we may be able to help.)—A. J. Walker. (Three cylinders is not a "new departure." Locomotives of that type have been running for some years, as you will find if you refer to indices under heading of compound locomotives.)—Ignorant. (Watt's "Electro-Metallurgy," Crosby Lockwood and Son, Stationers' Hall-court, E.C., price 3s.)—Newhouse. (You can fill the place with the fumes of sulphur, which will to a certain extent combine with the damp lime, and you can subsequently make up good coke fires, and keep the doors and windows open.)—Z. Y. X. (Is there an examination? Apply to the secretary for a nomination form, and get it filled up in accordance with the directions. A very peculiar query for an analytical chemist to put.)—A Reader. (All you have to do is to note the position of the different index fingers between the figures, and write down those just passed. Observe that one dial is the reverse way. The gas man will show you in five minutes; or, if you are going to use gas, procure Wilson's "Common Sense for Gas Users," Crosby Lockwood and Son.)—J. W. Copley. (There are several methods of etching steel—the simplest being, perhaps, to rub the part over with soap, draw with a needle, and fill in the lines with a strong solution of sulphate of copper, or preferably with aquafortis. A recipe given in No. 1,157 reads—1oz. sulphate of copper, ¼oz. alum, half teaspoonful of salt; reduce to powder, and mix with one gill of vinegar and 20 drops of nitric acid. Protect the parts with soap, wax, or even pitch.)

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The Best Cutter-Bar System is that known as HINE'S COMPLETE OUTFIT. Full particulars of these splendid tools sent free per post on application to EDWARD HINES, Griffin Works, Norwich.—[Advt.]

Holloway's Ointment.—In stomach complaints, Holloway's Ointment, well rubbed over the affected part, gives the greatest ease, prevents congestion and inflammation; checks the threatening diarrhœa, and averts incipient cholera. The poorer inhabitants of large cities will find this remedy to be their best friend when any pestilence rages.—[Advt.]

OUR EXCHANGE COLUMN.

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Equatorial Mount and mahogany garden **Tripod** Stand and Iron Column, suit 3in. or 3½in. Telescope, slow motion, by hooks, joint, and screw.—Hutchinson, Liversedge.

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Wanted, Juvenile Tricycle, in exchange for new Dynamo to value.—Hellyar, Electrician, 144, Dalling-road, Hammersmith.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 10, 1889.

MICROSCOPICAL ADVANCES.—XLVI.

By Dr. Royston-Pigott, M.A. Cantab.; F.R.S. F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; former Fellow of St. Peter's College, Cambridge.

Apochromatic Focal Planes.

THE appearance of two distinct sets of spherules lying in the upper and lower strata in diatoms occasionally, afford absolute proofs of the fine powers of an apochromatic glass furnished with a very delicate focal apparatus.

The lower stratum is found at a measurable distance beneath the upper. Indeed, true eclipses are occasionally seen. The lower are then partially hidden by the upper, and of entirely different aspects, white and deep violet. Besides this, often eidolic dots can be distinguished in the beads of each set at the same instant of observation under careful manipulation, as small as 1-200000th.

Lastly, when black stops are fixed a few inches below, parallel rays exhibit miniature images in both sets at once, especially if a weak amplifier be used to reduce the objective aperture and deepen focal perspective. A considerable list can be detailed of *eclipsed beading*, the lower being black or of the deepest violet colour. In all brilliant focal discs the miniatures of the condenser apertures can be seen, and these always lie above the bead or boss. (Eclipses will be further illustrated in the next article.)

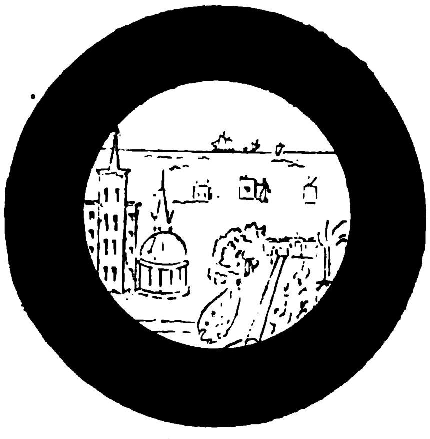

Fig. 1

In a diatom, *Creswelli superba*, the focus of a distant object 120in. away was determined to be 1-6000th.

This causes the diatomic miniature of a black round stop, 3in. below it, to be 1-72000th of an inch in diameter.

The foci of spherules and bubbles, as determined in the last article, are invaluable tests for the apochromatic glass. In the case of embedded bubbles, the miniatures of a window prospect are displayed with the utmost delicacy and precision in a cone of about 80° aperture, always recollecting that this miniature is projected on the further surface of the bubble at its focus. It must, therefore, be sought for there, and not above it.

In a concave lens the miniatures of distant objects are always erect (in a convex one inverted). Viewed with a Browning lens, the close crowding of the objects in a landscape, both east and west, is marvellous. A tall house on the extreme left and trees on the extreme right are both equally portrayed or attempted in Fig. 1. My 16ft. observatory, surmounted by a church steeple afar, houses in the square, "all in a garden fair," are beautifully defined in a hollow bubble found in the plate-glass window.

The Kühl photo. of Angulatum develops round, white discs which are truly the focal images of the aperture in the condenser. This doubtless is a great apochromatic triumph. A whole range of beaded diatoms is now at hand, all giving these very same bright focal discs.

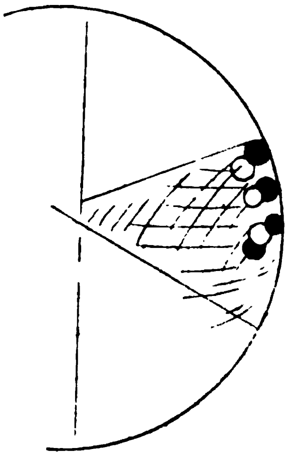

Fig 2

The *Cestodiscus superbus*, submitted to a fine Powell glass, produces some very interesting phenomena (No. 6 hole of P. and L. condenser).

Minute blue beads appear centrally in every boss, which is gorgeously brilliant as a circular, black-ringed disc (Empress lamp, without chimney). Below are seen dark dots, all on a singularly dark-grey ground, adorned with central blue beads, delicately-ringed violet black, when the screw-collar is turned inwards. At the same time, many concentric rings appear outside all, when the collar is opened.

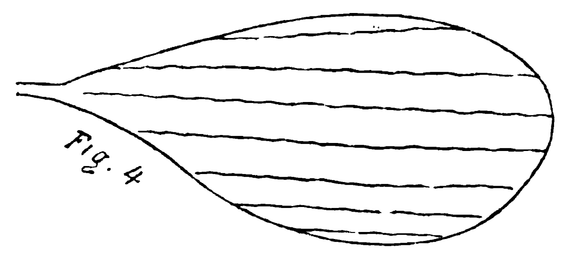

Fig. 4

The central dark dots (about 1-120000th) change from deep violet to a bright Cambridge blue when the largest condenser-aperture is employed. Altogether this scene of so much brilliant diatomic beauty surpasses every other known to me. The general size of the beadings is about 1-12000. Their convexity is demonstrated by the fact of the silica images being always found above the beads—i.e., exactly at the focal point.

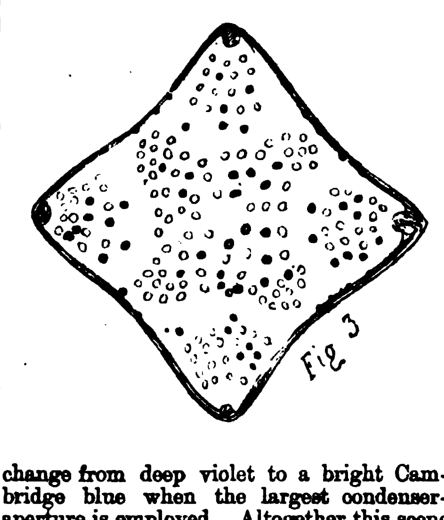

Fig 3

There are also two sets in *Amphitetras elegans*. Beginning at the lowest focus, where the diatom is centrally excavated, each division of the finest focal wheel being 1-230000 of an inch, we find:

Readings.		Effects.
80	....	Central eidolic dots on beads.
90	....	Ten exceedingly small black beads.
95	....	About 20 orange beads.
100	....	These all get a deeper colour.
105	....	Large increase of blue-black beads.
110	....	Dark ruby-edged, black.
115	....	About 100 black beads start into view.

Depth from upper to lower sets:
35-230000th = 6500th nearly.

The field is magnificently beautiful, appearing like layers of shining jewels (1,250 diameters).[*]

Crystal oil lamp 5in. from object, condenser open, 75° aperture,[†] no stops. It is remarkable that even the slight change in focal plane of 1-200000th of an inch produces a visible transformation of the appearance of the spherules, both in colour and marginal thickness. Some of the smallest black beads approach the 1-120000th. Eidolic dots above the larger beads are visible through less than 1-200000th. A fine focussing apparatus thus renders it singularly easy to determine where a miniature lies. By rotating the lamp-wick the flame appears in its natural shape, edge on, or flame broad on. Two black diffraction margins ornament the image of the flame. (A minute illuminated hole shows a continuous black margin.)

The thickness and darkness of the spherular margins is increased by using smaller apertures of condenser. My favourite condenser is one of Hinton's "quarters" (beautiful glasses), which can just glimpse the molecules of *Colias cæsonia*, the new test for *apochromatics*, which are not all, however, equally good. These focal changes are seen not only in diatomic beading, but also in the organic molecules of insect scales, if as large as 1-90000th.

The *Colias Test* is one of extreme beauty and complication of structure, which may be further alluded to. In a great many species, of which I have mounted about 500, double sets of molecules can be distinguished.

The ribbing of the test scale is singularly fine and thin, and richly beaded. At first, with a very fine 1-6th, the inter-costal regions look delicately wavy, like the ripple on the seashore after storm. Next, a certain glitter heralds the advent of rows upon rows of very delicate molecules, distributed in linear and curvilinear forms, and very closely packed together. There are three sorts of scales, but the test scale shows wide ribs at large intervals. It is pear-shaped, and has a general balloony appearance, being perfectly round and even at the thick end, with about ten ribs, some straight, others wavy.

Among the crowded rouleaus of minute beading streams of light glisten suspiciously.

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[*] The dots in the figure should be all accurately circular and somewhat larger. The drawing is uncommonly faithful to the microscopical vision, with the apochromatic glass of Powell and Lealand.

Remark.—Unless the diatom is mounted with a particular face upwards, these phenomena are invisible.

[†] When the aperture arrives at 120° all dots look smaller.

Very careful manipulation with the *apochromatic* glass (1-40 nat. angle) has revealed interspaces more or less circular, surrounded by rings of most extraordinary minute molecules. This form has already been seen on much larger scales in other featherlets. The power employed was 2,500, by means of this Powell objective and a Zeiss ¼in. ocular.

Having despatched a slide of this object to Messrs. Powell and Lealand, they inform me that the molecules they observe in it are very small indeed. They are, in fact, beautifully visible by means of their new glass.

(*To be continued.*)

CHEMICAL SUGAR.

AFTER the recent exposure in America of that daring swindle, "The Electric Sugar-Refining Company," and the loss and chagrin which the bursting of the bubble entailed upon the ardent speculators who believed in *electric sugar*, it seems not unlikely that the trade and people generally will regard incredulously the alleged production of *chemical sugar*. Nevertheless, the production of artificial cane sugar in the chemical laboratory by synthesis is *un fait accompli*.

The Germans, who are ever carrying their researches into the domain of technical chemistry and striving to grapple with the difficulties which are presented in the industrial arts, are again to the front, and it is to their patient investigation that this latest achievement is due.

Whether chemical sugar will ever become of commercial consequence remains to be seen. The chemical sugar which has lately been synthesised bears no relation to the so-called sugar saccharin which created such a flutter in the commercial world a short time ago. Saccharin is not a sugar: its name is unsuitable and misleading; it is properly called orthosulphoamido benzoic acid anhydride—a very significant, if complicated term, which shows at once its true place amongst chemical compounds. This substance is scarcely likely to supplant cane sugar for household purposes but it may very likely find plenty of scope in pharmacy for masking the taste of nauseous drugs in medicine. In cases of diabetes, and on account of its exceeding sweetness even in very dilute solution, it may find extended application as a cheap substitute for sugar in fermented drinks, especially as it said by Fahlberg to be a powerful antiseptic.

Long ago it was demonstrated by Kirchoff that grape-sugar ($C_6H_{12}O_6$), which is contained in honey, raisins, sweet cherries, &c., could be obtained from starch, while Braconnot succeeded in getting it from linen rags. Several varieties of sugar were noticed, and the optical experiments of Biot and the more extended researches of Dubrunfaut ascertained much information, and aided in distinguishing these varieties from each other. When a beam of polarised light is passed through a solution of a sugar and its direction thereby rotated to the left, that sugar is termed lævulose, or left-handed sugar, while, if the rays are directed to the right, the name dextrose or right-handed sugar is assigned to it.

Since Kirchoff's discovery the manufacture of grape-sugar (or glucose, as it is known commercially) from the starchy matters of potatoes, maize, &c., has been carried on very extensively, as it affords a much cheaper, though inferior, form of sugar than the produce of the sugar-cane.

Cane sugar ($C_{12}H_{22}O_{11}$) has hitherto been prepared only from natural sources and not chemically. The chief plants from which it is obtained are the sugar-cane (Saccharum officinarum), the Sorghum saccharatum of Asia, the beetroot (Beta vulgaris), the sugar-maple (Acer saccharinum), and certain palms (Saguerus sacchifera, Caryota urens, &c.). The properties of cane-sugar are very different to those of grape-sugar. It forms prismatic crystals, which, when broken, emit a faint, bluish light. It is extremely soluble in water, but practically insoluble in absolute alcohol. It melts at about 160° C., and does not recrystallise on cooling. This treatment converts it into grape-sugar and a substance called *lævulosan*, $C_6H_{10}O_5$. When boiled with acids in dilute solution, cane-sugar is readily converted into lævulose—the invert or "left-handed" sugar.

The problem of producing cane-sugar synthetically has hitherto been considered to be beyond solution; but in these days the word *impossible* must have its meaning very much modified, or must be expunged from our scientific vocabularies, or else retained as a mere etymological curiosity. So many "impossibilities" have been achieved that the prudent thinker will hesitate to run the risk of stultifying himself by a too rigid adherence to dogmatic assertions.

Although the production of chemical sugar for practical purposes has not yet been realised, yet we are brought a step nearer by the investigations carried out by Emil Fischer, assisted by Julius Tafel, in the laboratory of the University of Würzburg. A full account of their experiments is given in a paper published in the "Berichte des Deutschen Chemischen Gesellschaft," No. 1, page 87, 1889.

Herr Fischer appears to have succeeded in obtaining a true sugar, which is capable of undergoing alcoholic fermentation by means of yeast, just like ordinary natural sugar. There is only one thing wanting in this new chemical sugar, which causes it to differ from natural sugar, and that is it is optically inactive—it is incapable of rotating a beam of polarised light either to the right or to the left. The new sugar has been provisionally named *acrose*.

Glycerin, $C_3H_5(OH)_3$, that sheet-anchor of many a recent investigator, was used as the starting-point in the preparation of *acrose*, and from this substance, by way of its decomposition product, *acrolein* (C_3H_4O), two new kinds of sugar were obtained.

It seems an odd thing to get such a pleasant substance as sugar through *acrolein*, which is a foul liquid with an intensely pungent and irritating odour.

One of these new sugars has been called *alpha-acrosazon*. When this is treated with hydrochloric acid it yields another substance resembling glucosan ($C_6H_{10}O_5$ or $C_{12}H_{20}O_{10}$) in some of its properties, and this has been designated *alpha-acroson*.

Acrose is obtained by the following reactions. After getting *alpha-acrosazon* from glycerin and then converting it into *alpha-acroson*, the latter is dissolved in water and heated in dilute solution with powdered zinc and acetic acid: the combined action of these reagents rapidly reduces the solution of alpha-acroson. The mixture is then heated with sulphuretted hydrogen and filtered. The clear filtrate is evaporated *in vacuo* and the residue dissolved up in absolute alcohol. The alcoholic solution is then filtered, and the filtrate, after being highly concentrated by evaportion, is mixed with excess of ether. The ether precipitates the sugar acrose in the form of colourless flakes, which coalescing soon change into a colourless syrup. This syrup exhibits the characteristic properties of ordinary sugar: it has a sweet taste, reduces Fehling's solution (potash and copper sulphate), and generally responds to the usual tests for sugar, with one exception—viz., that of its inactivity towards polarised light.

The discoverers are sanguine that they will be able to overcome this difficulty, and to obtain the optically active variety of sugar by means of the action of certain ferments.

At present, like most new work, this is chiefly interesting from the purely scientific point of view; it is, however, none the less deserving of attention from the industrial and commercial world. The production of artificial indigo, nitro-glycerine, the electric-light, &c., was once only scientifically important, and there is no reason why, *cæteris paribus*, there may not be a great future in store for acrose, the new chemical sugar.

SMITH'S IMPROVEMENTS IN MARKING OR CUTTING INSTRUMENTS.

THE invention patented under the above title by Mr. T. Smith, of Commercial-road, Southampton, relates to a variety of instruments in which a marking or cutting point or edge requires to occupy a certain relative position or bear a certain relation to the direction of the mark or cut to be made. Among such instruments, as examples, may be mentioned a drawing pen, a knife to be used for cutting veneer, and a glass-marker or cutter. To the last of these examples the invention is especially applicable, and for the purpose of giving a clear explanation the description is confined to its application to such an instrument. Hitherto the construction of glass-markers or cutters, or what are more generally known as glaziers' diamonds, has been such that unless used by those well accustomed to them the results have often been far from satisfactory and often attended by breakage. Among the causes to which these failures may be attributed are first: The uneven pressure with which the diamond is applied to the glass, which unevenness is sometimes due to the length of the cut, the operator at arm's length unconsciously bearing on the cutter with less pressure than when he has it nearer to him and consequently exercises greater leverage upon it, and, secondly, where curved or crooked cuts are made the diamond has not been properly directed towards the lines of such cuts. The patentee claims to have entirely overcome these difficulties, and a person without any previous glass-cutting experience whatever, with one of his glass-cutters cannot fail to satisfactorily secure either a straight or crooked or curved cut. Fig. 1 is an elevation, and Fig. 2 a longitudinal section of a glass-cutter constructed according to the invention. A is a tube or handle closed at one end by the plug A^1 and formed at its other end with the partly spherical cup A^2. B is a partly spherical bulb formed in part with the case B^1 and constituting with the cup A^2, into which it fits, a universal joint. B^3 is a tube secured to or formed in part with the bulb B, and the upper end of which is screw-threaded to receive the plug B^2. C is the diamond which is set eccentrically in the disc C^1, in the centre of which is secured the lower end of the spindle C^2, whose upper end is reduced to a centre point. D is a small inverted-cup-shaped piston or plunger capable of sliding freely in the tube B^3, and the recess of which bears upon the upper pointed end of the spindle C^2. D^1 is a spiral spring which exerts its pressure between the plug B^2 and the piston D in such manner as tends to push the disc C^1 and diamond C out from the case B^1, in which, however, it is prevented from being pushed out beyond the required limit by the flanged D^2, of the disc C^1, which when such limit is reached rests on the flange, B^4, of the case B^1. To use the cutter it is grasped by the handle A and its lower end is pressed down upon the glass and it is then drawn in the direction required. By so pressing the instrument downwards the lower edge or flange, B^4, of the case B^1 will have come into contact with the glass, and no matter what further pressure the operator may apply, the diamond will bear upon the glass with such strength as the spring D^1 or D^2 is only capable of exerting upon it, thus preventing the often disappointing results

Fig. 1.

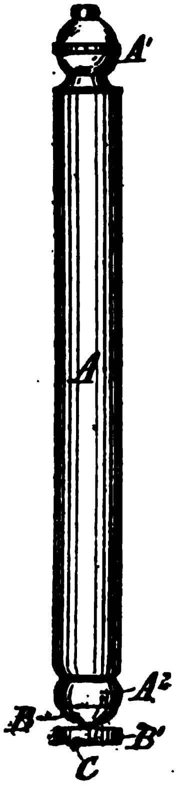
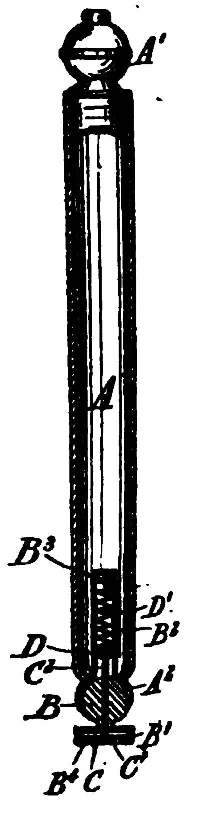
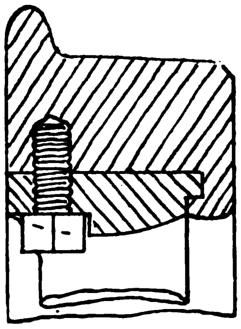
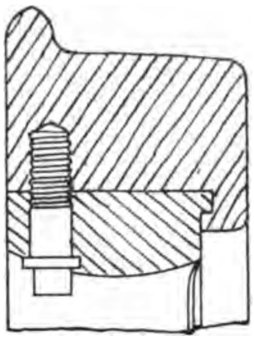


Fig: 2.

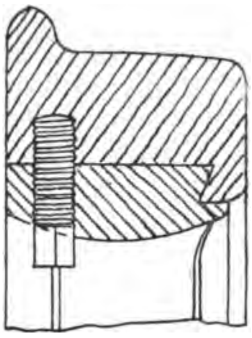




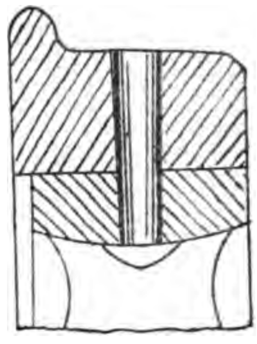
D



C



B



A

hitherto incurred by at one time pressing upon the cutter with a greater power than at another time. Supposing that when the cutter was pressed upon the glass the position of the diamond did not bear the proper relation to the direction of the cut to be made; for instance, let it be supposed that it or an imaginary radial line passing through it and the axis of the spindle C^3, was at right-angles to the direction of the cut intended to be made, immediately the instrument was drawn along, the diamond, after the manner of a wheel or castor, would turn round until the imaginary radial line was in line with the direction in which the instrument was moved, and would always thus adjust itself to any deviation from a straight path. Supposing also that when so applied to the glass, the handle A was not held perpendicular to its surface, any such alteration as might be necessary would be provided for by the joint A^2 B.

A MODEL LOCOMOTIVE.—VIII.

Wheels and Coupling-Rods.

NEARLY every detail of the locomotive affords examples of contrary practice. One superintendent advocates and carries out a system which is in many important matters the reverse of that of his fellow-engineers on other lines. We need only refer to such matters as compounding, coupling, the use or arrangement of bogies, inside v. outside cylinders, as cases in point. To some extent differences in the conditions of running will often account for contrary practice; but after all due allowances are made, there still remains much variation, which can only be satisfactorily accounted for on the grounds of personal predilection or prejudice, idiosyncrasy, and the strong conviction, almost amounting to instinct, of the man of long practice. For this reason I want, as I stated at the commencement of this series, to digress now and again from the bald description of the making of a model, to point out some of the principal variations in design, and the reasons for those variations. In this article I will therefore discuss the sizes, arrangements, and details of the wheels.

The sizes of driving wheels vary much. Dimensions are affected by speed, tractive force, and cylinder power. Other things being the same, tractive power is inversely as the diameter of the driving wheels. With large drivers therefore, large cylinders are necessary. But large cylinders are an advantage in one sense, because they render the starting of the engine an easy matter, and they have more capacity for expansive working than smaller ones. But then large cylinders require ample boiler power, and the large wheels limit the size of the boiler. Large driving wheels therefore are only adapted for very light loads, high speeds, and steady, regular running.

In our model I couple the hinder wheels with the drivers; but it would be equally in accord with recognised practice if I had coupled the leading wheels. On behalf of coupled leading wheels, it is claimed that the engine runs steadier, because the centre of gravity is kept well forward, and that the use of a heavy cast-iron drag-plate can be dispensed with. Against the practice it is contended that the wear of the flanges of the front-coupled wheels is excessive, and that the result of the fracture of a coupling-rod might possibly be more serious, as tending to throw the engine off the rails if the longer broken end remained attached to the front wheel. It does not appear that such an accident has happened; but this is perhaps more than anything else a question of the nature and condition of the line. On a roughly-laid line, with quick curves and steep gradients, it is not safe to couple the leading wheels; either the front wheels should be uncoupled, or a bogie truck employed. On good lines, with curves of long radius and moderate gradients, there is practically no risk in coupling the leading wheels. The expresses on the London and Brighton line, running sometimes at 60 miles an hour, are coupled in this manner.

The object in coupling is to divide or distribute the weight necessary for adhesion, each coupled wheel taking an equal share. In heavy goods engines it is a common practice to couple the whole of the wheels. In some express passenger engines, on the other hand, the wheels are entirely uncoupled, and the load on the big drivers is in consequence very great. In some of Mr. Stirling's engines the load on the 8ft. 1in. drivers equals from 15 to 18 tons, so causing great stress to the permanent way, a stress which it would be unable to sustain but for the fact that steel rails are used on the Great Northern Railway

In accordance with established custom, I place the coupling-rod pins opposite to the crank pins; but it is as well to point out that the practice of at least one railway is opposed to this. Mr. Stroudley, of the London and Brighton line, always places the coupling-rod pin on the same side of the axle as the inside crank, and he states that the durability of the axle-boxes, horn-blocks, and coupling-rods is much increased thereby, being superior in this respect to that of an outside cylinder engine, the durability of whose parts he states to be twice as great as that of an inside-cylinder engine; but on the other hand the outside pin and the coupling-rod have then to be counterbalanced instead of forming a portion of the counterbalance. The extra weight then required tends to increased wear of the tires.

The practice of counterweighting is of comparatively recent introduction in the history of railway locomotives, none of the earlier engines having been so treated, and much trouble was experienced in consequence, and various devices resorted to. At one time it was fallaciously supposed that the action of the steam itself was the cause of the unsteady motion of an engine—an idea long since exploded, since it is clear that the steam pressure is equal both on piston and on cylinder cover. The cause of unsteady running is the weight and the momentum of the moving parts, and as these act on the driving wheels, which not only sustain the greater weight but are placed near the centre of gravity of the engine, the full force of the moving parts operates where its action is most felt. Similar stresses operating on leaders or trailers would not have so marked an effect: hence the reason of the construction of the Crampton engines, where the driving wheels were placed behind the firebox. The lengthening of the wheel base also, and the adding of weight over the hinder wheels by means of a drag-plate, tends to steady running; but the practice of counterweighting, first adopted by Roberts, of Manchester, enables the mass of heavy reciprocating parts to be so perfectly balanced that their influence at the highest speeds is almost entirely eliminated. Approximate rules are—that for inside-cylinder engines the counterweights in the wheels should be equal to three-fourths of the gross disturbing weight on each side of the engine With outside cylinder engines, where the sinuous action is more severe, the counterweights should be equivalent to the whole disturbing weight. The rule adopted for the engines on the London and Brighton line, inside cylinders, is as follows:—The revolving weights are balanced in full. Two-thirds of the connecting rod measured from the crank end counts as revolving weight, and two-thirds of the remainder, including part of the connecting rod, the piston and rod, slide blocks, and pump ram. A weight equivalent to the amount is divided between the two wheels in the inverse proportion of their distance from the centre line of the cylinders. When this is done for both cranks there is a small and a large balance weight in each wheel; the balancing is completed by moving these weights towards each other in inverse proportion to their masses. In coupled engines the weight of the side rods and cranks have to be included in the estimation.

Wheel centres are mostly made of wrought iron built up in separate spokes, ring segments, and boss pieces, and welded into one mass. Comparing past with present practice, Nicholas Wood states that the cast-iron wheels originally used upon locomotive engines wore ½in. in nine months, and that the substitution of wrought iron was a great advance, because their wear was only about ⅛in. in twelve months. To lessen the evil incidental to the rapid wearing away of wheels of cast iron in the early railway period, the practice of chilling the tread was introduced, by which device the life of a wheel was greatly lengthened, so that it would run for many years without requiring renewal. But this chilling (case-hardening as it was called) produced an evil of another character, for the sudden cooling of the rim, and after-shrinkage of the arms caused tensile stresses, which frequently resulted in fracture when running. To obviate this evil, the wheels were cast in two halves and bonded, and wheels also with wrought-iron spokes variously curved were made and long used. Nicholas Wood appears to have been the first to suggest the use of wrought-iron tires hooped on the cast-iron centres. Mr. Losh, in 1830, patented a wrought-iron wheel with wrought-iron spokes, cast into the nave at one end, and bent at the other to form the rim, but apparently without weld. The shrinkage of the tire—also of wrought iron—around the rim held the central portion firmly. In 1835 the railway wheel was practically fixed in its present form by John Day, who welded up the spokes and rim in a manner not essentially different from that now employed. It is probable that this laborious, and not always satisfactory, method will be gradually replaced by the cast-steel wheels. Mr. Webb has entirely discarded them, and only uses cast-steel wheels, of which there are several thousands now running on the London and North Western Railway. To insure soundness, he casts them centrifugally on a machine making from 40 to 60 revolutions a minute, and he has experienced no trouble with them. To cast is much simpler than to forge, and since mild steel of any required quality can be guaranteed, there is little doubt of the ultimate general employment of wheel centres of cast steel.

Railway tires are rolled out of the solid to the rough section required, are bored to a slightly smaller size than the turned diameter of the wheel body, and are then heated and shrunk on, and variously held with rivets, studs, and retaining rings. Tires are subject to two evils: they are very apt to fracture and fly off in several fragments, and they are subject to excessive wear, and between these two evils the engineer has to steer his course. Perhaps in referring to fractures I ought rather to speak in the past tense, because the accidents due to fractured tires are much less numerous than formerly. More care is exercised in the shrinking-on of the tires, and the wheel rims are made stouter, so that the tire shall not be subjected to constant bending between the spokes. A tire must from the first be in a condition of initial stress by reason of the practice of shrinking it over its body, the act of shrinking putting it into tension—a tension, too, that will not be uniform in character, because the inner layers of metal cooling and setting almost instantly will not permit the outermost layers to shrink in their natural and proper manner. For this reason the allowance for shrinkage should never be excessive. Mr. Stroudley's allowances are: for 4ft. internal diameter, No. 19 B.W.G.; for 5ft., No. 18; for 6ft., No. 17 B.W.G.

The temperature at which the tire is put on is from 700° to 800°. Another rule, due to Mr. Reynolds, is to allow the $\frac{1}{1000}$th part of the diameter. But on both these points practice widely differs. The substitution of simple hydraulic pressure to force the tire on the rim without heating it, in the same way that the wheels are forced on their axles, has also advocates. Mr. Reynolds has pressed on large numbers of tires with an allowance equal to the $\frac{1}{1000}$th part of the diameter, and he says that a pressure of 20 tons per foot of diameter is sufficient to force them on, and that the operation is more easily performed than that of fixing the wheels on their axles.

Some typical tire sections are shown in Fig. 31. A is a method of fixing which is falling into disuse, because the tires are liable to fracture through the rivet holes. The modern practice is represented by B, C, D, which methods are adopted, under various modifications, by most engineers.

Notwithstanding the coning of the wheels, it is easy to see that so rapidly moving a body as the locomotive passing from a straight line to a curve of quick radius must have a very strong tendency to quit the curve at a tangent, and that it would do so, but for the coercion of the wheel flanges. But though the engine keeps the rails, it is at the expenditure of enormous friction between flanges and rails, causing abrasion of both to take place, with a great loss of power. The outside leading and the inside trailing wheels are especially subject to friction. Hence the reason for the employment of a bogie or swivelling truck on engines which run on lines having quick curves. These, originally used in England, found, though neglected here, rapid and universal favour in America, are largely used on the Continent, and are at the present time, and for some good while past, becoming more and more extensively employed in English practice. It is beyond my province to explain the systems of bogie construction, as there is no bogie in our model. I will only point out that this mechanism furnishes a means by which the axles may approximate to the double conditions required to enable engines to run on straight lines and on curves. In the first case, the axles should be parallel and the tires parallel; in the second, the axles should be radial, and the wheels on the outer rail larger than those on the inner rail. The bogie truck with parallel axles, whose centre lines arrange themselves either parallel or radially with the rigid axles, and whose wheels are coned, furnishes an approximation to the double conditions required.

J. H.

SOME CURIOSITIES OF MAGNETISM.*

I PROPOSE to direct your attention this evening to a few points in the science of magnetism which lie a little out of the beaten track, and are interesting simply as scientific curiosities and for the light that they may tend to throw upon theory. I shall refer to well-known facts only so far as may be necessary for the purpose of linking together my curiosities into a more or less connected story; and since I wish to be perfectly intelligible to everyone present, I ask the indulgence of those who are well acquainted with the subject if I am at times somewhat rudimentary. The two most familiar pieces of apparatus, by means of which magnetic phenomena may be exhibited, are the magnet and the compass. An ordinary magnet is, as everyone knows, a bar of steel, either straight or bent into the form of a horseshoe, which has the property of attracting and lifting small objects of iron or steel. A compass consists essentially of a thin, straight magnet—technically called a needle—having near its centre a little cup, by means of which it is balanced horizontally upon an upright point. The needle may easily be turned round in a horizontal plane; but when left undisturbed it always sets itself in such a position that its two ends point very nearly north and south. If we examine any magnet which has been bought at a shop we shall probably see that one of its ends is marked with the letter N., or simply with a transverse line. This is the end which, if the magnet were suspended after the manner of a compass needle, would point towards the north. The marked end is generally spoken of as the north pole of the magnet, the other, or unmarked end, being known as the south pole. The marked end of a magnet attracts the south end of a compass needle, and, if not held too near, repels the north end. So, also, the unmarked end attracts the north-pointing end of the compass needle, and repels the other. These well-known facts are expressed by saying that unlike poles attract, while like poles repel, one another. A soft-iron bar quite free from permanent magnetism attracts either end of the compass needle indifferently. If, however, a slight trace of magnetism be imparted to the bar, it will attract the two ends of the suspended needle with unequal forces. This unequal attraction affords one of the simplest tests for magnetisation; but it is by no means easy to apply such a test when we use a magnetic needle which, like that before you, is several inches in length. If, however, we use a very short magnetic needle, such as those contained in the small compasses that many of us carry on our watch-chains, it is clear that we can hold the end of our test-bar an inch or so from both poles at the same time, and if one pole is attracted more forcibly than the other, that pole will at once turn itself towards the bar and indicate that the bar is magnetised, and the direction of its polarity. Experiments made with a pocket compass could not be shown to an audience, and I have therefore prepared a magnetic needle in such a manner that, although it is very small—less than ½in. long—its indications will be easily visible to everyone present. The arrangement is very simple. Instead of being pivoted in the usual way, this little needle is suspended by a fibre of unspun silk, and it has attached to it a small circular mirror, which reflects a beam of light upon a large graduated scale attached to the wall. The movements of the spot of light upon the scale correspond with the movements of the little magnetic needle, and they not only indicate the direction in which the needle is deflected, but also provide us with the means of measuring its deflections. This delicate apparatus, which we will call a "magnetometer," shows us that almost every piece of iron or steel possesses magnetic polarity. A knife, a pair of scissors, a door-key, none of which have been intentionally magnetised, all cause the spot of light to be deflected either to the right or to the left, according to the end which is presented to the magnetometer. But I have here a short bar of soft iron which has been treated in such a manner as to destroy every trace of its permanent magnetism, and since its treatment it has been carefully guarded from accidental magnetic influences. One end of the bar has been painted red; this is merely for convenience of reference, and is not intended to denote any magnetic difference whatever between the two ends. Holding this bar quite horizontally and in an east and west direction, I present one of its ends—say the red one—to the magnetometer. If this is done carefully, no material deflection results. The spot of light remains almost steady. But if I disturb the east-and-west position of the bar by turning its black end a little to the south, the spot of light is immediately deflected towards the left, indicating that the bar has become magnetised, and that its red end is a north pole. Restoring it to its first position, the magnetism disappears. Turning the black end towards the north, we find that the spot of light now moves to the right, showing that the red end of the bar has become a *south* pole. Again, if, while preserving the east and west position we tilt the black end upwards, we observe a violent deflection of the spot of light to the left. Lowering the black end, the spot moves with equal energy towards the right. These effects are produced by the magnetic force due to the magnetism of the earth itself. This is the force which directs the compass needle. It has, at any given place, a definite direction and a definite intensity. The direction of the earth's magnetic force at any point in this room is, roughly speaking, from south to north at an inclination of 67° to the horizon. Its intensity is equal to a little less than half a unit on the system of measurement generally adopted. It is impossible on this occasion to go fully into the question of units, and it must be sufficient to say that in a field of unit intensity a unit pole is acted upon by a force of one dyne. It will, however, assist in the formation of definite ideas, if we remember that the intensity of a unit field of magnetic force is equal to about twice the total intensity of the magnetic field due to the earth. Now, the earth's total magnetic force, the direction of which is inclined at an angle of 67° to the horizon, may be considered as the resultant of two other forces—viz., a vertical force acting downwards towards the centre of the earth, and a horizontal force acting from south to north. The intensity of the horizontal component is, again in round numbers, about one-fifth of a unit, while that of the vertical component is about two-fifths of a unit. There is a convenient way, based upon a conception of Faraday's, of forming a mental representation of a field of magnetic force. The whole of the space in which the force acts is supposed to contain certain so-called lines of force, which we may picture to ourselves as ordinary physical lines. The direction in which the force acts is indicated naturally enough by the direction of the lines, while the intensity of the field is represented by the number of lines traversing a given space. In a field of unit intensity these lines are supposed to be exactly one centimètre apart, so that if an imaginary flat surface were held transversely to the direction of the lines of force, then one line would pass through each square centimètre of the surface. In a weaker field the lines would be further apart; in a stronger one they would be packed more closely together. The earth's total field is, as I have said, of about half the unit intensity; there is, therefore, only one line to every two square centimètres of a transverse surface. It must not, of course, be supposed that such lines have an actual existence distinct from the surrounding space, or that the magnetic force is in any way concentrated upon them. The conception is a purely artificial one, and, in spite of certain objections which may be urged against its adoption, it is found exceedingly convenient in imparting definiteness to one's ideas, and in assisting calculations. When a bar of iron is held in a magnetic field in such a manner that lines of force pass through its length, the bar is magnetised longitudinally, the end at which the lines enter becoming a south pole, and that at which they leave a north pole. The effect of the earth's field is, of course, greatest when the bar is held at an angle of 67° to the horizon, its ends being at the same time directed towards the north and south. The longitudinal effect disappears altogether when the bar is horizontal, and its ends point east and west, for then no portion of the lines of force or of their vertical and horizontal components can traverse its length. But the mere fact of lines of force running through a thing does not necessarily develop sensible magnetic properties in it. If we hold a rod of glass or of wood in a magnetic field, lines of force will pass through it; yet such a rod does not thereby acquire the power of attracting or repelling the pole of a compass needle. The fact is that iron, and in a less degree a few other metals, possess the remarkable property of multiplying the lines that would naturally fill the space occupied by them. A long and thin iron rod placed in the earth's magnetic field will not merely be traversed by half a line of force for each square centimètre of its section as a glass rod would be. The half-line will be multiplied something like 400 times, raising the actual number of lines going through the rod to about 200 per square centimètre. It is these lines, emerging from one end of the rod, re-entering at the other end, that act upon magnetic poles in the neighbourhood and cause the observed attractions and repulsions. By means of electric currents it is easy to produce magnetic fields having a far higher intensity than that of the earth. Here is a brass tube on which are wound several hundred convolutions of cotton-covered copper wire. When the current from a battery of Grove's cells is caused to circulate through the wire, a magnetic field is

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* Lecture delivered at the London Institution, on Feb. 11, 1889, by SHELFORD BIDWELL, F.R.S.

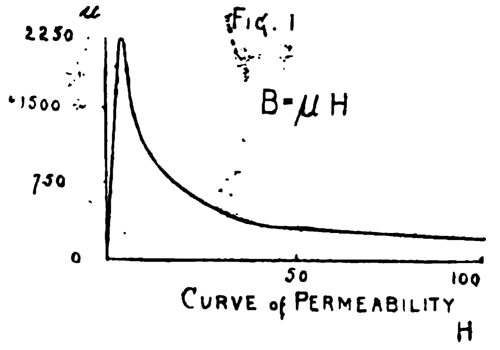

Fig. 1

Curve of Permeability

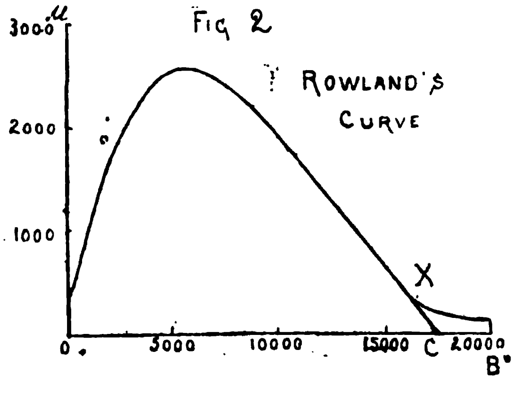

Fig. 2

Rowland's Curve

generated inside the tube, the intensity of which is about 300 units. A rod of iron placed inside the tube is traversed by perhaps as many as 18,000 lines per square centimètre. Although this is a very large number, you will remark that it is smaller in proportion than was obtained when the magnetic field of the earth alone was employed. In that case a field of half a line to the centimètre was found to induce 200 lines in the iron, the multiplying power being 400. But with an external field of 300 the multiplying power is only about 60—a very considerable falling off. It is usual to denote the number of lines per square centimètre in the magnetic field by the letter H, and those induced in the iron by B, while the multiplier is indicated by the Greek letter μ. We may therefore write $B = \mu H$. B is commonly spoken of as the "magnetic induction" and μ as the "permeability." It used to be supposed that, except for high values of the magnetising force, the permeability, μ, was practically a constant for the same specimen of metal. We have already seen that this is by no means the case, and how very far it is from being so is clearly shown by the diagram, Fig. 1, in which horizontal distances represent the magnetic force, H, and vertical ordinates the corresponding values of μ for an average specimen of soft wrought iron. It will be remarked that, as the magnetising force increases from the smallest values, the permeability at first rises with enormous rapidity, attaining in a field of 3 or 4 units a maximum value of more than 2,000. Then it falls again, rapidly at first and afterwards more slowly until, with a field of 100 lines to the centimètre, the permeability is no more than 150. It is clear that within the limits of this diagram the lowest possible value has not been reached, and it is a matter of very great scientific interest to inquire what, if any, would be the ultimate permeability with an indefinitely strong field; or, in other words, to find an answer to the question, What is the greatest possible number of lines per centimètre that can be induced in a piece of iron, if indeed there be any limit at all. To this problem Prof. Rowland, of the United States, applied himself fifteen years ago, and he believed that by a novel method of plotting his experimental results he had succeeded in solving it. Instead of plotting values of μ against those of H simply, as is done in Fig. 1, he constructed some curves in which μ was plotted against the magnetic induction B, that is to say, against H multiplied by μ. One of these curves is shown by the black line in Fig. 2. Like the former one, it begins with an ascent, reaches a maximum, and then falls with tolerable regularity. From data obtained by actual experiment, this curve was carried as far as the point marked X, before reaching which it had apparently become an almost perfectly straight line; Rowland, therefore, assumed that it would continue to be straight until it met the horizontal axis at a point which would give the greatest possible value of B for an infinite magnetic force. He was thus led to believe that for iron the maximum of magnetic induction (i.e., the greatest possible number of lines per centimètre which could pass through it) was about 17,000 or 18,000. Rowland's conclusion, or what has been regarded as its equivalent, is given in almost every textbook of electricity and magnetism which has since been published, and it seems, in spite of its apparent anomaly, to have been generally accepted as correct. Unfortunately, however, Rowland did not carry his experiments quite far enough. He left off with the comparatively weak magnetic field of 65 units, which induced in his iron the 16,500 lines per centimètre corresponding to the point X in the curve. If he had gone a little further he would have found that the curve, instead of continuing to fall, as he assumed, in a straight line to the point C, would bend aside in the manner shown by the dotted line in the diagram, ultimately becoming almost parallel to the horizontal axis. This dotted line represents the results of some experiments in which the magnetic field was carried up to 585 units.* The corresponding magnetic induction was found to be about 20,000, exceeding by 2,000 the number which Rowland thought would be the greatest possible with a magnetic field of infinite intensity, and even then there were no indications that any limit was being approached. In some recent researches by Prof. Ewing, an account of which was communicated to the Royal Society last November, these values have been enormously exceeded. Prof. Ewing succeeded in producing a magnetic field of no less than 24,000, and a piece of wrought iron in this field was found to be traversed by 45,300 lines per centimètre of section. From the general character of his results, Ewing concludes that there is no limit whatever to the degree to which magnetic induction may be raised, and there can be no doubt that he is right. But it appears from other experiments described in the same paper that, after all, Rowland was not entirely wrong. In a modified form, and subject to a little revision of the figures, his proposition turns out to be substantially correct. For, while it is no doubt true that the number of magnetic lines which can conceivably be made to run through a piece of iron is infinite, we learn from Ewing's experiments that the number of new lines in excess of those contained in the magnetic field before the iron was placed there has a very definite limit. This limit for the piece of wrought iron which he used appears to have been about 21,000, and it was practically reached with an external field of 2,000. For this sample of iron we may therefore say that in fields of 2,000 and upwards $B = H + 21{,}000$. In a field of 2,000 the induction would be 23,000; in a field of a million it would be a million and 21,000; but in either case the number of lines due solely to the presence of the iron would equally be 21,000. This important result may be expressed by saying that magnetic saturation is practically reached in a field of 2,000 units. I have said that a unit line of force urges a unit north pole in a definite direction with a force of one dyne. A unit south pole would be urged with the same force in exactly the opposite direction. Now, every magnetised bar or needle has north and south poles of equal strength. When, therefore, such a bar is placed in a uniform field, its two ends are acted upon by equal and opposite forces. Thus the bar has no tendency to move bodily through space: it will merely set itself, if free to do so, with its length parallel to the direction of the magnetic force. This fact is frequently illustrated by floating a cork with a magnetised needle attached to it in a basin of water. The needle, after a few oscillations, comes to rest in a north and south position; but it exhibits no tendency to move as a whole either towards the north side or the south side of the basin. For the horizontal component of the earth's force is sensibly identical at both ends of the needle, and while at one end the needle is pulled towards the north, at the other end it is equally pulled southwards. But although the earth's force may be regarded as quite uniform throughout a comparatively small space, such as this room, it is not so over the whole surface of the earth. The horizontal force is, for instance, about 10 per cent. greater in the Isle of Wight than in Scotland, and if we could make a great bar magnet with its south pole at Ryde and its north pole at Edinburgh, and support it so that it could move freely in the direction of its length, the bar would at once start off in a southward direction, and, after travelling slowly across France and Spain, would finally come to rest with its middle point somewhere near the Gulf of Guinea, on the West Coast of Africa, when its poles would find themselves in fields of equal intensity. We can easily show a similar effect on a smaller scale. We set up the hollow coil of wire in an upright position upon a tripod, and arrange the connections in such a manner that when the battery current is flowing the lines of force pass through the interior of the coil in an upward direction. Inside the coil these lines are closely packed together and nearly parallel; beyond the two ends they spread out in all directions, like the branches of a tree. Below the coil we have a steel bar magnet, the north end of which enters the coil to the extent of an inch or two, while its south end rests upon a block of wood. When we connect the battery by pressing a key the magnet is at once lifted up bodily and drawn inside the coil in opposition to the force of gravity. Breaking the current, the bar falls back upon the block, the sound of its impact being audible throughout the room. The reason is, of course, clear. As soon as the current is started, the magnet finds itself in a field of force, in virtue of which its north end is urged upwards and its south end downwards. But the field is not uniform: it is stronger inside the coil than outside. The force on the north end of the magnet, therefore, predominates over the opposing force on the south end, and the bar moves upwards until (neglecting gravity) its two ends are in fields of equal intensity. Instead of using a magnet, the experiment may be performed equally well or even better with a rod of common iron, for the lines of force in passing through the rod will convert it into a powerful temporary magnet with its north pole uppermost. The magnetism of the bar of iron when in a strong magnetic field may be demonstrated in the usual way by showing its power to attract any small iron objects such as these nails. It will be observed that not only does the iron rod attract the nails, but that the nails themselves have acquired the power of attracting each other, and hang in strings of considerable length. This is because the magnetic lines emerging from the end of the bar pass through the nails and convert them also into temporary magnets. The moment that the current is broken the magnetic force vanishes: the iron loses its attractive power, and the nails fall to the table. We have here an example of what is known as an electro-magnet, a convenient arrangement, by means of which a powerful attractive force can be instantly evoked and as instantly annihilated. The little horseshoe-shaped piece of iron, not 3in. long, which I hold in my hand, will, when an electric current is passing through the wire which is wrapped around it, easily lift a weight of 7lb. Without the magnetic force which the current supplies, it is incompetent to pick up a single nail from this heap. Here I have a larger electro-magnet which, with sufficient current, would probably support two or three hundredweights. Still larger ones have been made which can lift several tons. The questions have often been discussed what are the conditions affecting the lifting power of an electro-magnet? and what is the greatest lifting power attainable? One point of fundamental importance was settled experimentally by Joule many years ago. He found that the power of a uniform electro-magnet varies directly as the sectional area of the iron core, so that, for example, a magnet with a section of two square inches would, other things being equal, carry twice the weight that could be supported by one with a section of only one square inch. The same eminent philosopher carefully studied the effect of varying the strength of the current passing through the surrounding coil, and ascertained that while, up to a certain point, increase of current was accompanied by marked increase of lifting power; yet, when the current exceeded a more or less definite limit, further increase of it produced comparatively little effect. Reasoning upon his experiments, he came to the conclusion, in which long afterwards Rowland concurred, that no current, however great, "could give an attraction equal to 200lb. per square inch." Recent researches have shown that this statement, though it has been very generally accepted, is not quite true. In some experiments made in 1886 with a semicircular electro-magnet and a semicircular armature of soft iron, a weight of more than 200lb. per square inch was easily carried, though the current employed was very far indeed from being infinite. It was, in fact, about five ampères, and the number of ampère turns per centimètre about 400.* This question is indeed very closely connected with the one which we have already discussed with regard to magnetic induction. If there is no limit to the number of magnetic lines which can be induced in an iron bar, then, theoretically, there can be no limit to the lifting power which an electro-magnet may be made to exert. Practically, however, a limit is imposed by the fact that we cannot command an unlimited current of electricity, nor would wires of any known material convey it even if we could. With sufficient current this little 3in. magnet might, no doubt, be made to lift a weight of 20 tons; but any attempt to pass such a current would result in the immediate fusion, or even vaporisation, of the wire by the intense heat that would be generated. The lifting power of an electro-magnet with an iron armature is proportional to the square of the total number of lines which run through the iron, a total made up partly of the lines due to the current in the coil (which would exist if no iron at all were present), and partly of the additional lines due to the superior permeability of the iron. The effect may, therefore, be considered as resulting from the joint action of the iron core and of the surrounding coil. That portion of the attractive force which proceeds from the coil only is, with currents of ordinary strength, comparatively small. But we have to remember that it goes on increasing indefinitely as the current increases, while the portion due to the permeability of the iron attains, as we have seen, a limit. With very strong currents, the part played by the iron core would become relatively insignificant. Thus, if it were actually possible to supply the 3in. magnet with sufficient current to enable it to lift 20 tons, the effect would be almost wholly due to the coil, the iron itself supporting only a few pounds in virtue of its magnetisation. Ewing's experiments enable us to determine the greatest weight that a magnetised iron bar could support by itself without any assistance from a surrounding coil. I find it to be about 260lb. per square inch of section. A rod of iron which has been magnetised by the action of a magnetic field is generally found to retain some of its magnetism when withdrawn from the field. This "residual magnetism," as it is called, is held much more tenaciously by hard steel or iron than by metals which have been softened by careful annealing. The reversed magnetic force which, while it is acting, is just sufficient to reduce the residual induction to nothing, has been called by Dr. Hopkinson the "coercive force." That force which not merely reduces the induction to zero while applied, but just suffices to destroy the residual magnetism permanently, he calls the "demagnetising force." In two specimens, the one of soft iron and the other of hard steel, which Hopkinson submitted to a magnetising force of 240, the residual induction was found to be about 7,200 and 8,700 respectively; but whereas the coercive force of the iron was only two or three units, that of the hard steel was more than 19. A sample of steel containing about 2½ per cent. of tungsten had a residual induction of 6,800, and required for its permanent demagnetisation a reversed magnetic force of no less than 70. Such steel is of great value for the commercial manufacture of permanent magnets. Vibration or jarring has a remarkable effect in removing the residual magnetism of soft iron. It also greatly assists the magnetising action of a small force. I have here a soft iron bar painted red at one end. Holding the red end uppermost, I tap it gently with a wooden mallet; and now, reversing its position so that the red end is downwards, I apply this end to the magnetometer. The movement of the spot of light at once indicates that the red end is a south pole. The magnetisation of the iron while under the influence of the earth's vertical force was facilitated by the tapping; some of the magnetism thus acquired was permanently retained, and hence the polarity now observed. But if, while thus holding the bar with the red end downwards, I again tap it with the mallet, the spot of light immediately flies to the opposite end of the scale, indicating that the tapping has not merely depolarised the bar, but has enabled the earth's force to actually reverse its polarity. The red end, which was south, has now become north. In experimental work it is frequently desirable to demagnetise samples of iron or steel which have been exposed to the action of strong fields. It would be easy to do this, at least approximately, if we knew what demagnetising force would be just sufficient to destroy the permanent magnetism, and if we had the means of applying such force conveniently. This, however, is very rarely the case. But the desired object may be attained in another way. The magnetised bar is subjected to a series of magnetising forces which alternate in direction and gradually decrease in intensity until they become exceedingly small. Under each successive application of the force, the magnetism of the bar is reversed, and at the same time diminished, finally disappearing altogether. I have arranged an apparatus by means of which this operation of demagnetisation by reversals can be performed very conveniently. Its nature is indicated in Fig. 3. A B represents a German-silver wire wound in a close spiral upon a wooden cylinder, along which a contact spring C is capable of sliding. The two ends of the wire are connected through a current-reverser D with a battery, E. One end, B, of the wire and the spring C are also connected with the hollow coil S, inside which is placed the bar to be demagnetised. The resistance of the whole of the German-silver wire being many times greater than that of the coil S, it follows that when the sliding spring is at the end A of the cylinder, the proportion of the current which passes through the coil is much greater than that passing through the German-silver wire. As C moves from A to B, the current through the coil S becomes gradually less and less, and when B is reached there is practically no current in the coil at all. While the current is being thus diminished in strength, its direction is reversed many times by means of the commutator D, and in this manner there is produced a succession of alternating magnetic forces of diminishing strength, which have the effect of demagnetising the iron bar inside the coil. In the instrument before you the slide and the commutator are actuated simultaneously by the simple operation of turning a handle. Here is a bar which, when applied to one of the poles of the magnetic needle, causes repulsion. It is, therefore, magnetised. We place it in the instrument, and after a few turns of the handle, we once more test the bar. Finding that it now attracts both poles of the needle indifferently, we know that it has been freed from permanent magnetism. We have seen that the permeability of an iron rod (and, therefore, its magnetic susceptibility) depends upon the intensity of the field in which it is placed. But even in the same field its value is subject to some variation, for it also depends, to some extent, upon the physical condition of the iron, and is affected by such causes as changes of temperature or mechanical stress. If, for instance, we hang an iron wire vertically in a not very strong field, and stretch it a little by attaching a weight to its lower end, we shall find that the stretching causes a temporary increase in the permeability of the wire, and, consequently, in the intensity of its magnetisation: the wire will act more powerfully upon a magnetometer, and produce a greater deflection in the stretched than in the unstretched condition. But if the experiment be repeated in a strong field the effect will be reversed. The same load which before increased the magnetisation of the wire will now be found to diminish it. In a field of a certain medium strength, which can be determined by trial, the stretching will have no effect at all upon the magnetisation. This value of the field is called, after the first discoverer of the phenomenon, the "Villari critical point" for a certain load. The diagram Fig. 4 shows the results of some experiments upon an iron wire about three-quarters of a millimètre in diameter, in both the unstretched and the stretched conditions, the load employed being a weight of 7lb. In this diagram the horizontal distances are proportional to the magnetising field and the vertical distances to the corresponding magnetisation. The critical point, where the two curves cross each other, occurs when the intensity of the field is about 11 lines of force to the centimètre. There can be little doubt, though I do not know of any experiments that have been made on this point, that the effects of compression would be of the opposite character to those produced by extension. The action of strain upon susceptibility no doubt explains a very curious effect, first noticed, I believe, by Prof. Wiedemann, which occurs when a circularly magnetised iron wire is twisted. It may be well to explain what is meant by circular magnetisation. Suppose that we magnetise a strip of very thin iron or steel and bend it into the form of a ring like an ordinary napkin ring, making the joint between the ends so perfect that there is no break whatever in the continuity and uniformity of the iron. Such a ring will exhibit no external indication of magnetism, for the lines of force which proceed from the north pole will at once enter the south pole without passing through the air at all. By properly joining a number of such rings together we might form a circularly-magnetised tube, and if we filled up this tube with a series of similarly prepared tubes of gradually decreasing diameter, fitting perfectly one within the other, we should build up a circularly-magnetised solid rod. A rod so constructed would, like the elementary rings composing it, yield no sign of magnetisation to ordinary tests, for no lines of force would issue from it into the surrounding space. Nevertheless, it would be magnetised. An iron rod or wire may be circularly magnetised by the simple operation of passing an electric current through it. Here is a piece of thick iron wire which has been so treated. Bringing one end of the wire near the magnetometer, we see that no material deflection is produced. But if, while holding the end of the wire which is nearest to the magnetometer as steadily as possible, I give a slight clockwise

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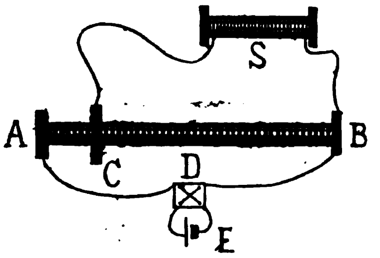
* Bidwell, *Proc.* Roy. Soc. Vol. XL. p. 486.

FIG 3



DEMAGNETISATION BY REVERSALS

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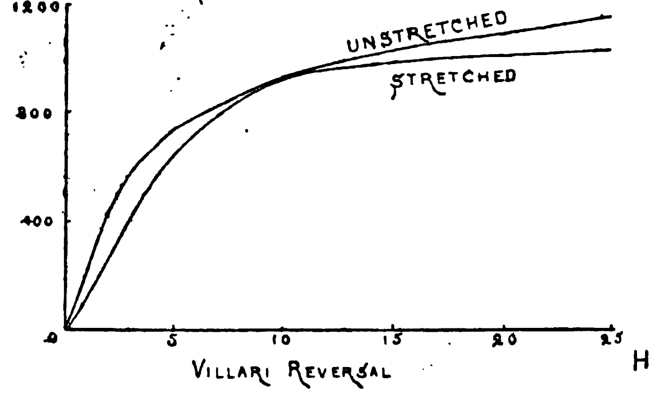
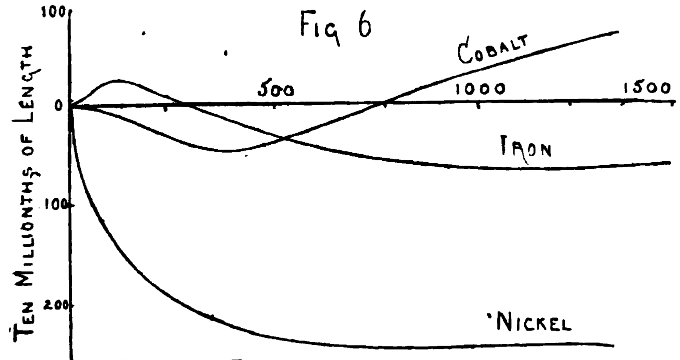
* Bidwell, *Proc.* Roy. Soc. Vol. XL. p. 487.

FIG. 4.

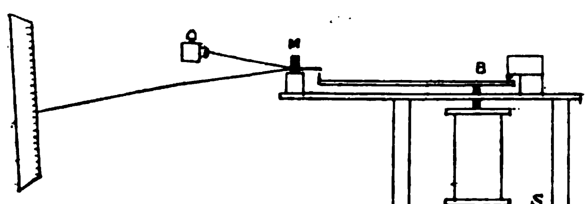


VILLARI REVERSAL



MAGNETIC ELONGATION & CONTRACTION.

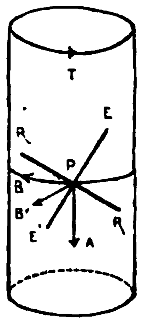
FIG. 7.



MAGNETIC ELONGATION

twist to the other end, the spot of light is deflected violently towards the right, indicating that the fixed end of the wire has become a strong south pole. If we reverse the twist the polarity is at once reversed, and the spot of light flies to the opposite end of the scale. We may repeat this operation a great many times, giving the wire either polarity at will by the application of a suitable twist at the free end. Prof. Chrystal has given an explanation of this phenomenon which appears to be quite satisfactory. Fig. 5 is intended to represent short length of a wire which has been circularly magnetised by a current passing from above downwards. The magnetic force at any point P in the wire is in the horizontal direction, P B. Suppose the wire to be fixed at the bottom and to be twisted at the upper end in the direction indicated by the arrow-head T (i.e., in a counter clock-wise direction as seen from above), then the metal is stretched in some such direction as P E, and compressed in another direction, P R. P E and P R therefore become axes of greatest and least susceptibility, and the resultant magnetisation will take the direction P B', which has a vertical component downwards in the direction P A. The lower end of the wire should, therefore, exhibit north polarity as the experiment shows that it does. The effect caused by stress upon the susceptibility of the magnetic metal nickel is opposite to that produced in iron. Stretching diminishes its susceptibility, compression increases it. Hence, if we perform the twisting experiments with a wire of nickel instead of iron, the resulting polarities should in each case be the contrary of those which we just now observed. This also agrees with the experiment. We now pass to the consideration of what appears to be a class of converse phenomena. As the magnetic qualities of a rod of iron or other magnetic metal are affected by a temporary strain or slight alteration of its form, so it has been found that the form of such a rod may be slightly altered by magnetising it. About the year 1840 Joule ascertained, by the aid of a delicate piece of apparatus, that a bar of iron became a little longer when it was magnetised, resuming its original length on the disappearance of the magnetism. The experiment is a well-known one, and is often referred to as tending to throw light on the real nature of magnetic phenomena. But the simple statement that an iron rod is lengthened by magnetisation does not contain the whole truth. Joule found that when he gradually raised the magnetising force from a small initial value, his iron bars at first increased in length somewhat quickly and afterwards more and more slowly, until when the magnetising force had reached about 100 units they appeared to have attained a limit, and ceased altogether to expand. At this point, therefore, Joule stopped his experiments, and for 40 years or more it seems that no one else ever carried them any further. In the year 1885 an accidental observation led me to believe that there was still something to be learnt about the matter, and I accordingly proceeded to repeat the experiment with far stronger magnetising forces than had previously been employed. The latest results are clearly shown in the diagram Fig. 6, in which the horizontal ordinates represent the magnetising force in C.G.S. units, and the vertical ordinates the elongations in ten millionths of the length of the rod. Looking at the curve marked "Iron," we see that as the magnetising force rises from zero up to 125 units, the rod gradually becomes longer. But when the magnetising force is raised beyond this value, the rod, instead of simply retaining its maximum extension, begins to contract again, resuming its original length with a force of about 275. Still further increasing the force, the iron is found to become actually *shorter* than it was in the unmagnetised condition; and it continues to contract until the force has attained the value of about 1,000, beyond which point its length becomes sensibly constant. The same diagram gives the results of experiments made with the two other magnetic metals, cobalt and nickel. Cobalt, it will be seen, behaves oppositely to iron: it begins by contracting, and after attaining a minimum length, becomes longer again. Nickel also is found to contract, but, unlike cobalt, it never passes a minimum, its length remaining unchanged when the magnetising force exceeds the value of about 800. The contraction of nickel under magnetisation had been previously observed by Prof. Barrett. It must be remembered that the absolute magnitude of these elongations and retractions is exceedingly small. Thus the greatest elongation of the iron rod used in these experiments was barely 6-millionths of an inch. The measuring apparatus is, therefore, necessarily one of great delicacy. That which I have constructed, and which is now before you, will measure small changes of length, to one 25-millionth of an inch. Imagine an inch to be divided into so many equal parts, that to count them at the rate of 100 a minute day and night, without ever resting, would require six months' continuous work; then this instrument is capable of measuring one of such parts. The nature of the apparatus in indicated in Fig. 7. The iron rod to be examined is placed in an upright position inside the magnetising coil.* Its upper end acts at B upon a long lever which turns upon a knife-edge very near to B; the other end of the lever tilts a small mirror, M, which also turns upon knife-edges, or rather needle-points. By means of a limelight lantern the image of a horizontal wire is, after reflection from the mirror, projected upon a distant vertical scale. A very slight deflection of the mirror causes a considerable movement of the image, and from the extent of this movement the change in the length of the wire can be easily calculated. In a rude kind of way I can show you the instrument in operation. The image of the wire is seen as a black line across the scale which is hanging upon the wall. When a current of electricity of sufficient strength to produce a field of about 100 is passed through the coil, the image of the wire at once moves downwards, showing that the length of the iron rod has become greater. A current five or six times as strong as the last is now turned on. Immediately the black image moves in the upward direction, indicating a diminution in the length of the iron. It has lately been shown, mathematically, by Prof. J. J. Thomson, of Cambridge, that this remarkable behaviour of an iron rod in elongating with a moderate magnetic force and contracting with a strong one, is a necessary consequence of the phenomenon which has already been spoken of

FIG. 5



WIEDEMANN'S TORSIONS

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* For further details of the arrangement see *Proc. Roy. Soc.* No. 242, 1886, p. 110, and *Phil. Trans.* Vol. CLXXIX. (1888), A, p. 205. The instrument used at the lecture was made after the latter paper had been communicated, and was exhibited at the Royal Society Soirée in May, 1888.

as the "Villari reversal." This being so, we may venture to make a prediction with regard to cobalt and nickel. We can foresee with tolerable certainty that, if the experiment were made, a Villari reversal would be found to occur with cobalt, and that it would be of the opposite character to that in iron—i.e., stretching would diminish the magnetisation when the magnetic force was weak, and increase it when the magnetic force was strong. I am not aware that such an effect has been yet observed. In nickel, on the other hand, there will be no Villari reversal at all. This latter statement has already been to some extent verified, since, although several attempts have been made (some quite recently by Prof. Ewing) to detect such reversal, none have been attended by success. A few words in conclusion with regard to the effect of heat. Iron, when made red hot, loses its susceptibility, and practically becomes a non-magnetic metal. Nickel loses the greater part of its magnetic property at a much lower temperature, perhaps about 300° C. I have here a piece of apparatus in which this effect is rather neatly shown. A copper disc to which a thin projecting tongue of nickel is soldered, hangs like the bob of a pendulum from a double thread. This bob is drawn out of its normal position by the action of a horizontally-fixed bar-magnet, which attracts and holds fast the nickel tongue. We place a spirit-lamp beneath the tongue. In a few seconds the heat destroys the magnetic quality of the nickel, so that the magnet can no longer hold it. The bob accordingly falls back under the action of gravity, and performs an oscillation. In the course of its swing, however, the metal becomes cooler, and when it returns to the neighbourhood of the magnet the tongue is once more attracted. But again becoming heated by the flame, it is instantly liberated, and the process in repeated. By properly regulating the size of the flame the bob may be kept swinging for a considerable time, like the pendulum of a clock, especially if the uniformity of the action is not affected by currents of air. This exhausts the list of curiosities which I have selected for review this evening. If they do not for the most part appeal very strongly to the commercial instincts of the so-called practical man, they are nevertheless of much scientific interest, and no molecular theory of magnetism will be complete which fails to give a full account of every one of them.

CASTING CIRCULAR TOOTHED SEGMENTS.*

THERE is a particular point to be observed in the casting of circular toothed segments for large wheels. A large wheel of 20ft. diameter will be cast in ten segments of 15 or 20 teeth each. If each segment be carefully measured, it will be found that the end two or three teeth are of wrong pitch: they lean away from the middle of the segment sometimes quite considerably. I have myself dressed off 1/16in. to ⅛in. from teeth of 5in. pitch.

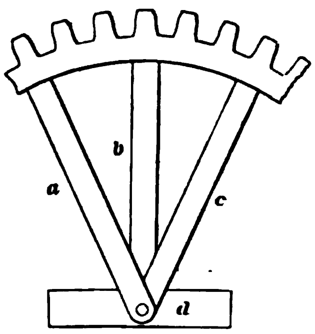
Often only the end tooth suffers; the next tooth, if affected, is only slightly so, and the third hardly appreciably so. The cause of this irregularity is variously stated. Some moulders and pattern-makers will tell you that the ramming of the sand between the teeth has the effect of altering the radius of curvature of the segment and throwing the end teeth outwards. In other words, this explanation would imply that our segments for a 20ft. wheel of 200 teeth are really only of a radius suitable for, say, a 19ft. wheel of 190 teeth.

Others again will explain the discrepancy by saying that, as the casting contracts in the sand, the body of the segment shortens and draws away from the end teeth to a slight extent, and these, being still soft, are bent over by the contraction of the body of the casting. This explanation will be less acceptable to those who believe that cast-iron expands at the moment of solidifying. The fault is very irregular; a first-class moulder whom I once knew, and who was very successful in obtaining very accurate segments, informed me that he overcame the difficulty by firmly bedding in the sand at each end of the pattern a heavy mass of iron. He then rammed up the teeth, beginning from the end teeth and proceeding towards the middle of the segment. He claimed this proceeding kept the pattern from being deformed by the pressure of the rammed sand teeth, and, as judged by results, there was truth in his reasoning, for the peculiar distortion of the end tooth or two would be much less, or entirely absent, in this man's castings. When large wheels are built up of segments, great care is needed in pitching these at the points of junction, for it is easy to see that, as the end teeth of each contiguous pair of segments are distorted in opposite directions, there is a sudden transference as the junction is passed, from a slack to a tight pitch.

One advantage of the moulding machine for large gears is that a complete circle or wheel rim can be cast. The disadvantage of this, however, is that there is a greater chance of waste arising from failure of some of the first moulded teeth, especially when the wheel is large or of small pitch.

Many foundries, however, have no large moulding machine, and moulding machines are not specially noted for producing accurately-pitched gears. I would suggest to those moulders, and to foundries generally who really desire to cast gear segments with accuracy, and avoid entirely the distortion of the endmost tooth or teeth, that they should adopt the following plan. I have not myself tried it, but have reason to believe it will answer.

To the mould of segment as shown in sketch I would add two or three radial channels, *a b c*, which should be moulded with a plain bar and communicate with a cross channel, *d*. The segment, when cast, would then be simply part of a wheel rim with attached arms. In solidifying and cooling in the mould, the contraction of the bars or arms *a b c* would draw the segment bodily towards the centre of the circle of which it forms a part. The circumferential contraction would take place as before, but would not now have the effect of distorting the end teeth, for the reason that the segment, as it contracted in length, would be simultaneously drawn into a position suitable for that length. Of course the bars *a b c d* would be only so much pig-metal, and be returned to the furnace. They should, of course, be proportioned so as to have a proper rate of contraction not slower than that of the segment itself. Precautions to allow the contraction of the arms, to have full effect on the segment, will suggest themselves to the moulder in the way of rendering the resistance of the mould as small as consistent with holding the molten metal. On such points I need not further enlarge, except to say that, as the mischief of distortion is probably effected at and soon after the point of solidification, when the teeth are easily bent out of the true radial line, it will be in the direction of good practice to free the teeth of rammed sand as soon as practicable after solidity is gained. They can be covered again with loose sand to prevent too rapid cooling, but if made free, and the top weights removed, the temporary arms may be cut away any time; at once, if desired. The small extra expense in moulding and casting such arms ought to be repaid in accuracy and satisfaction at good work. Of course the bar *d* is simply inserted as an anchor against which the arms pull, or these might be cast round a stake driven down at the centre of the circle. The same principle of controlling the method and direction of contraction may be employed in other parallel cases of irregular-shaped castings, and will be found useful. I believe it to be the only really correct method to insure accuracy in gear segments.



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* By W. H. BOOTH, in *American Machinist*.

THE HASTINGS TELESCOPE.

IT is stated that Prof. Charles S. Hastings, of Yale University, New Haven, Conn., has discovered a method of finding practicable combinations of three kinds of glasses to produce objectives without secondary aberration. Some of the results of his new method, as applied in making a telescope of small size, are described by him in a recent number of the *American Journal of Science* as follows:—The largest objective which could be made of the pieces in my possession was of 2¼in. clear aperture. This, though smaller than desired, was sufficient to give a fairly satisfactory answer to the questions. Accordingly, the glasses were worked accurately to the curvatures and thicknesses corresponding to the computations and mounted for use. The astonishing beauty of the images in the new telescope was its most surprising feature at first. The familiar purple was wholly wanting, or, at least, could only be recognised with the closest attention, with magnifying powers greater than forty to the inch aperture, and on objects most suitable to its exhibition. But the moment that the instrument was applied to astronomical use it was also evident that its defining power was remarkable. The companions to Polaris and Rigel, instead of being objects which require somewhat careful looking, as is the case with my eye and an ordinary achromatic of the same aperture, were strikingly plain. More difficult, but certainly seen, was the fifth star in the trapezium of Orion. The binary star Eta Orionis was so well elongated that its position angle was estimated to within 5° of its true value. On the other hand, Xi Ursæ Maj., which I suppose to have at present a separation of 1·7", was divided only with difficulty on a fairly good evening, though it was supposed that it would be easy. Saturn showed all that I have seen with an admirable telescope of considerably greater apertures, including more than half of Ball's division, the ring C, a single belt, and five satellites, though Tethys and Dione have not been seen unless they had an elongation equal or greater than that of the end of the ring. Rhea has been seen in conjunction. By reference to the records of many observations which I have made with various telescopes, the power of the new telescope was estimated as equivalent to a 3¼in. objective of the ordinary construction. The powers used varied from 53 to 265 diameters, with 194 as the most satisfactory for Saturn and for double stars. Another method of determining the relative power of the telescope was by comparing the distances at which a table of logarithms could be read with it, and a very perfect telescope of 2¾in. aperture made a number of years ago, and with which I have observed a great deal. Allowing for the 5 per cent increase in size in the new instrument, the mean of five tolerably accordant determinations indicated a gain of 23 per cent., or that the new objective was equivalent to a 3⅜in. objective of the ordinary construction. This ratio of improvement is doubtless higher than would generally be admitted as possible by most opticians, but it must stand for the present as the best value attainable.

USEFUL AND SCIENTIFIC NOTES.

Bromide of Ethyl as an Anæsthetic.—Bromide of ethyl, C_2H_5Br, which was recommended as an anæsthetic in dental practice by Herr Schneider, dentist to the German Emperor, at the Munich Odontological Congress held last year, has since that time been employed in a large number of cases by Dr. Friederich Herz, a dental surgeon in Vienna, who contributes an interesting paper on the subject to the *Internationale Klinische Rundschau* of April 14th. He uses a simple inhaler like that of Skinner, with some cotton-wool inserted to soak up the bromide of ethyl, of which he pours in about ¼oz. at first, adding a little more afterwards if required. In some cases less than 75gr. proved sufficient. Anæsthesia came on rapidly, usually in one or two minutes, and then was sufficient for from five to eight extractions. The patients took the bromide far better than chloroform or ether, neither struggling so much nor presenting any unpleasant symptoms after waking up. Some patients, who had previously suffered a good deal from ether, expressed themselves as highly delighted with the new drug. Dr. Herz has not tried the bromide on young children, but he thinks it will be found very suitable for them, in consequence of its not unpleasant taste and the simplicity of the apparatus required. How far bromide of ethyl would be applicable in important operations cannot as yet be stated. Blum, of Bamberg, however, repeated the inhalation at a single sitting, and was enabled to extract 32 very firmly-set roots. It may be mentioned that according to Lewin, bromide of ethyl does not induce paralysis of the heart.

Development of the Skull.—Dr. Dight gives an account, in the *Journal of the American Medical Association*, of his examination of a collection of human skulls which are stored away in an old monastery in the Kedron Valley, midway between Jerusalem and the Dead Sea. The doctor, who is professor of anatomy in the American College of Beirut, Syria, has made a careful comparison of these skulls with those of the same race at the present day. The measurements show some significant differences. The Caucasian skull has, during the past 13 centuries, increased in circumference nearly 2in., and has gained in cranial capacity 3½c.in. There has been no increase in width. The brain has gained in height and length—i.e., there has been a development of the upper and anterior parts of the brain, the parts which we should expect to increase by education and civilisation, as they preside over the moral and intellectual functions. The lower portions of the brain, in which the lower or more selfish propensities are centred, and which give breadth to the head, have, in the march of the centuries, failed to grow as rapidly as the higher brain centres, hence the non-increase in the width of our skulls.—*British Medical Journal.*

SCIENTIFIC NEWS.

ALTHOUGH the April meteors were watched for by, amongst other observers, Prof. Herschel, Mr. Denning, Mr. Backhouse, and Mr. Monck, few were seen, but some of them were of considerable importance. A notable specimen was observed by Mr. Backhouse and by Prof. Herschel, over Derbyshire, and the latter has estimated the beginning and end points to be as low as 50 and 46 miles respectively. Another observed by Mr. Denning and Prof. Herschel was estimated to be 76 and 60 miles above Monmouthshire.

The variable X Cygni forms the subject of a note by Mr. Yendall in No. 191 of Gould's *Astronomical Journal*. Its [character was discovered by Mr. S. Chandler in 1886; but its variability is something of a puzzle, the interval between minimum and maximum differing so much in length at various epochs.

By the death of Mr. John Thomas Crossley, at the ripe age of 89 years, the nation loses a man who was in his active life one of the most accomplished teachers. A pupil of Joseph Lancaster, he imbibed the true system of educating, as distinguished from cramming, and under his care what are known as "British" Schools were multiplied and guided by teachers who were trained under Crossley. His greatest success was probably his system of mental arithmetic, by which many of the boys at his model school were able to perform astonishing feats, and his work, "The Intellectual Calculator," had in consequence an enormous sale, passing through nearly a hundred editions. For many years Mr. Crossley had retired from active work; but in his home at Cheyne-walk he was always pleased to talk over schemes of education with his old friends and pupils.

The death is announced of Mr. Robert Damon, F.G.S., the well-known geologist, conchologist, and naturalist, on the 4th inst , at his museum at Weymouth. He was in his 75th year. Mr. Damon was a great traveller, having wandered all over Europe, and penetrated into Asia and Africa. He was the author of an elaborate work on the "Geology of Weymouth and District," and possessed one of the finest collections of shells in this country. He obtained a marvellous series of fossil fishes from the Cretaceous of the Lebanon, Syria, now in the British Museum, also a most complete example of the skeleton of the rare and now quite extinct sirenian, "Steller's Sea-cow," from Behring's Island. Some few years ago, when in Russia, he travelled from Nijni Novgorod down the Volga to Astrakhan for the purpose of collecting the fishes of the Caspian Sea. He lately purchased the celebrated collections forming the "Museum Godeffroy" in Hamburg. Mr. Damon's loss will be keenly felt by a wide circle of scientific friends all over the world, by whom he was warmly respected and esteemed.

Mr. William Wells, of Holmewood, Peterborough, died the other day, at his London residence, in his 71st year. Mr. Wells was elected on the Council of the Royal Agricultural Society in 1861, and chairman of the chemical committee in 1866, a position he held up till the time of his death. As a practical agriculturist, his name will long be remembered, especially in connection with the work he accomplished in the draining and reclamation of Whittlesea mere.

In his Friday evening discourse on "Aluminium," at the Royal Institution last week, Sir Henry Roscoe showed an enlarged photograph of a page of Sir Humphry Davy's note-book for October 19, 1807, in which are recorded the results of some experiments with the alkalies and alkaline earths previously supposed to be elements. The commercial production of aluminium had improved, Sir Henry Roscoe said, in the possibility of obtaining it in greater purity, in the rapidity of the processes, and in diminished cost. It could not be obtained, as iron was, from "ironstone" by melting, but a roundabout method had to be followed, and improvements in manufacturing the different materials employed in successive stages had helped in the production of aluminium. For example, in the reduction from chloride of aluminium, sodium is employed. This, in 1856, cost 4s. an ounce; now it is 4s. per pound, and is turned out in vast quantities at a rate far more rapid than a few years back. Some of the details of its production were described, and the lecturer passed then to the preparation of the chloride of aluminium from which the metal itself is obtained by the action of sodium. With regard to the cost of the coal employed in the processes, he said it must not be supposed that anything like London prices were paid—4s. per ton was the average. The elimination of iron and other impurities had been the subject of much study. Now a bar of the well-made metal would have only 1 per cent. Many of the uses of the metal were referred to. It could now, he said, be drawn into very fine wire, with a high breaking strain. Tubes of it have a beautiful sound when struck, but as yet it had not been successfully used for bells. Being so light, it was well suited for optical instruments, as it possessed great strength. In art metal work it had the advantage of being easily manipulated, and it formed a good surface for gilding.

The Rumford Medals of the American Academy of Arts and Sciences have been presented to Prof. Albert A. Michelson.

The Croonian lectures to be delivered by Dr. Lauder Brunton before the Royal College of Physicians on Thursday, June 6, 13, 20, 27, and July 4, will be on the "Connection between Chemical Constitution and Physiological Action." The lectures are delivered at 5 p.m.

Sir John Soane's Museum, 13, Lincoln's Innfields, will be open from 11 to 5 on Tuesdays, Wednesdays, Thursdays, and Saturdays in May, June, July, and August. Cards of admission for "private" days, or for students, can be obtained of the Curator at the Museum.

At the Royal Botanic Society's Gardens, Regent's Park, Mr. E. M. Holmes lectures to-day on "British Poisonous Plants," at 4 o'clock.

At the Royal Society, on May 2, a long paper was read "On the Spectrum, Visible and Photographic, of the Great Nebula in Orion," by Dr. W. Huggins, F.R.S., and Mrs. Huggins, which bears on a subject which has recently been much discussed in some scientific circles. In his "general conclusions," Dr. Huggins says, "It seems to me premature, until we can learn more of the significance of the new groups of lines, and especially of their connection with the nebular matter generally, or with certain condensed parts only, to express more than provisional suggestions as to the nature of these nebulæ. It may be that they represent an early stage in the evolutionary changes of the heavenly bodies."

In an addendum to a paper on "The Wave-Length of the Principal Line in the Spectrum of the Aurora" (*Proc.* Roy. Soc. Vol. XLV.), Dr. Huggins says: "After consideration, I think that I ought to point out that Mr. Lockyer's recent statement that 'the characteristic line of the Aurora is the remnant of the brightest manganese fluting at 558,' is clearly inadmissible, considering the evidence we have of the position of this line."

The cottage in which Alessandro Volta spent the summer and autumn months of many years in those studies which resulted in the discovery of the pile which bears his name has been secured as public property, and the little house in the village of Lazzate now has a tablet bearing an inscription of which the following is a translation:—"Alessandro Volta in this his modest and beloved house tested and completed the marvel of the Pile, the renovatress of science and industry, whence the country folk in their astonishment, and also in their gratitude for the American tuber [potato] he was the first to bring to these parts, called him the beneficent magician. The municipality and people, in recognition and in pride, erected this stone on the 22nd April, 1889."

A contemporary states that Dr. Eisenmann, of Berlin, has invented a piano which, by the aid of electro-magnetism, can sustain, increase, and diminish sound. This has been attempted by other experts, notably Boehm, the inventor of the metal flute. Another novelty will be that by moving the electro-magnets the timbre of the tone is changed; for example, from that of a violoncello to a piccolo.

An electrical standard laboratory has been established in Paris, with funds obtained from the profits of the 1881 Exhibition. M. de Merville is the director, acting under a consulting committee of ten. Meters of various kinds are tested, standard cells, insulation, conductibility of wires, and amongst other standardising work the photometric value of lamps. Special research work will be permitted to outsiders, and regular researches will be carried on by the staff when there are no instruments to test. For instance, Hertz's experiments are being repeated and verified. The laboratory is in the Place St. Charles.

Prof. Regnauld recently presented a note to the Academy of Medicine, Paris, in which he stated that chloroform, as an anæsthetic, possesses a marvellous power, but that it is not without danger, and under the influence of air and light is rapidly altered. As to the chloride of methylene introduced to notice some years ago, the researches of M. Regnauld have established that this product is merely a mixture of four volumes of chloroform with one volume of ethylic alcohol.

In Berlin a workman employed in a chemical factory having been told that sulphonal is a soporific, and wanting something of the kind for his wife, determined to try it on himself first. He took 30 grammes and slept for 90 hours, and after a short interval of wakefulness, slept again for 24 hours, without experiencing any ill-effects.

It appears, from the Report of the City and Guilds Institute, that the gross expenditure at the Central Institution was £10,242 18s. 5d., and the amount received from school fees was £1,725 8s. 3d.; but at the Finsbury Technical College the expenditure was £8,142 8s. 2d., and the amount received by fees was £1,908 5s. 6d. It is satisfactory to find that the number of candidates in the technological examinations continue to increase.

A fine specimen of the kite (Falco milvus) was trapped in Surrey recently. This bird, which seems to have been quite common in London itself about the time of Henry VIII., is now rarely seen even on the moors, though it is sometimes met with in Wales.

The fastest passage yet made between Capetown and Southampton has just been accomplished by the *Tartar*, the net steaming time being 17 days 10 hours 28 minutes—an average speed of 14·3 knots for the whole distance.

Hair Dyeing among Working People.—If current reports are to be believed, the practice of dyeing the hair is not merely the resource of a few sensitive persons, but has become somewhat widely popular, and is ruled by far more practical considerations than a wish to seem attractive. Working women, and even men, it appears, are given to decorating themselves in this way as a matter of necessity, and in order to earn their living. Grey hair looks aged, and suggests inefficiency; or perhaps it does not, for some other reason, satisfy the fancy of critical customers; consequently it is not in favour with employers. Hair dyeing has therefore become an established custom. Vigour, even youth, will not always excuse the defect, though, as is well known, greyness is in a multitude of cases no true sign either of age or of weakness. Such a state of matters may by some be condoned as being expedient. To our mind this is not enough. There must be something bad and unhealthy about a system which condemns an applicant for work on what is often a wholly deceptive point in personal appearance. Where grey hair is clearly a mark of senile failure the case is different. Rejection is often inevitable, though the facility of imposture by means of a dye proves the need of more efficient tests. The refusal of candidates physically capable on this ground alone is, on the other hand, simply a barbarity of taste. One can readily sympathise with persons thus virtually forced in self-defence to practise deceit. A variety of hair dyes are in common use. Lime, lead, ammonia, copper, nitrate of silver, and other matters enter into their composition. Their effect as local applications is far from innocuous, though most of those who use them know and care little about their specific actions. It is therefore to be hoped, for this reason also, that a sensible considerateness on the part of employers will render needless a habit the increase of which is equally discreditable to business custom, taste, and a reputation for honesty.—*Lancet.*

On the 20th ult. an interesting test was made of a small locomotive on a gradient at Peasley Cross Collieries. The engine has 12in. cylinders, 20in. stroke, 40in. wheels, and 140lb. per square inch maximum working steam pressure. It pulled fifteen loaded waggons up a gradient 1 in 50, and through a curve of 300ft. radius. The gross weight of the waggons was 180 tons and the engine 20 tons, the total weight moved being 200 tons. The engine was made by Messrs. Edward Borrows and Sons, of the Providence Ironworks, St. Helen's Junction.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

SATELLITES OF URANUS.

[29905.]—Je crois intéresser vos lecteurs et j'espère provoquer des observations de leur part en leur annonçant, avec un vif plaisir et un sentiment de vive reconnaissance envers Sir H. Grubb, que je vois, avec mon excellent huit pouces, les satellites Titania et Obéron d'Uranus. Il n'y a plus moyen d'en douter.

Louvain, 5 Mai. **Dr. F. Terby.**

THE WHITE SPOT ON SATURN'S RINGS.

[29906.]—I should like to be permitted to mention that, while Mr. With was viewing Saturn about 8 o'clock last night with my 8½ equatorial reflector, he easily detected the white spot, and pointed it out to me. It appeared of nearly a round shape close to the edge of ring B, where that is cut off by the shadow of the ball. I found that with the higher powers—200 to 300—the marking became more apparent, and during moments of best definition the contrast of its colour to that of the rings was evident.

It now appears very improbable that it is only an optical illusion; and, taking all the circumstances into consideration, are we not more justified in regarding it as another real addition to the many other anomalous features of Saturn?

Perhaps I ought to state that the speculum in use was one of Mr. With's own make, only four of which, I am given to understand, he has now left.

Hereford, April 30. **G. Parry Jenkins.**

SATURN.

[29907.]—I examined Saturn on April 29th to see if the white spot would be visible in my 3¾ Wray. After considerable scrutiny, with difficulty, I detected a bluish elongated appearance on the edge of the shadow of the ball; but, till I saw Mr. Elger's sketch in the "E.M.," was inclined to think it only fancy.

If a marking, ought not some motion to be visible? Can it be a refractive effect of atmosphere, after the nature of a mock sun? Definition was good, as I saw 17 (2) and θ (3) Virginis with e.p. 105; O and P. XI. 126 Virginis with 172; also the *p.* star of the Debilissima was steady, the other fainter, and 42 Herculis was visible with 320. It is curious that this star is single, to me, with any less power, while some of the others become invisible if much more power than that given is used.

Reading. **G. T. Davis.**

VENUS.

[29908.]—I observed Venus on every available occasion for two or three days before and after conjunction, and had many very goods views of the beautiful hair-like crescent, when the sun was behind a cloud-bank and the planet in clear sky. As the planet neared conjunction the illuminated portion appeared of a light coppery tinge. Is this an illusion, or have any other observers noticed it? Inst. 5⅛in. o.g. by Grubb, power 100 and 170.

Austwick Hall, May 4. **T. R. Clapham.**

LIGHT—THE CORONA AND AURORA.

[29909.]—Two explanations of the corona, or luminous appearance which surrounds the moon in a total eclipse, which have been offered may be here noticed. The first is that it is due to the light of our own atmosphere caused by the sun; but, as has been observed in the excellent letter (29815) bearing the pseudonym of "Sympathiser," the law of brightness observed is totally different from what it would be on such a supposition. Anyone who can draw a figure representing an eclipse will easily satisfy himself that this is so. From any point on the earth's surface where the eclipse is total, draw a line touching the moon. It will be found to be wholly within the umbra, and therefore as it passes through no portion of illumined atmosphere, to an eye looking along it, there will appear the total darkness in the immediate neighbourhood of the moon.

2. Another explanation is that it is due to solar atmosphere, and this no doubt is in part true, though the corona seems to be too extensive to be thus accounted for entirely. For the comet of 1843 passed the surface of the sun within about a seventh part of the sun's radius. What sort of atmosphere can it be, if a comet could dash through it at a speed of more than 300 miles in a second, and be so little affected by it as it seems to have been.

2. There is yet a third supposition to which it may in part be due. According to the undulatory theory, all space is pervaded by a medium to which we give the name of "æther," and this æther is in a state of vibration, and since everything whatever—solid, fluid, our own atmosphere, or anything else in a state of luminous vibration—produces an effect upon the eye, it is evident that this must do so likewise—that is, it must produce a luminous appearance. Also, since whatever be the law of density, the vibrations are much greater in the neighbourhood of the sun, an eye looking in a given direction will always see more light in proportion as the direction is towards the sun—that is, the light will fade away as we recede from the sun.

In connection with this may be mentioned the substance seen as the Zodiacal Light. If this is an envelope surrounding the sun, it ought to produce something of the same effect as above—that is, give a much greater light in the sun's neighbourhood than elsewhere. Whether it does so or not, and gives a light continually decreasing, I do not know; or whether its appearance is such as to be consistent with its being a *ring nebula*—rather thin, and extending nearly to the sun, and seen better at some times than others, owing to the visual line passing through a much greater portion of illumined stuff—I cannot say. It may contribute something to the corona; but owing to its faintness, &c., probably not much. If the above view is correct, some consequences will follow from it.

1. If there is a narrow corona due to the sun's atmosphere, and a wider one due to the æther, perhaps attentive observation may show that the light begins rather more suddenly to fade away than if it were due to one cause only.

2. When the activity of the sun is the same all over its surface, the brightness of the corona will be the same at all points equally distant from the sun, as far as it is due to the æther and sun's atmosphere, but not otherwise. The activity is greater in the neighbourhood of the sun's equator, and so the corona may perhaps sometimes be seen to extend further in the direction of the equator than elsewhere. Perhaps one of our readers, as "F.R.A.S." or "Sympathiser," who know better than I do what has been observed, will kindly say whether either of these two last has ever been noticed?

3. The aurora, seen just before sunrise, when the sun is hidden by the earth's limb, will be a segment of the same object as that seen in an eclipse when it is hidden by the moon's, except that the atmospheric illumination will be very different in the two cases.

4. According to the undulatory theory, the æther spoken of above is assumed to exist; but if our view is correct, it will be actually seen in the corona and aurora. **W. G. Penny.**

PHRENOLOGY.

[29910.]—"F.R.A.S." will find the engraving of a photograph of Piggot in the special number of the *Graphic* on the Special Commission. If the person who examines a photograph is practically acquainted with the parts and points of the human skull, he will be able to measure the head so far as the relative size of the lower and upper parts by drawing the two lines which I described in my letter (p. 133). Whether the view is a three-quarter side or a full view, the angle to which he refers has nothing whatever to do with measuring the head above the line drawn from the centre of ossification of the frontal bone. "Glatton's" sketch shows a head which is not level, but leaning forward; his lines C and K are not properly drawn. The phrenologist does not measure the neck: he places the head level, then draws the first line through the opening of the ear. He will find a reply to the rest of his questions in the following answer to "Cymro."

"Cymro" will not learn everything required to examine and measure the relative proportions of a person's head in a day, any more than any person could learn the practical part of a mechanic's work in a day. But in reply to his questions, which are evidently the result of a desire to learn and of honest doubt, I may say that the head must be placed level—that is, as the person fixes his eyes on some object before him there will be no strain or pressure on the optic nerve or the eye. To do this correctly requires some practice and observation. 1st. Draw a line through the opening of the ear. 2nd. Draw another line parallel to the first one, commencing at the centre of ossification of the frontal bone. He will require som[illegible] with a knowledge of the skull to point out these centres to him; but having had them shown to him, a very little practice will enable him always to find these points afterwards without making any mistake. The line through the opening of the ear may come below the wing of the nose or above it, just as the person has a long or a short nose, &c. In measuring the mind power of a person, we measure the relative size of the parts, not the whole head alone. In measuring the size of the top head we compare it with the size below the line drawn from the centre of ossification of the frontal bone, so that the comparison is, as "Cymro" says, between what is below and above. The two vertical lines on the sketches which I sent are drawn from two points of the skull which exist upon every skull—the mastoid process behind the ear, and the centre of the zygomatic arch along the side of the face some distance in front of the ears, these points always come opposite certain parts of the brain. The length of the brain in front of the line from the centre of the zygomatic arch, compared with the rest of the brain, will give a measure of the intellectual powers, whilst the size of the head behind the line drawn from the mastoid process is a measure of the social nature of the person.

The phrenologist also takes into consideration temperament, health, and, above all, quality of organisation, to do which "Glatton" will see it requires not only a great deal of training, but close study, and, above all, a great amount of observation. What he says about idiots is quite true, because there are different kinds of idiots, as well as different causes of idiotcy. A little practical training and observation will soon teach a person with good observing powers how to tell who has a thick, coarse, spongy skull, and one who has a thin, finely-knit one. A person can no more learn how to examine a head by what can be said in a letter without some practical teaching, any more than I, who have been a reader of our English Mechanic since it started, could ever make a mechanic without going into a mechanic's shop to get a knowledge of the physical thing to be found there; and I am sorry to say the reason why many intelligent and educated practical men turn away from phrenology is that they have met with so many humbugs pretending to practise something for which they had neither the training nor ability, without which it would be just as impossible to make either a good mechanic or a judge of phrenology. I am always pleased to meet people with honest doubts or inquiring minds, and for such allow me to give a list of works where they will find a full description of the science of phrenology and how to practise it, also answers to the questions which will occur to their minds:—Dr. Spurzheim's "System"; Combe's "System of Phrenology"; "Phrenology, and How to Use It," "The Skull and Brain," both of the two last by N. Morgan, of Sunderland; "Phrenology made Practical," "Crimes and Criminals," by F. Bridges; "Phrenology Illustrated and Applied," by C. S. Fowler, also his last work, "Human Science"; "Lectures on Man," by L. N. Fowler. Yet I would say, Remember a well-read man is not always a practical man; you must practise phrenology to prove it. **Mark Moores.**

Exchange Rooms, New-street, Birmingham.

ORGAN NOMENCLATURE.

[29911.]—I had sketched out a short letter in connection with the above, but did not post it. But I see Mr. Audsley has exhausted the subject by giving a digest from the best available sources; and as he desires to know my views, I gladly give them. It must be accepted that the spelling in the time of the older masters of the "art" was not quite as perfect as nowadays, for we find "waynscotte" and "mettle," and similar renderings; hence we can assume that "Ged*ackt*" or "Ged*ackt*" may just as well have been wrong in its orthography. The word undoubtedly is derived from "decken," to cover with a lid, as the first closed or covered diapasons were *covered on the top by a lid* soldered down, and were tuned by ears, and later on when the ears were dispensed with, and *sliding caps or lids* used to tune by, the term was more fully exemplified, as the closing then was similar to lids of canisters, but deeper on the rims. The construction altered again by the "half-closed" systems, or "Röhr" (German for "reed"); hence we got the "Röhr Gedeckt," or "Reed closed," similar to what is known as the "chimney" stopped diapason (French, "flûte à cheminée").

The verb "deck" in English further confirms this, as "the fields were 'decked' with flowers"—i.e., covered with flowers. Similar quotations are very often met with in the old authors. The incorrect spelling of very many names in the organ line may be attributed mainly to the habit people have of taking the statements of builders or others for granted. No inquiry ever seems to be made to test the truth or correctness of the subject—*precedent* in very many cases seems to lead people—so that if A. pronounces or spells incorrectly, B. does so in order not to disagree with him, as he has not the moral courage to use the intelligence he may be possessed of to express his views. It is a fact in the organ *trade* that *precedent* in every thing *once* ruled the day. Any attempt to inquire into the "mysteries" of the *internal* portion of an organ was repulsed by a constant fear of encroachment, and a dread that the simplicity of the matter might become apparent, and the enormous prices knocked on the head. Some few years ago I worked for a gentleman who kept a music establishment and taught several instruments, and I was asked what dimensions a small organ would need to be with a certain number of stops. He wrote as follows :—

GRATE ORGIN.
Open dipason.
Stop do base.
Claberella trible.
Principle.
Picola.

SWELL ORGIN.
Stop dipason.
Gamber tenner C.
Gemshorn.
Oboy tenner C.

PEDDLE ORGIN.
Bordoon 16 fete.

CUPPLERS.
Swell to grate.
Swell to peddles.
Grate to peddles.

3 COMPISITINS TO GRATE.

Now, if in these years of education and enlightenment such errors as these occur, it is excusable to look over the errors of the earlier builders, as to a certain extent they *were builders*, not men of letters.

As to the prefix "Lieblich," I am of opinion that it is out of place, and in very many cases foreign to the implied quality of "lovely toned." One would prefer to leave the public or experts to apply such terms, if in their opinion they were deserved; one might as well say "lovely" head of So-and-so, by So-and-so, in describing a portrait for a catalogue, as indeed the registering on the stop-knobs is simply *cataloguing* the pipes for the use of the players.

I have read Mr. Audsley's notes on nomenclature *three times over*, in order to try and find out a loophole whereby one might reasonably thrust in an objection, and I found none. But I wish he had extended it, as his acquaintance with foreign names has cleared up a lot of error by explaining their origin. **Wm. Robinson.**

ORGAN MATTERS.

[29912.]—I HAVE carefully read all Mr. Audsley's papers and letters on organ matters, and have derived a large amount of valuable information from them. I intended to begin the erection of a really first-class chamber organ some months ago, and Mr. Audsley was kind enough to give me some information through your paper; but circumstances occurred that prevented me putting the work in hand at that time. Now I am ready to start, and intend following Mr. Audsley's arrangement of twin swells, as described in his "Notes on the Chamber Organ." I propose having 15 stops, divided between two manuals, say, 5 on the upper, and 10 on the lower, the pedal department having a bourdon (wood, 16ft.) and violoncello (zinc, 8ft.).

Will Mr. Audsley kindly give me a specification for the 15 manual stops which will thoroughly carry out his ideas? I am sure such a specification would be greatly appreciated by all your readers interested in organ matters. As there is so very great difference in tone-colour of stops of the same name, as made by various makers, it would be advisable if Mr. Audsley will give the scale, material, and a short description of each stop he specifies.

Mr. Dixon's scheme for a 50-stop chamber organ is altogether out of the question for any house of ordinary size, or, indeed, of extraordinary size. For chamber use I think Mr. Audsley will agree with me in the opinion that all the requirements of chamber music can be obtained in a properly-schemed organ containing from 15 to 20 *speaking* stops, and as this will always be the popular size, I trust he will kindly favour me with the specification, for which I shall be very grateful.

G. Landell.

[29913.]—THE bad taste of Mr. Michell's remarks on the works of a builder, whose shoe-latchet he is not worthy to unloose, needs no comment from me.

I do not for a moment suppose either Mr. Roosevelt or Mr. Crosby will treat such spite with anything save the contempt it deserves, for they will well know its source. I suppose Mr. Michell thinks he hits me very hard in his last letter, especially where he says: "Mr. Audsley will not succeed as an amateur in persuading intending buyers to pay the increased cost which his ideas involve, besides the commission which he disinterestedly charges for his advice." Notwithstanding the potency of the covert sneer, the blow falls harmlessly, and it is even comforting to one's *amour propre* that so distinguished an authority gives me the credit of having any ideas at all; and as regards the latter part of the quotation, I need only say that when my professional services are engaged in connection with any organ, I trust I shall be more fortunate in being paid than I have been in connection with such work done for Mr. Carlton C. Michell.

I may say in relation to the organ for the Church of St. Barnabas, that had it not been for my personally introducing his *confrère*, Mr. W. Thynne, to the talented clergyman alluded to, under my own roof, and my special expressions of admiration for his talents as a voicer and tonal colourist, Mr. Michell would have had nothing to do with the St. Barnabas organ and some others that I might mention. I can prove this, if Mr. Michell still essays to distort the truth, by a letter in my possession.

Mr. Michell is very mysterious in his remarks about the "would-be critic in the picture-gallery," and I am free to admit that for once he is too profound for my poor comprehension. He adds, in the next paragraph, "Mr. Audsley very much admires *my* means; he says the colours are fine, and, forsooth, the framework too." May I ask him (although, doubtless, in this case, as in that of the pointed question in my preceding letter, I shall receive no answer), what are *his means?* I must plead entire ignorance of them. So far as my knowledge and powers of observation extend, I have attributed the beauty of every organ which I have heard, which bears the name-plate of the late firm of Messrs. Michell and Thynne, to the remarkably fine quality of the voicing of its stops; and I know every flue-pipe therein has been the work—and the work alone—of Mr. W. Thynne, whose special talents in this direction I have more than once recognised in these columns. But it occurs to me that Mr. Michell has so long used the "I" and "my" that he has forgotten his *confrère*, Mr. Thynne, and it is greatly to be regretted that he systematically ignores that gentleman in all his letters. Fortunately, however, the respective merits and talents of the two gentlemen are well known to the organ-building world, and need no remarks of mine. Mr. Michell's advice is "Compare for yourselves, and then give honour where honour is due." So say I.

Devon Nook, Chiswick. **G. A. Audsley.**

PSEUDOSCORPIONIDEA.

[29914.]—I AM glad I am not responsible for the "octosyllabic" heading, as I only use it because I find it on p. 196; but I may just say that I can confirm the remark as to the chelifer being parasitic. I have never looked for the creatures specially; but I once found a specimen with bright-red claws firmly gripping the upper part of the leg of a large "meat-fly" or "blue-bottle," I forget which.

A. S. L.

[29915.]—I HAVE frequently looked in entomological and microscopical works for some reference to the above-named parasites, but the interesting letter of "Appendiculata" is the first mention of them I have seen. He says "Some are said to be parasites on the common fly itself." It was in this connection I first became acquainted with them, some ten years ago, in a school-room at St. Helier's. Observing a fly which, though on the wing, seemed clumsy in appearance, slow in its gyrations, and observing frequent intervals in the dance, I caught it, and found it was clogged at the junction of the hind legs with the body with two of these beauties. I recognised their portraits at once —each held a leg in one of its lobster claws. The fly seemed utterly at their mercy and quite powerless to get rid of them, while the mechanism of their forceps suggested that it was much easier for them to hold on than to loose. I detached one of them for closer inspection, when it seemed perfectly helpless and useless; but once put near its victim, appeared to fall into place without effort. I forget whether the root of the wing was not also infested, but have some idea that it was. I could find no other fly similarly afflicted, and have not seen one since. **H. Marle.**

CATASTROPHES AND COMETS.

[29916.]—WHY any reader should care a button to know what such philosophers as Aristotle or Volney guessed about mythological legends I cannot conceive; but anyone desiring such information will not get it from "F. W. H." (p. 196), whose letter (29887) has only statements all misleading. None of the nations named had any tradition of a past "conflagration" of the world. Each knew of one great world-wide deluge, but only one. The Greeks partly confused their tales of this, the Flood of Deucalion, with those of a later partial one, that of Ogyges. The Egyptians alone, in classical times, were taught by their priests that their country had been exempt from the general Flood that drowned all others. The Indians have no such name as "Xisuthrus," which is only Berosus's spelling of the Chaldean hero corresponding, as to date, not with Noah, but with his grandfather Methuselah, but to whom they gave also the chief marks of his father and grandson. Like Enoch, he is taken up to the gods without dying, and, like Noah, he builds and saves mankind by his ark; but, like Methuselah, he was the first antediluvian ruler or pope, and ends his reign and life in the very year of the Deluge. The most delusive error of "F. W. H.," however, is that of each nation having dated their general Flood—this in one centenary or millennary, that in another. On the contrary, all who fixed its century have done so to one identical century—nay, even one identical year. This is so with the Indian tradition, that of the Parsees, and that of the Arab Abulhassan Kuschiar, chosen by Sir J. Herschel as the only one to quote in his chronological table. ("Outlines," Article 926.) This Arab's figures very likely depended somewhat on the Biblical ones; but the Zoroastrian and Brahminic are distinct and independent, both of the Bible and of each other. Yet all correspond to the exact year of one of the five possible readings of Genesis; and this date, 4990 years ago, agrees the best of any with the physical testimony of the alluvium everywhere, that it has not been so many as 60 centuries, nor so few as 40, since the last gravelling, nor, indeed, with any probability so many as 55, nor so few as 45.

Nobody imagines, as "F. W. H." would suggest, special comets "for each and all of" the floods erroneously dated, because even the believers in each of them make that one the only one in human history. The geological facts also tell of only one since there have been men—or flint weapon makers. They tell of plenty of earlier and greater catastrophes, involving more or less of deluge; and doubtless a good many comets did fall and produce those. They may have been watery alone, or more likely have contained other matters besides. That a body of water, even alone, should exhibit the phenomena presented by most of the comets of which the apparition has been recorded, no physicist with a name to lose has ever called impossible, or would ever pretend to know whether it were so. Sir J. Herschel and Zöllner held the contrary as probable, that aqueous masses in space, even with no other matter, would present the usual cometary features. **E. L. G.**

WATER MOTORS.

[29917.]—THE differential gear described by "F. A. M." in letter 29898 last week was designed by me some four or five months ago for the purpose of driving potters' wheels; but upon trial we found it to answer so well that, with some modification, I decided to apply for a patent for it, and I did so on Dec. 13, 1888. **W. D. Sandwell.**

Victor Engineering Works, Victor-road, Holloway, London, May 3.

INTELLIGENCE IN LOW FORMS OF LIFE.

[29918.]—THE following may interest your readers, as the facts appear to prove "intelligence" in animals very low indeed in the scale of life—animals without brains or nerves.

While examining a large collection of Brachionus rubens (a fresh-water rotifer), I observed a lorica, the proper contents of which were replaced by an infusorian which continually rotated. The infusorian was ciliated all over, and had besides only a contractile vesicle and nucleus. When swimming, which it did rapidly with a circular movement, it was spindle-shaped, but capable of great change in form. The contents were for the most part clear, only a little granular at the rear end. A few days after I found that most of the rotifers contained one of these guests, some of the rotifers being alive, although partly devoured. Very soon the attack was seen. The infusorian began operations by turning itself slowly and gentle round the rotifer's foot for a time, and then rapidly. This appeared to cement the rotifer's foot to the glass. The rotifer now lashed about with great vigour in its vain efforts to escape, but was not able to swim away. The enemy was repulsed many times, and thrown to a distance, but returned to the attack. In about half an hour the rotifer became exhausted, and the infusorian got through the opening in the lorica from which comes the rotifer's foot. But the infusorian being very much larger than the inlet, the following device was resorted to :—The front part of the infusorian was contracted to a mere ribbon, the contents of the animal cell being pressed into the back part, so forming a globe. The ribbon was now easily inserted into the lorica. Then the contents of the globular part, which were before outside the rotifer's lorica were injected into the ribbon, so reversing matters and transferring the bulk of the infusoria to the inside, and leaving only the "ribbon" outside, which was easily drawn in. The infusorian now assumed a globular form (with, for a time, a tongue-like protrusion), and rotated constantly. The rotifer's intestine first disappeared, the brain and eye last. The rotifer's cilia moved rapidly for quite half an hour after the entrance of the enemy. Having devoured the rotifer, the infusorian divides into two or four new animals (within the lorica), which animals are exactly like the parent, only smaller. The rotary movement continues during the time of division. They escape through the top of the lorica and swim away swiftly to seek fresh victims. I have not seen this infusorian attack any other animal or feed in any other way. I have seen the above take place twenty or thirty times; the mode of attack and the result was always similar, except that once or twice the rotifer did manage to break away. During the attack the contraction and dilatation of the infusorian's vesicle were very rapid. By the way, in the same collection were Natholca acuminata, and also a form exactly like Hudson's Natholca scapha, which last he considers to be a marine form only.

Will some of your readers kindly call Dr. C. T. Hudson's attention to the above?

It must be remembered that Brachionus rubens is a strong and rapid swimmer, and swims away when irritated. **R. P. Grace.**

TELESCOPES AND OPTICS.

[29919.]—The further information kindly given by Mr. Linscott is just such as makes me feel very forcibly my partial deprivation of sight. It has long been my desire to make (and get others to make) a full and fair comparison between the different forms of reflectors, both ancient and modern; and I have from time to time tried to obtain correct information on the subject, and have also done what I could in the matter myself by testing and comparison.

The mattes has two aspects—viz., the perfection attained in the case of old mirrors as compared with old object-glasses, and the relative efficiency of old mirrors when compared with modern ones.

Dealing only with the latter, I see that Mr. Linscott remarks on the accuracy of the curves which the old workers attained; and the fact of the 15in. Cassegrain mirror being of the true form required (viz., elliptical), would seem to confirm this.

Then comes the curious fact that the mirror was also intended for use as a Newtonian; but if the maker of the telescope was aware of the necessity for working the Cassegrain mirror to an ellipse, how was it he did not know that such a curve was useless for a Newtonian? Again, if, as appears to have been the case, the small mirror was always worked to a spherical curve, and the large mirror worked to suit it, how could the large mirror's figure be adjusted to suit two or three small mirrors of different radii of curvature, and therefore having different degrees of aberration? Yet every old Cassegrain and Gregorian had its set of two or more small mirrors as well as its set of eyepieces.

Very few indeed of these old mirrors are now to be found in their original state, as their owners have generally either spoilt them themselves, or had them spoilt, by repolishing, so that it is not easy to find out what they were capable of. Some few, however, have come under my notice, and I have found that, as a rule, the figures of the large mirrors were most peculiar, with usually a good deal of dishing in round the central hole, and of rounding off of the margin, and I believe Mr. Wassell has found the same thing. How, then, could such queer figures have borne such high powers as we read were applied to them? Had my sight not failed me, I had intended to have had experimental mirrors worked to different curves, their figures carefully tested, and their forms registered —this being done in the case of both the concave and convex mirrors. It would then have been a most interesting series of experiments to have noted the effect of combining these curves in different ways.

Unfortunately, our talented correspondent never carried to a practical conclusion his series of articles on the theory of mirrors, or Mr. W. Bradbury would, no doubt, have been able to indicate precisely how to calculate what amount of aberration each zone of the large mirror should show in order to obtain the requisite correction for that of the small mirror.

I had hoped, too, that Dr. Royston Pigott would have told us a little more of what his (modern) Cassegrain would do as compared with a Newtonian; but though he *spoke of its excellence*, he virtually failed to *tell us what it would do*.

A. S. L.

ROSE ENGINE.

[29920.]—The English *Cyclopædia*, dated 1861, under the head of "Turning," says: "Two superior machines for engine turning were invented by Messrs. Perkins and Heath some years ago, in which the rosettes are dispensed with, and their place supplied by an eccentric wheel or cam which produces one wave only; but, by means of toothed wheels, as many of these waves as are requisite are introduced during each revolution of the mandrel. This engine produces an immense variety of patterns with the very great advantage of all the waves being exact counterparts of each other."

I think these machines would have been suitable for making rosettes, and possibly might be those mentioned by "C. C. E." on page 481, last volume. Messrs. Perkins and Heath used them in connection with the note-manufacture for the Bank of England. In the same publication, under the head of "Engraving," a "Universal Rose Engine or Guilloche Machine," by F. C. Wagner, Berlin, is described as follows: "This machine has, besides the guilloche apparatus, an eccentric apparatus connected with two eccentric, an oval, an angle, and two radiating apparatuses; an apparatus connecting the guilloche and centric apparatus, an apparatus to produce spiral wave lines in every different shape, and a volute-like apparatus. These all admit of being used separately, or in combination in so many ways, and their separate or combined employment can be so variously modified by the distinct motions of the carriages, &c., that a practically unlimited number of patterns can be produced, comprising an endless variety of curved, waving, and spiral lines, drawn with mathematical precision." "The machine," observes Mr. Henry Bradbury (who has the exclusive possession of it in England), "is set in motion by means of levers, tooth wheels, and handles, by which the motive power has no influence whatever upon the correctness and delicacy of the patterns — properties infallibly guaranteed by the arrangement of the machine. Owing to this simple manipulation, the entire attention may be concentrated upon the composition of patterns, offering a boundless field to the inventive spirit. In spite of the many apparatuses and actions which combine to constitute the guilloche machine, the management of it is very simple. All the portions remain in constant connection with one another, and may, by means of arrangements of a very simple character, be immediately set in motion or stopped. The machine itself is a singularly elegant piece of mechanism, and unlike earlier engraving machines, it occupies a comparatively small space."

I was for two years the possessor of a rose-engine lathe with reciprocating motion, &c., similar to Mr. Maclean's No. 2, p. 488; but like "F. A. M.," could not get any information, and failed to get any result that, in my opinion, was worth the trouble and expense. This, of course, is a confession of incapacity on my part: but I disposed of the ponderous machine without regret. I tried to get information from a watch-case maker, who had one similar to that described by "F. A. M." on p. 11, but he did not understand anything beyond case work. I strongly advise "F. A. M." to investigate the capabilities of the "Rose-Cutting Instrument," if he has not already done so. With regard to Wagner's Universal Rose-Engine, I would particularly like to know where further information about it may be found. "J. K. P." and Mr. Maclean are sure to know something.

Cape Town.

THE HAYDON CUTTER-BAR v. CARRE'S SOLID TOOL.

[29921.]—The Rev. Fred. Carre cannot see the point of my statement that I had turned up a 4in. face-plate with a Haydon cutter-bar in a 3in. lathe without back-gear, owing to my omission to state the depth of cut taken.

F. C.'s original statement (letter 29694) was: "I do not think it (the H. bar) can be compared at all with a properly-formed solid tool in the amount or character of the work it will turn out."

I should have thought that both "the amount and character" of the work turned out by the H. bar would compare favourably with that of the solid tool, when we take into consideration the grinding which is required to keep an edge on a tool turning cast-iron at a high speed. Grinding a solid tool is not by any means an easy job, whereas grinding the H. cutters is as easy as A B C—when you know how; and a supply of them can be ground beforehand, and the bar need not be taken out of the slide-rest; the solid tool has to be readjusted for height after each grinding, and cannot be ground many times without reforging. Perhaps F. C. can do this for himself; but not many amateurs can, though anyone worthy of the name can file up and harden a cutter for the H. bar. All these things influence the "amount" of work turned out. As to "character," it has been stated over and over again that, with the H. bar properly ground, a surface can be produced which even a touch with glass-paper would spoil, and I don't see how a solid tool could do better.

It would be absurd to compare the cut taken in a 3in. lathe running at high speed with that taken in a 5in. back-geared, but I find that I can, with a cutter only $\frac{5}{32}$ square, take a cut $\frac{1}{32}$ deep in wrought iron, and rather more in mild steel. I have not broken a single cutter since I learned to grind them properly.

I am, unfortunately, unable to avail myself of F. C.'s valuable hint about standing up, &c., but I can turn iron and steel with perfect ease sitting down with the H. bar.

Having done what I can to explain to F. C. the "point" of my statement about turning the 4in. face-plate, perhaps he will, in return, explain the "point" of the following sentence, which appears in his first letter on this subject:—"By some interested parties I have been sought to be persuaded that my bar is not the correct make. It has not the mark, without which, in the true quack self-advertising style, it is nothing more than a worthless imitation."

It has just struck me that perhaps F. C. has a solid tool of so superior a design as to account for his preference. I remember he once sent a drawing of a tool which struck me as novel, and which, no doubt, is the one he has been comparing with the Haydon bar, to the latter's disadvantage. Will one of our authorities on turning—"J. K. P.," "F. A. M.," &c.—refer to this drawing (Vol. XXXIX. p. 369), and tell us what they think of it? Perhaps "O. J. L." would give us a series of papers on the "Carre Solid Tool," as he did on the H. bar in Vol. XLI.?

F. C., as a parting word, kindly gives timid mechanics leave to flood the "E. M." with their communications, but follows it up with the dreadful threat of taking no notice of them. But can we readers of the "E. M." absolve F. C. from the self-imposed—though undoubtedly painful—obligation of pointing out our mistakes in theory and practice, and of protecting us from the insidious advances of "interested parties" and "quack self-advertisers" which he has discharged with so much credit, delicacy, and good feeling for several years?

The "E. M." would be dry reading, even though flooded with the communications of ordinary mechanics, should anything happen to divert or dry up the refreshing stream which has for so long trickled through its pages from F. C.'s vast reservoir of mechanical knowledge.

April 31. **A. H. S.**

CUTTER-BARS.

[29922.]—For a great many years I, as an amateur metal-turner, have been using Willis's tool holder or cutter-bar, described and figured at pp. 996, 7, 8, and 9, of Holtzapffel's second volume, and referred to by "R. R. N." in his letter 29873. I find it preferable to any other bar I have tried. In my practice I use for forming cutters short pieces of triangular files, which are softened, shaped, and rehardened.

The greatest attention must be given to the shape of the cutter, and to its being kept in the best order by the grinding-stone. Unless this is carefully attended to, the kind of bar or holder will, of itself, be of small importance.

As to the shape of the cutter and the top and bottom rake necessary to be given to it, Prof. Robert H. Smith gives a most instructive chapter in his excellent work on "Cutting Tools."

The superiority of cutter-bars with detached blades, over tools forged in the solid, for all moderate-sized work, must be very obvious to every one who has given them an intelligent trial. In the year 1885, the City and Guilds of London Institute for the advancement of technical education, had the following question in the Honours grade:—"Give particulars of the tools and cutter-bars used in the slide-rest for different metals, with the essential points in their forms and cutting angles." **R.**

[29923.]—I should not have troubled you again on the cutter-bar question, but that Mr. Carre constantly asserts and now endeavours to say also with my assent (which is incorrect), that Haydon's cutter-bar is only suitable for light cuts.

I now inclose you a few shavings of steel I have picked up below one of my lathes using a Haydon's cutter-bar. You will find these shavings $\frac{5}{16}$in. wide and more than $\frac{1}{32}$in. thick, which I think amateurs at least, will concede is not a light cut.

Edward Hines.

PERSPECTIVE DRAWING.

[29924.]—The method proposed by "Glatton" for perspective drawing —viz., "hold your pencil parallel with the line (or set of lines) you wish to represent. Look along it, and the point where it would, if prolonged, strike the wall, is the vanishing point," is a most valuable suggestion. I discovered it myself about 18 years ago, and have constantly used it. Some 10 years ago I reduced the method to writing, intending to publish it; but the publishers to whom I transmitted it did not care for the venture. I have got the MS. now, and merely write this in order that, if it should ever appear, "Glatton" may not think I have appropriated his ideas, than which nothing could be more mean or ungentlemanly. **Henry Cunnynghame.**

Hurlingham Lodge, Fulham.

THE METRIC SYSTEM.

[29925.]—"Ponto's" idea (letter 29875) of the metric system may do only in so far as figures suit to form a simple decimal fraction.

How would he proceed to make the following question easier by converting all the terms into decimal fractions, than by vulgar fractions?

A certain amount gives £3 17s. 6d. at 4½ per cent. What would it give at 3 per cent.? And besides, supposing instead of £3 17s. 6d. he made the amount £3 17s. 7d., or any amount that gives many places of decimals?

It is all very well to take figures that are suitable to put into decimals easy and quick of calculation; but take random figures. Of course the principal may be put into decimals, provided there are not too many places of decimals and no repeating decimals; but in the question I have put, although the amount will only go to three places of decimals, yet it is better to multiply this by two-thirds than by an indefinite number of sixes. In the former you can arrive at the correct answer; but in the latter only approximately so. In many cases it is better to find the principal and make a new calculation. **H. L. Wraith.**

DRY-AIR PROCESS.

[29926.]—Can any of your readers give me information about the process of drying with great rapidity by means of cold dry air? I want to apply it to the drying of small articles in which the colour is apt to run unless dried very quickly. How is the air dried and chilled, and how applied?

F. W.

HINTS ON CLEANING AND BLEACHING PAPER, PRINTS, &c.

[29927.]—The following methods will be found to remove stains of nearly every description from white paper. I have before me now a number of old plates obtained from the *Gentleman's Magazine*—they had been very badly used by a large colony of cockroaches. After being rubbed with bread and then bleached, they are probably better-looking and whiter than when first issued by the printer.

To begin with, if the paper is blue, it is best left alone, as it is sure to turn out mottled when finished. The plate or sheet of paper should be spread on a few thicknesses of clean paper laid on a level surface. The dirty surface should be rubbed with a piece of crumb of stale bread; the bread should be old enough to roll into small grains, and blow off from the part which is being cleaned. Great care should be taken not to use sufficient pressure to injure the surface of the paper, as, of course, in that case the printer's ink will be removed also. This process will, in many cases, give such good results, as to do away with any occasion for further treatment, as it removes all purely surface stains.

Grease stains may be removed by one of the following methods. If the stains are excessive, place folds of absorbent paper on each side, and patiently remove as much as possible with the help of a warm iron; if too strong a heat is used, the paper will be scorched. For smaller stains use French chalk and patience. The chalk (in a very fine powder) is applied with a pellet of wool, covering the greasy surface with just so much as will stick to it. After a few hours this should be lightly brushed off and a fresh supply put on. This is a very effectual mode. Chloroform, benzine, ether, spirit of turpentine (this latter should be the kind prepared for internal use); benzolene, such as is used for illuminating purposes, is an excellent grease remover when it has been purified by treating with sulphuric acid (to remove tarry matter), and subsequently washing with pure water and carbonate of soda.

Benzolene can never be used for cleaning purposes in the state in which it is sold; the contamination of an oily measure is quite sufficient to spoil it. Turpentine, chloroform, and ether, as well as various alkaline solutions, must not be used on a printed surface, as they will "start" the ink.

Coloured stains of small size are best removed by painting them with chlorine water, or chloride of lime solution (the former is preferable). A small camel's hair brush should be used, and the fluid applied sparingly.

It should be borne in mind that the stain may take some time to disappear; paint the stained surface and leave it for a time. When the stain has vanished, wash the part with pure water with another brush. Sometimes the surface (if smooth) will be made more like the rest of the leaf if it is "hot-pressed" between two sheets of highly polished paper.

Damp-stains, mildew, and marks of a similar nature must be removed by the following method. Place the sheet of paper on a clean sheet of glass (so as to be quite smooth), stand it under a tap with a slight stream of water; incline the plate in different directions so that the water may flow over every part of the paper, and so wash off all the dirt that may be soluble in pure water. Drain, and without removing from the glass, immerse (if possible) in solution of chlorine or chloride of lime. It is best to avoid touching the paper after it has once been wetted. If the plate is not immersed in the bleaching liquor, the solution should be dropped on every part of it until saturated; then leave it for some time. When the stains are all gone, place the sheet under a stream of running water for a day or so (moving it about from time to time) in order to remove every trace of the bleaching solution.

The chloride of lime solution is made as follows: Chlorinated lime, 1oz.; distilled water, 1 gallon. Mix thoroughly by trituration in a mortar, and transfer to a bottle, shake frequently during six hours, then strain through calico. The solution when finished should be quite clear.

If the plate is mounted on calico it should be soaked off first, and as much paste as possible scraped from the back. A bone or wooden paper-knife makes a good scraper. All grease-stains should have been removed previously, as they render the paper impervious to fluids.

W. H. Tunley.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67717.]—**Smoke-Pipe.** — Your correspondents "J.S., East Cowes" (March 15), and "Aliquando" (April 5), have, I think, made a mistake as to the source from which they gain their information. The pattern has been taken from Warn's "Sheet Metal Worker's Instructor" (which is a copyright), as you will see by the following design taken from that book, and I think you will find that the explanation is certainly more simple and easier for the ordinary workman to understand. To strike the pattern of two cylinders for joining at an oblique angle (or slanting direction). D A and E C (Fig. 4) represent the larger cylinder, and let H F and I G be drawn the required size of the cylinder that has to be connected to it at any angle or position required. Draw line F G at right angles with H F, and describe the semicircle from F to G, and divide it into six equal parts, as 1, 2, 3, &c.,; draw lines through these points at right angles with F G, now strike the semicircle A B C representing the size of the large cylinder, and extend the lines D A to M, and C A to L; take the radius of the semicircle, as *o* F or *o* G, and from A mark off the same distance to M; now take half the length of the base of the cylinder, as from K to H or K to I, and mark off a like distance from A to L. Now, instead of drawing a quarter-circle, as required in Fig. 1, where the cylinders meet at right angles, here a quarter of an ellipse is required, as shown from L to M, the radius of which may be obtained in the following manner. Draw line from M to N, also from L to N at right angles, and draw the diagonal line L M; draw a line from the point N to cut through the diagonal L M at right angles, producing the points *c* and *b*. With *c* as centre, radius *c* L, draw the curve from L to *a*; with *b* as centre, radius *b a*, draw the remainder of the curve from *a* to M. Divide the curve from L to M into three equal parts, and draw perpendiculars from these points to meet the curve A B, as *d f*, *e g*, M *h*, draw also lines parallel to A D from *f* to *i*, *g* to *k*, and *h* to *l*; where those lines are intersected by the lines drawn through the smaller cylinder, will be the points from which to trace the curve, as *r s t u*, &c. Draw twelve perpendicular lines in Fig. 5, as F *m n o*, &c., the same distances apart as the divisions in the semicircle (Fig. 4), and take the length of the lines in Fig 4, as F H, *m r*, *n s*, &c., and transfer the same to the perpendiculars in Fig. 5 marked by the corresponding letters. Draw a curve from the points thus obtained, as from J *v u*, &c., which will give the pattern for the smaller cylinder. To obtain the curve for the hole in the larger cylinder: Draw D B and H I (Fig. 6) at right angles, take the distances from A to *f g* and *h* (Fig. 4), and mark off like distances on each side of A on the line D B, as *f g h*, and draw lines from these points parallel to H I. Draw a perpendicular from point K to R (Fig. 4), and carry the length of K H and K I (Fig. 4) from A to H and A to I (Fig. 6), also the distances *x r* and *x v* (Fig. 4) from *f* to *r* and *f v* (Fig. 6) from *y* to *s* and *y* to *u* (Fig. 4). Transfer to Fig. 6 from *g* to *s* and *g* to *u*, take the distance from R to *t* (Fig. 4), and mark off the same from *h* to *t* (Fig. 6); the curve drawn from the points thus obtained will give the aperture required to receive the smaller cylinder.

Technical.

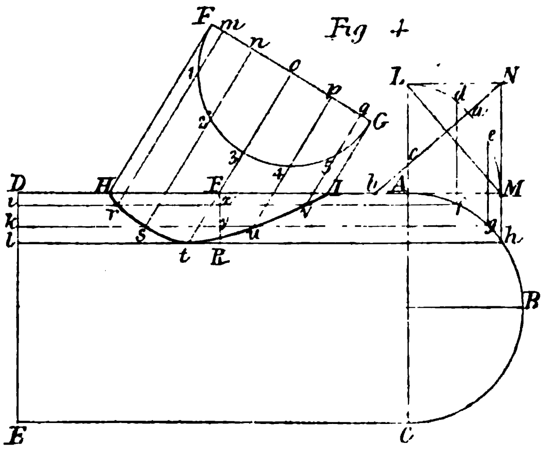


Fig 4

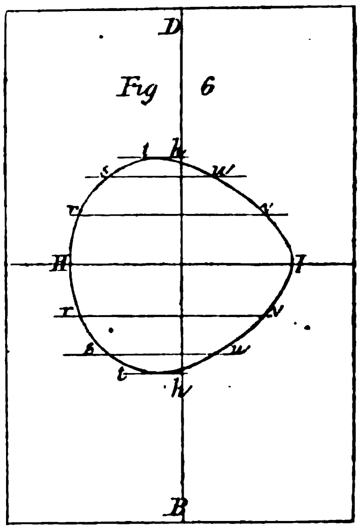


Fig 6

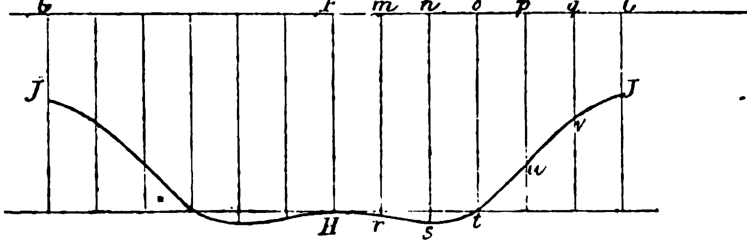


Fig 5

[67816.]—**Limelight (U.Q.)**—A blow-through or safety jet consumes about 4c.ft. per hour of oxygen, and your cylinder would probably keep you going about 9½ hours. Where coal-gas cannot be obtained, the safest light to use is the oxy-calcium. I should advise you not to meddle with the ethoxo light, which, even with the best apparatus, is risky. The safety jet is powerful enough for most purposes.

B. R. W.

[67862.]—**Distribution of Load.**—"T. C., Bristol," having appealed to the good services of "M.I.C.E., Bath," we must consider the matter closed. At the same time, I was in hopes that, by leaving resilience out of the question, and taking W an infinitely small distance, on one side of neutral axis B B, and again an equal distance on other side of this axis, a close average might be obtained. Practically, by supposing a weighing machine, such as is used for loads on locomotive wheels, on which our rigid table could be tested, would give a sufficiently approximate solution. My best thanks to "T. C." and "M.I.C.E." for taking such trouble in the matter.

Liverpool. W. S.

[68011.]—**Medical Battery.**—Does not "Ignor" understand that he must give some idea of the materials of which his battery is made? Is it a carbon and zinc arrangement or a chloride of silver and zinc cell, or what? It is useless to guess.

Nun. Dor.

[68054.]—**Diamond Cutting.**—The same reply as 68138.

Eos.

[68069.]—**Division Plate and Index for Lathe (U.Q.)**—Use an ordinary drilling spindle with $\frac{1}{16}$in. drill on slide-rest. Form of hole a matter of opinion; perhaps a slightly conical one, with index peg to match, is best, but the holes must be deep. I prefer them going clear through the plate. I always divide my plates with dividers, which produces a more accurate plate than what can be got from a paper pattern.

A. F. Shakespear.

Lüttichaustr. 14, Dresden.

[68138.]—**Lapidary's Work.**—Vol. III. of Hotzapffel, chapter xxxiv., pages 1302 to 1347, contains full information with many illustrations of the subject. The Indian lapidaries, with the rudest appliances, do beautiful work, a brief description of which I sent to to the "E. M." many years ago.

Eos.

[68159.]—**Scalding by Hot Tea.**—There is probably some good reason for this, though I do not know exactly what it is, for surely the same law manifests itself in the fact—if it really is such, though I have not yet been able to complete the experimental proof of it—that some fluids—e.g., (bread and) milk and cocoa—apparently take longer to cool than others—e.g., tea and coffee (not made with boiled milk). This is, however, possibly only a subjective phenomenon, and a thermometer might indicate that people could take the latter at a higher temperature. Most likely it will be found to be the case either that boiling has some effect on the heat convecting, conducting, or radiating powers of such fluids, or that, when boiled, they feel differently to, or come into complete contact more or less rapidly with, our mucous surfaces than the unboiled fluids do.

Guy's Hospital. HAROLD G. DIXON.

[68191.]—**Wounds.**—The reply of "Constance" last week reads like a joke!—one can scarcely take it as serious. If serious, I would recommend her not to have the rings where only the privileged one may see them; but adorn herself instead with a ring in each nostril, where we may all admire and worship. Have them about 3in. long—the rings, I mean, not the nostrils.

Bristol. T. C.

[68191.]—**Wounds.**—It is very possible that if "Constance" pierces the nipple itself, it will interfere with the nursing of her children. Amongst civilised people the occurrence of abscesses about the nipple at the period of gestation is frequent. The piercing and wearing of a ring here would probably increase the likelihood of such trouble occurring, and would aggravate it if it were present. To pierce the skin over the lower edge of the breast, below the nipple, would be less dangerous.

HAROLD G. DIXON.

[68191.]—**Wounds.**—Apart from the danger of cancer to which I referred in a previous reply to this query, and which applies far more strongly to the case of cicatrices in a woman's breast, this operation would certainly close up at least one-half of the lacteal tubes, and in the case referred to in the query, besides preventing the nursing of children, might endanger the life of the mother through suppuration. That any sane person would either abuse themselves or recommend others (especially females) to do so, is something to be wondered at. Further, I ought to mention that, in my opinion, any jeweller or unqualified person who performed this dangerous surgical operation would render himself liable to prosecution.

Plymouth. B.Sc.

[68191.]—**Wounds.**—Why cannot "Constance" be satisfied with her body as God made it, instead of wanting to lower herself to the level of a savage, who does not know any better? It is incredible that in this enlightened nineteenth century any Englishwoman should wish to mutilate herself in a way which is utterly without sense or reason, besides being cruel to her offspring. I may say that such a course as she suggests would materially prevent her properly nursing her children, and the larger the ring the worse for the child. In a savage country, where the natives are in the habit of leaving the breasts bare, one could understand the desire for adornment; but in England, where it is only the custom to expose about half, and when the rings would necessarily not be shown for decency's sake, it is simply idiotic and absurd.

T. P. M.

[68191.]—**Wounds.**—Seeing your letter in last week's "E.M." with reference to pierced breasts, I hope the following experiences may be of assistance to "Constance." Ever since I have had breasts I have worn rings which I had inserted in the nipples at the request of an intimate friend. I am now aged 20, and the mother of a healthy family, and have experienced no difficulty in nursing all my children myself. I wish to draw "Constance's" attention to the fact that my nipples were skilfully pierced below the orifice so as to avoid any danger of disturbing the passage. Having now learnt by experience the various inconveniences attached to the practice of wearing these rings, I should strongly advise "Constance" to resist "Jack's" proposals, as I am now of opinion that they are by no means useful, and, as they are not displayed in public, very little satisfaction is derived from them as an ornament. I should long ago have discarded them had I not now become entirely used to them after five years' continuous wear.

FANNY.

[68191.]—**Wounds.**—It is not the business of the "E. M." to interfere with ladies' fashions; but they say that ladies adopt their fashions to please the sterner sex. May I, on behalf of that sex, beg of the lady who writes on p. 199 to reconsider her determination? I am well aware that almost any portion of the skin may be safely pierced, except certain highly sensitive and specialised portions, the nipples included. Even the male nipples are less adapted for piercing than other parts; but in the case of the female nipple, the danger of piercing that highly sensitive organ is very considerable. I have had personal experience of the matter, and have still several places where rings or wires could be inserted. But I should not like to have rings in my breasts, because I like a good rub down with a rough towel. But if the fair sex must have its way, I should suggest piercing the skin just above the nipple, around which the ring would then fall, like the setting of a jewel. I should advise Jules Orme's method to be followed, using a silver needle. The trouble is very slight: we used to leave the silk threads in until the places healed. Can anyone say what would be the effect of slightly searing the hole by means of an instantaneous heating, by electric current, of a platinum wire previously inserted?

RING.

[68206.]—**Parish Law.**—This question should be submitted to a solicitor with the Public Health Act before him. Anyway, the question is of little interest except to "Rusticus" and his fellow ratepayers, and I should think the best thing to do would be to collect the funds necessary and take counsel's opinion. "Rusticus" might find an answer in "Lumley's Annotated Edition of the Public Health Act, 1875."—S.M.

[68214.]—**Steam Tricycle.**—I know of nothing to prevent a tricycle being driven by steam on public roads; but of course the speed is limited by the same Act as controls the use of traction engines. A steam tricycle, too, is misplaced ingenuity; for the tricycle is a machine for exercise, and it would be an unmitigated nuisance to have people running about the streets on steam tricycles.

NUN. DOR.

[68222.]—**Cement.**—A cement to resist sulphuric acid can surely be found in plaster of Paris, which, being sulphate of lime, cannot well be acted on by sulphuric acid. T. M.

[68225.]—**Cloudy Objective.**—It is impossible to suggest what this objective is for unless it can be inspected. Why does not the querist take it to an optician and put the question to him? X.

[68230.] — **G.W.R. Automatic Vacuum Brake.**—The pressure cannot be more than 15lb. per square inch with any vacuum brake, and in practice is little more than 12lb. at any time. The size of the pipe has nothing to do with it, as compared with the Westinghouse, which, being a pressure brake, may have as much as 60lb. or more on the square inch. The Westinghouse brake is the quickest train-stopper, and the only perfect brake in existence. NUN. DOR.

[68236.]—**Candle Making.**—Making tallow candles is not worth doing; but if the querist must do it, he will find it better to "cast" them in moulds. The price of tallow varies, but it can be found by consulting the market reports, and as to making a certain number of candles to the "pound," that is where the skill of the dipper comes in—so many dips for each size, and then the candles are sorted afterwards. But I thought tallow candles were almost unknown now. J. T.

[68243.] — **Explosives.** — If this "cannon" could be seen, one might be able to suggest what explosives were used to make the engine work.

J. T. M.

[68244.]—**White Wood Furniture.**—There is no special work of the kind required by querist; but there are several textbooks on carpentry and joinery, and much information in back volumes. Many years ago Mr. Smither gave a series of letters on the subject, and there were articles by "O. J. L.," I think, not long ago. C. P. L.

[68249.]—**Fans.**—I do not know of any formulæ for calculating the "amount" of air drawn in by a centrifugal fan; but it could, of course, be calculated from such formulæ as are to be found in Molesworth's "Pocketbook." S. T.

[68252.] — **Japanning.** — The whole art of japanning consists in cleaning the articles, applying the japan, and "stoving." Directions have been frequently given, and recently I saw a reply which explains everything, and contained a diagram of an oven. I think it was called "Enamelling Bicycles."

T. J.

[68255.]—**Lunar Photography.**—"Clericus" may well ask for information about taking instantaneous photographs of the moon. All he has to do is to fit the camera to the eye end of the telescope, having removed the eyepiece, and focus up sharply; but as to "instantaneous," I am doubtful. S. F.

[68265.]—**Modified Battery.**—To MR. BOTTONE.—In your book you mention it for closed circuit work. How long will it run before it polarises? EXPERIMENTER.

[68267.]—**Asbestos Paint.**—What is it Mr. Spencer wishes to know about abestos paint? All he has to do is to grind the asbestos to powder, mix with the desired pigment or colouring medium, and then grind up well with size or glue, as I suppose he wishes to avoid so inflammable a material as oil. But is not asbestos paint a patent? B. C. L.

[68329.]—**Glass Gauge.**—The following measurements, as given by the largest sheet-glass makers in England, are accurate enough for your gauge. Sheet-glass varies; polished plate alone being of a uniform thickness. There is no standard thickness for any particular strength, 15oz. equals $\frac{1}{12}$in.; 21oz., $\frac{1}{10}$in.; 26oz., $\frac{1}{8}$in.; 32oz., $\frac{1}{7}$in.; 36oz., $\frac{1}{6}$in.; 42oz., $\frac{1}{5}$in.

Whitehaven. D. B.

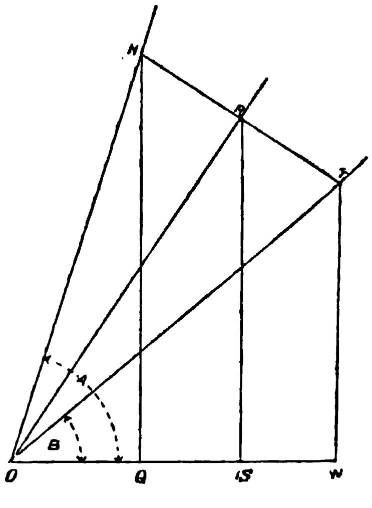
[68362.]—**The Mass of a Binary Star.**—I am obliged to "F.R.A.S." for his reply to my query. This was intended neither as "a paradox" nor a "catch question," but simply as a statement of a real difficulty which I had encountered. And "F.R.A.S." does not seem yet to have apprehended my difficulty. He says that "Jupiter is 5·2028 times further off the sun than we are." By Kepler's third law, therefore, his periodic time should be $\sqrt{(5\cdot2028^3)}$, or 11·8674 years, and not 11·862, as given by "F.R.A.S." He, however, states that 11·8674 years is the periodic time which the earth would have, were it at the distance of Jupiter from the sun. The formula, therefore stands—

$$\frac{11\cdot8674^2}{11\cdot8674^2} = \frac{\text{mass of sun and earth}}{\text{mass of sun and Jupiter.}}$$

But from this it would follow that the earth and Jupiter were equal in mass, which we know not to be the case. And this is the difficulty, the solution of which I asked from your readers. FINSBURY.

[68390.]—**Hagioscope.**—My previous reply in No. 1,257 was printed so as to ignore a distinction I intended to make between a hagioscope and a lepers' window. "F.R.A.S.," on p. 194, also identifies the two. I believe that what is usually called a hagioscope is made in an interior wall or buttress, so as to permit those in an aisle or chapel to see the high altar. A lepers' window is essentially a window in an outer wall, for the use of those who were not permitted to enter the church. Sometimes an opening in the east wall of a porch has a slanting direction towards the altar, and when blocked up at a later date is often taken for a holy-water niche. There is one like this at Mitton, in Yorkshire, which, if opened would, I believe, form a hagioscope. NEPHESH.

[68428.]—**Problems.**—Every cosine has three corresponding angles—viz., A, 360° + A, and 360° − A; where A is the angle corresponding with the cosine which is given in the tables. In the equation $\cos. A = 4 \cos. \frac{3A}{3} - 3 \cos. \frac{A}{3}$. If we put a value for cos. A (suppose ·216 for example) and put x for $\cos. \frac{A}{3}$ for shortness, we have $4x^3 - 3x = \cdot216$. As this is a cubic equation, it must have three roots, these will be found to be ·9, −·827, and −·073, which are the cosines of 25° 50′, 145°−50′, and 94° 10′. ·216, which we started with, is the cosine of 77° 30′, and also of 437° 30′, and also of 282° 30′, and each of these is exactly three times the corresponding angle found as above by calculation. By drawing a circle and marking off the various arcs and cosines, the above will be understood better. 2. To show geometrically that $\sin. A + \sin. B = 2 \sin. \frac{1}{2}(A + B) \cos. \frac{1}{2}(A - B)$; in the figure make N O W = A, and T O W = B,



then a little inspection will show that if we bisect the angle N O T by the line O R, the angle R O W will be $\frac{1}{2}$ (A + B) and the angle N O R = T O R = $\frac{1}{2}$ (A − B). The line N T is at right angles to O R and N Q, R S, and T W are drawn at right angles to O W. Now N T is bisected in R, hence NQ + TW = 2RS. Divide both sides by O N, then—

$$\frac{NQ}{ON} + \frac{TW}{ON} = 2\frac{RS}{ON} = 2\frac{RS}{OR}\cdot\frac{OR}{ON}$$

but ON = OT

$$\therefore \frac{NQ}{ON} + \frac{TW}{OT} = 2\frac{RS}{OR}\cdot\frac{OR}{ON}$$

which is equivalent to the equation in sines and cosines, the truth of which is therefore proved.

Bath. M.I.C.E.

[68391.]—**Hot-Water Circulation.**—In further reply to "Nemo," he certainly has made a mistake of some sort; ⅜ compo never weighs 2¼lb. to the foot—scarcely 1¼lb. to the yard; a lot used only weighs 18oz. He must be using lead pipe, and that, too, of extra thickness, the average weight being 4lb. or 5lb. to the yard. I am of the same opinion as "D. B.," that the expansion pipe is absolutely necessary to insure safety. The pipe specified is all right for 65lb. I know nothing of block-tin tube.

SKIBO.

[68425.]—**Bicycle Chains.**—Each pin, link, &c., is hardened separately in the usual way, and tempered to a brown-yellow colour; temperature, 500° F. The majority of the chains in use are not hardened at all. A. F. SHAKESPEAR.

Lüttichaustr. 14, Dresden.

[68430.]—**Induction Coil Making.**—To F. W. MASON.—H. Green ought to be able to obtain more than ¼in. spark from his coil if it has, as he states, 1lb. No. 34 wire. The fault lies, I expect, in the condenser, it not being of large enough capacity. You could try the following arrangement with your power—it is one that I use when any coils of mine operate the same as H. Green's. The arrangement is a sort of resistance-board; the connections are as in sketch, which needs hardly any description. The stud 1 of the regulator is straightaway connected to out-going terminal. 2, 3, 4 studs are connected together by means of a ¼lb. or ½lb. s.c. wire, about No. 32 B.W.G., when A of regulator is on stud 1, the result is simply as if the handles were connected to the coil; but on studs 2, 3, 4 the current has to pass through the wire before it reaches the terminal, and, this meaning more resistance, it necessitates the weakening of the current. H. Green could have six studs and about ¾lb. of wire between them. Try a condenser of 100 sheets, 1½ by 2½. The sparking between contacts is caused by insufficient condenser capacity. If H. Green's coil were mine, I should use a separate condenser (not in coil), and connect it up to two condenser screws. The following would, I think, suit you for a commutator. It is on the principle of the switch of the condenser. The sketch needs hardly any explanation. When A and B are on 1 and 2, + electricity flows over A, and negative over B; but when A and B are on 3 + 4, + flows over B, and – over A. The paper entitled "Coil Phenomena" will be ready in about five weeks. Any further information H. Green may require I shall be very pleased to give. F. W. MASON.

FIG. 1.

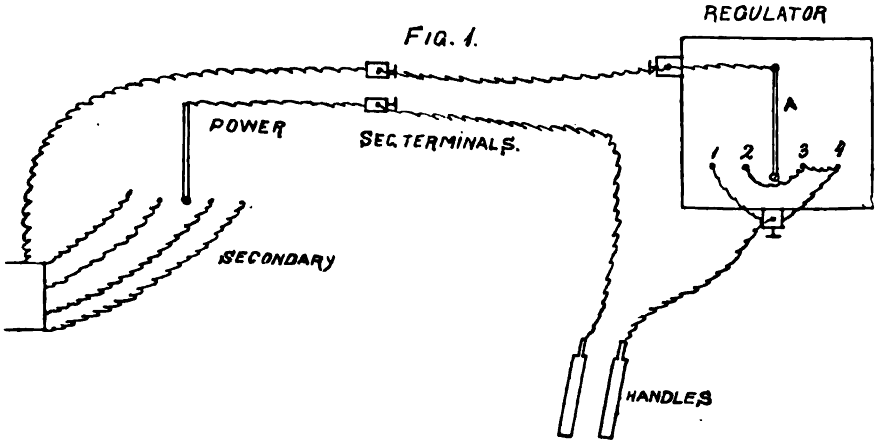
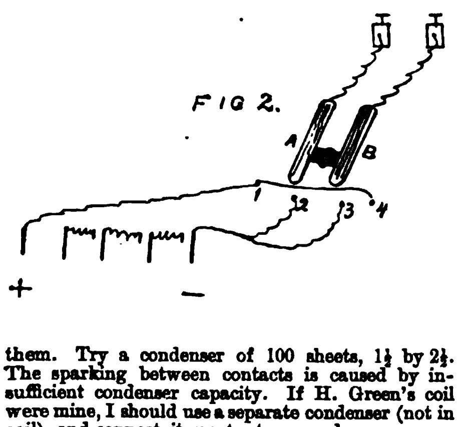


FIG 2.



[68433.]—**Bacteria.**—Very likely the fungus found on the unboiled infusion was Penicillium glaucum, as that is about the commonest mould; but very likely also it was a species of Mucor. But has not "J. B. P." mistaken spores produced by his mould for cells of yeast (Torulæ)? He no doubt found some bacteria, as they may be met with anywhere; but how did he recognise them if they were not in motion, for all the Schizomycetes are most easily confounded with dust-specks and other inorganic things? On reflection, the querist will see that the extreme minuteness of bacteria and their inappreciable weight are the best aids to universal distribution. But why did he boil his infusion in one case? and why, if he boiled it, did he not seal his tube hermetically, leave it, and after an interval examine its contents for organisms, as high temperatures have been used to see how great a degree of heat bacteria and their allies can survive, or else to finally destroy any life in an infusion subsequently kept sealed up and afterwards examined for organisms appearing abiogenetically? As it happens, the results of his two experiments are really the same, and the differences observed merely depended on the relative fitness of the two infusions to encourage life, which would be rather greater in the unboiled one; but millions of aërial organisms will enter an exposed ¾in. tube, whatever becomes of them subsequently.

Uttoxeter. N. S. R.

[68434.] — **Air - Pump.**—The sort of pump "Eden" has in view is probably a sort of cross-breed between the filter and Sprengel. Water will do very well for filter pumps, which need only produce a partial vacuum. For vacuum tubes, water or any other liquid, except mercury, is not practicable; first, because, being thirteen times lighter than mercury, it would require a tube thirteen times longer—that is at least 60ft. But suppose this could be managed, how could the evaporation of the water in vacuo be prevented? Would not its vapour take the place of the air as soon as that were drawn out? The only pump without a lathe that occurs to me at the moment for exhausting vacuum tubes, would be made somewhat after this fashion: Fit into a piece of triblett brass tubing 2ft. or 3ft. long, hermetically, a wood or metal plunger going to the bottom, and then leaving a bit projecting for a handle. Choose this tube of such a diameter as the vacuum tube, or other article to be exhausted, has; then connect both pump and vacuum tube by a piece of indiarubber tube sufficiently long to admit the working of a pinch-cock between them. Just under the plunger bore a side hole into the brass tube, which can be opened and closed by turning up and down again the end of the indiarubber tube which encircles the brass; draw out the plunger, and the air follows; close the pinch-cock to prevent the air re-entering the vacuum tube, open the little side hole by pressing the indiarubber aside, drive in the plunger, and one barrelful of air, perhaps half, perhaps two-thirds that of the receiver is removed. Continue the operation until all is removed which can be done; but is the game worth the candle? Proper, well-constructed vacuum pumps are a glut in the market, and can be purchased for a few shillings, of small dimensions. Mercury pumps cost very little more, and the requisite mercury, though rather high in price just now, can still be had for about 20s. For most educational and technical purposes, mercurial pumps are seldom needed. Those who know how to work and keep in order the ordinary brass pumps, can always get a fair vacuum with them. Exhausting with mercury pumps becomes tedious, and often ends in spilling the metal and fracturing the pump, except where in constant use and managed by experienced hands, as in lamp factories. From a subsequent query it appears that the making of vacuum tubes is "Eden's" object. With the time he spends in making a bad one, he will probably be able to purchase two good ones. He will never be able to compete with the foreigners, who have brought glass-blowing to great perfection.

A. CAPLATZI.

[68436.]—**Equatorial Telescope.**—Divide hour circle into 24 spaces for hours, then divide each space into 15, 20, or 30 for 4, 3, or 2 minutes. You will want to read closer than these divisions will permit you, and I would advise you to read Vol. XXIV. pp. 105, 143, Vol. XXVI. 263, Vol. XXV. 623, 632, Vol. XXVIII. 380. I gave some instructions in Vol. XXXVI. 190, 363, 390, 459, for circles and verniers. A meridian line laid down from a magnetic observation, even after allowing for variation, will only do for placing an equatorial stand approximately correct; the final adjustment is a much more delicate task. You will require three screws on base of stand, one for elevating or depressing the polar axis, the other two for shifting to the east or west. Most astronomical handbooks give instructions, also Horne and Thornthwaite's "Hints."

Ramsgate. J. C. LINSCOTT.

[68438.]—**Spirit of Camphor.**—I do not for a moment question the experience of S. Bottone in the administration of spirit of camphor; but I do think that these administrations must have been upon the same subjects over and over again. As it is my business to know about these things, will you allow me, Mr. Editor, to assure "N." that his wife was suffering from partial poisoning by the camphor which she took; the effect would be only transient, say, an hour or two, so that her indisposition for two months is certainly not the effect of the camphor, but it is the outcome of the effect, and I believe she would have been quite well had she not taken it. I can swallow ¼oz. of spirit of camphor in water at one time without any inconvenience, but that does not say everyone can do so. This would be equal to about 24 grains of camphor. "N.'s" wife took about 7 or 8 grains of camphor, which was quite sufficient to upset a susceptible person. If my wife took 1 grain she would be helpless for about half an hour, as I have given her 2oz. of camphor water disguised so that she did not know what it was, and in a few minutes the symptoms have appeared. The immediate effects are giddiness, somnolency, and lethargy, with a very slight increase in the pulse, with a rise in temperature of 1° or 2°. These effects pass away after a time, and are followed by languor. If "N.'s" wife ever experiences these symptoms again, let her take 30 drops of tincture of henbane in a little water, as it is a perfect antidote to camphor.

A. B.

[68439.]—**Gas-Works.**—Use five retorts, build two ovens—one to contain three retorts for winter use, and the other two retorts for winter use. This is important, so that either oven can be put out of use for repairs, without stopping gas-making. Employ a specialist to set retorts, see advertisements in the *Journal of Gas Lighting* or *Gas World*. Chimney 12in. square inside, 25ft. high from ground, preferably lined 4½ with firebrick. If setting is correctly built, it should be easy to keep retorts at suitable temperature—viz., a bright cherry-red inside. The coke required for furnaces will be, the whole produced from retorts plus about 2 cwt. per ton of coal carbonised; 1¼ cwt. charge should produce 650c.ft. of gas in six hours; three charges per day are usual, night charge not to be left in more than eight hours, or impurities will greatly increase, day charges six hours only. Get Hughes and Richards' "Gas and Gas-Works," Weale's series, price 4s. 6d. GAS ENGINEER.

[68443.]—**Telescope.**—It is impossible to say from your query what is the matter. The o.g. may be good or good for nothing, do you know? If good, send the eyepiece to "Lancaster, Birmingham," or if you like to send it to me I will examine it for you gratis.

Ramsgate. J. C. LINSCOTT.

[68450.]—**Portable and Standard Cell.**—Hardly understand your query. Quite true that apparently the $HgSO_4$ battery does the same work as the AgCl; but, for all that, the $HgSO_4$ is not a standard of 1 volt, whereas the AgCl is. In a few weeks I am going to write on a new standard, constructed on the principle of the Leclanché, which I think will be of some benefit to "ours."

F. W. MASON.

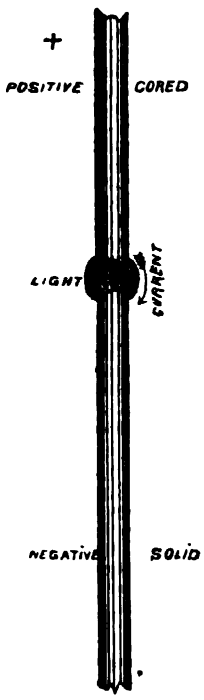
[68477.]—**Induction Coil.**—I should say that the fault of your coil was in the condenser not being thoroughly isolated, as I had one sent me to repair that acted the same as yours, and found the fault there. Take the condenser out and try the coil again. See if the hammer stops; if not, you have found the cause. As to the kinks in the secondary, that would not cause the hammer to stop, but it would fracture the wire so that it would burn asunder. Try the secondary with a galvanometer and one of your pint cells.

No Sig.

[68477.]—**Induction Coil.**—If "No Induct" will advertise his address, I shall be pleased to show him an induction coil that I have made according to Mr. Mason's instructions in "E. M.," No. 1,245, excepting that I have used exactly the same sizes and quantity of wire that your correspondent has done, and with most satisfactory results. With three chromic-acid cells I get about an inch spark; and with a six-power switch and a water regulator, it will give a current mild enough for a child to bear, or one sufficiently strong to knock down an ox. Perhaps the querist has not insulated each layer thoroughly well with paraffined paper, an impression Mr. Mason strongly urged on amateur coil makers. If "a kink or two" was felt to pass through his fingers when winding his coil, he should have stopped and carefully examined it to see if the wire was not abraded; for if the covering was off, and he allowed it to go on the coil, that will explain the cause of a failure. He will have to rewind (I've been there) his bobbin, and besides carefully insulating each layer, must be particular to notice that the wire is not broken, and the covering is perfect. If he intends to get a good spark, he must add a condenser, of dimensions given, if he has not already done so, and the platinum connections will not then get burnt.

H. Green.

[68455.]—**Electric-Light Carbons.**—Because the positive burns into a cup-like form, and the negative burns to a point. The positive burns away about twice as fast as the negative. The light is emitted chiefly from the positive pole, so it is the top carbon, as the light is generally required below the lamp. The wire from the + (or positive) pole of the dynamo goes to the + carbon, and the negative to the negative. Cored are coppered as well.



W. Durtnall.

[68474.]—**Connecting Dissimilar Batteries.**—No, you cannot add the Leclanché cells in circuit with your bichromates. If you do, you will reduce the strength of the whole.

F. W. Mason.

[68478.]—**Long-Distance Thermometers.**—The correspondent of the *Standard*, being probably interested in these instruments, may himself answer this query. Nevertheless, a variety of replies may prove instructive: hence I make bold to offer my opinion and suggestions, though I know nothing of the thermometer "Pyro" refers to. It cannot embody very much that is new, for so many patent contrivances, to effect the same purpose, have already been proposed and abandoned, that it would be rather difficult to find something really new and practical. The best and simplest means for securing immunity against fire are still, in my opinion, vigilance and carefulness. The less we rely on frail instrumental means (which require even greater vigilance) the better. There are here exceptions as everywhere else. In places where goods liable to spontaneous combustion are stored—say wharves, warehouses, &c., chemical, air, mercurial, and unequal-expansion thermometers, may be usefully employed. But they must be well got up, well attended to, and frequently tested, or they will prove traps. With the [illegible] of ease and proneness to shirk work not in the daily routine, it is almost too much to expect such constant attention. To fix a thermometer of no matter what kind in every room and closet of our houses, to maintain a number of electric bells, batteries, wires, and connections in perfect working order, ready to signal a foe who, we hope, will never come, and who, in 100 cases against one, never does come, is far too troublesome, and not to be expected of ordinary people. As a reader of the "E.M.," "Pyro" must know something of electricity, and if so he need only be told to look upon a long-distance thermometer as a sort of electric push, having the same sort of line, battery, and indicator as a bell has. Instead of his hand pressing the button and completing the circuit, the mercury in the tube which is connected with one end of the line expands by the heat, and rises till it meets the other end, when the alarum will sound, if everything is in good order. Should "Pyro" adopt air thermometers, then the column of air in the tube rises and presses up a metallic diaphragm against the two ends of the line, and thus again completes circuit. If two strips of copper and brass, 6in. long by ½in. wide, be riveted together and soldered, one end of this united strip fixed to an angle piece, the other tipped with platinum, and brought near to a similarly platinised stud, the rising heat expanding the further copper strip more than the near brass one, will bend up against the stud, and thus again complete the circuit. The ends of the line, of course, being connected one to the stud and one to angle-piece. The temperature at which the circuit should be completed is determined and regulated by a screw behind the strip. There are various other ways of causing the temperature of an apartment to complete an electric circuit.

A. Caplatzi.

[68480.]—**Dull Black for Sheet Zinc.**—Clean the zinc and immerse in solution of platinic chloride.

Sm.

[68482.]—**Gramme Dynamo.**—Put 3½lb. to 4lb. No. 20 d.c.c. on the armature. To balance this use about 3lb. No. 18 on the fields as the series coils; and for the shunt coils at least 15lb. No. 24. If you are limited for space, in winding you may use silk-covered wire for the shunt coils; if not, use d.c.c. The sections should not be less than 10, and need not exceed 30. The armature should be of the Pacinotti type, if the highest result is desired. At about 2,000 revs. per minute you should get five or six ampères at 50 volts pressure.

S. Bottone.

[68483.]—**German Yeast.**—In the farm where I am stopping they use about 1½oz. of fresh German yeast to about 15lb. flour. The girl soaks and rubs the yeast in a small quantity of warm water—say, one quart, which then becomes somewhat like milk. Then is added salt, and as much more warm water as will make the quantity of flour to a rather stiff mass. In about two or three hours, according to the warmth and degree of stiffness, it is ready for oven, and capital bread it is, too—hearty, sweet, and good-looking.

C. O. X.

[68483.]—**German Yeast.**—A very good bread may be made from flour (best quality) 10lb., warm water (temperature about 85°) 3½ to 5 pints, German yeast a sufficiency (mixed with about 4oz. of water), common salt 1 to 2oz. (according to taste). Yeast very often makes bitter bread, and therefore I think a better plan is not to use yeast at all, but substitute bicarbonate of soda and hydrochloric acid in its place. This makes the bread beautifully light by the carbonic-acid gas, which is given off by the $NaHCO_3$, and as a resultant you get NaCl, or common salt, and therefore in mixing the dough you need not use so much salt as you otherwise would do. $NaHCO_3 + HCl = NaCl + CO_2 + H_2O$. German yeast consists of the spores from the bottom of the vats, partially dried, packed in bags, and then sent to this country. It needs longer for germination than English yeast. Of course, in the case of yeast, fermentation should be complete before the fermented dough is put into the oven to bake. The dough should be well mixed in every respect, for thus you will obtain a bread with even pores and of good consistency. The crust ought to be crisp, not "withy." Many bakers make their bread with "seconds" flour, and add a little powdered alum to make the bread a good colour—i.e., white. This adulteration, however, is easily detected by the logwood test.

Frederick Davis.

[68484.]—**Ammeter.**—To Mr. Bottone.—For the ammeter no box will be needed, there being no coil, but a single strip of copper about ¼in. wide 4in. long, laid parallel to the magnetic needle, below it, at a distance of about 2in. For the voltmeter, the outer box of a common Tandstickor lucifer box, say about 1¼in. by 2¼in., does admirably. This must be wound with ¼oz. of No. 40 German silver, cost, 6d. Magnetic needles, in either case, 1in. long.

S. Bottone.

[68485.]—**Winding.**—How is the weight drawn—horizontally or vertically? In any case ¼H.P. is more than enough; but you must limit either the size of the drum or the engine for correspondents to assist you.

Bristol. T. C.

[68487.]—**Size of Boiler.**—As usual, no speed is given; you can do "real work" at various speeds. Suppose you try 24in. by 15in., and if of iron, of 3/16in. plate, for the sake of making tight joints.

Bristol. T. C.

[68488.]—**Plaster Casts.**—I would recommend "Elektron" to paint his plaster casts over with soft soap or caustic potash. I think he would then be able to skin off the oil paint.

Ecnal.

[68489.]—**Electro-Motor.**—To Mr. Bottone.—Wire on armature, 4lb. No. 18; wire on fields, 6lb. No. 20. It will take 5 or 6 ampères at 50 volts pressure to drive it. It should then give rather more than ¼H.P.

S. Bottone.

[68492.]—**To Mr. Bottone.**—The size given is actually about the same as my little 5c.p. dynamo, which really gives extraordinary results. When the iron is good and soft, I can light a 10c.p. 15-volt lamp with these little machines. Put about 2oz., or 20 mètres, of No. 24 silk-covered wire—No. 24 is 0·635 millimètre in diameter; wind your field-magnets with 2lb. No. 24 silk-covered wire—say 320 mètres; connect up as a shunt machine. This will give 1 or 2 ampères at 15 to 20 volts pressure, if driven at 3,000 revs. per minute.

S. Bottone.

[68493.]—**Wind Vane.**—A wind vane can be made to register direction indoors by means of a pair of mitre wheels, one keyed on to the bottom end of a long iron rod which carries the vane, the other keyed on to a short rod which carries a pointer at the other end; this rod of course passing through the wall and dial-plate inside.

H. A.

[68495.]—**Quick-drying Gum.**—Take equal weights of best glue and of golden syrup; soak glue in water for 24 hours, pour off superfluous water, and melt glue in a clean gluepot, add the syrup, and well mix; lay on hot. Of this I have used much in my amateur rebinding and renovating of broken-backed books, of which I have had some experience, thanks to the wretched material for the hinges, and the hard, brittle glue used by the professionals. It dries quickly, and is elastic when dry. If wetted with brush and hot water (instead of finger and cold) it will, I believe, answer our querist's wishes.

F. G. Ll.

[68497.]—**Daguerreotype Photo.**—"Bichromate" will find all information he wants in Hunt's "Manual of Photography" (London: Griffin and Co.), or in a "Treatise on Photography," by Capt. Abney (Longmans). It may interest him to know that I have in my possession daguerreotype pictures taken over forty-five years ago, and they are now as sharp and clear as when taken.

H. A.

[68497.]—**Daguerreotype Photo. Process.**—The studio may be exactly the same as any which has been found suitable for the wet or dry-plate process, and the only difference in the apparatus (besides the polished silvered plates) is the addition of three vapour boxes for the iodine, bromine, and mercury. The iodine and bromine vapours are the sensitisers, and the mercury vapour the developer; the plates are fixed in the usual hypo. bath, and intensified with hyposulphite of gold poured over them, immediately applying a gentle heat. The vapour boxes (as well as I can recollect) were rectangular with a metal cup in the bottom, which was held over a spirit-lamp for a time (only to be found by practice), the silver plate being slipped into the top face downwards, and the top hinged so that the plate may be examined from time to time. No doubt these boxes could be obtained from Caplatzi, who advertises in these columns.

Plymouth. B.Sc.

[68499.]—**Problem.**—Determine sum total of alkaline sulphates and the sulphuric acid in them. Multiply the sulphuric acid found by 2·1775, deduct from the product the sum of the sulphates, and multiply the remainder by 4·4072. The product expresses the quantity of sodic sulphate.

Sm.

[68499.]—**Problem.**—

	Grains.
Weight of water	2,540
Weight of acid	980
	3,520
Total weight of solution	4,285
Weight of alkali	765

Let x = weight of soda

y = weight of potash

then (1) $x + y = 765$

(2) $\frac{x}{32} + \frac{y}{48} = 20$

or (2) $3x + 2y = (96 \times 20)$

and (1) $3x + 3y = 3 \times 765$

Difference $y = 375$

But $x + y = 765 \therefore x = 765 - 375 = 390$

Weight of soda = 390 grains

Weight of potash = 375 "

W. C. Jocelyn.

[68500.] — **Removing Pole.** — "Double B." might have been told by the first person he met the answer to this query, it is so simple—fix the nut on the box, and screw the bolt in from the top.

Plymouth. B.Sc.

[68500.] — **Removing Pole.** — In place of the bolt D have a plate screwed to top of box with a set-screw to screw into that. You might use the thumb-screws and plates to be obtained of most ironmongers.

Bristol. T. C.

[68500.]—**Removing Pole.**—Presuming there is an objection to fastening the pole by a couple of thumb-screws through the staples, "Double B." can obtain at many ironmonger's extra long thumb-screws with threaded sockets to screw into; if he fastens one of these sockets to the under side of the lid of his box, and runs the thumb-screw through the pole, &c., into it, I think his difficulty will vanish.

B. Harcourt.

[68500.]—**Removing Pole.**—If the staples are strong enough, why not bore them at the point marked C on sketch, and fix the bolt horizontally instead of vertically? It would then be above box. If staples are weak, fix another one between them, treated in a similar manner, using either bolt and nut, or bolt and pin.

Whitehaven. D. B.

[68500.]—**Removing Pole.**—Provided that the staples are strong enough to bear the whole strain on the pole, and that the bolt is merely required to hold the pole from slipping through the staples. I should say bore a hole through the pole from side to side, close against one of the staples and drive an iron rod through, the ends of which would catch the staples and which could easily be driven out again when required. Otherwise fasten a block of wood inside the box where the bolt goes through, and put a coach-screw through the present hole in the pole to screw into the block. Nephesh.

[68500.]—**Removing Pole.**—1st method: Cut a hole, with centre bit, brace, and chisel, from the bolt-hole to end of pole, use a broad washer on bolt, and have either a fin of wood nailed on the box to fill the slot when the pole is slid in, or a loose piece to slide in, fill the slot, and wedge. 2nd. By allowing the original bolt to drop drown into the box drawing out the pole, and having another square-headed bolt with a plate-nut let in flush with the top of box, over the bolt-hole, and fastened down with countersunk wood screws. This bolt may be easily put in each time and tightened up with a spanner on its square head. Joselene.

[68501.]—**Judson Cell.**—With a Judson cell the E.M.F. is 1·6 volt. If the carbon be 6½in. high by 2¾in. diameter, the internal resistance may be as low as 0·25 ohm, in which case the current on the short circuit would be 25)160(6 ampères fully. Of course if you are using my new depolariser, the E.M.F. is higher, say two volts, and the internal resistance lower, so that you would get more ampères. Use zinc 7in. by ¼in.; porous cells, 7in. by 2in., four graphite plates surrounding the porous cell and connected together, each 4in. by 7in. by ¼in.

S. Bottone.

[68502.]—**Pocket Coil.**—To Mr. Bottone.—Size of bobbin core, ¼in.; diameter of heads, 1½in.; thickness of heads, ⅛in.; total length, 3in.; primary coil, two layers of No. 26 silk; secondary coil, two or three ounces No. 40 silk-covered copper wire. A cell with zincs and carbon, 3in. × 1in. × ⅛in., will work it well. Use chromic acid, 3 parts; water, 20 parts; sulphuric acid, 3 parts—all by weight. Do not use this mixture in battery until cool.

S. Bottone.

[68503.]—**Photography.**—(1) In shade diffused light is best, and animals are as much annoyed with the glare of the sun in their eyes as human beings. (2) Any of the flash lights sold by Marion and the other photo. advertisers in these columns; if you can afford it, get two worked with the same pneumatic tube and ball or bellows. (3) Use a screen of ground glass or tissue paper between the lamp and sitter. (4) Certainly, keep the focussing light burning; otherwise the shock to the eyes of the sitter would be far too great.

Plymouth. B.Sc.

[68505.]—**Brass Casting.**—The cause of your pot splitting up at the side was the fire was too quick for the pot. A smith's fire is not a good thing for melting brass in. You should get a Battersea melting furnace and a salamander crucible. You should always warm the crucible well before you put it in the fire. You should not put anything in the crucible with your brass. You should dust your moulds with plumbago after you have withdrawn your patterns. W. W.

[68505.]—**Brass Casting.**—To "Novice."—After you have withdrawn your pattern from mould, you should dust it (the mould) with a little flour or peameal, then dust very lightly with plumbago; you will then be able to obtain a clean, sharp casting; for a flux put a little borax in the crucible with the brass. I always use annealed plumbago crucibles, Salamander brand, which I have been able to obtain through "Sixpenny Sale Column," one to melt 4lb., costs about 1s. 6d.; these will not crack or fly; but you should go to work gently, and not force the heat on too quickly; use a cover to crucible. Titanium.

[68506.]—**Cold Air.**—A friend of mine, who resided many years in India, told me they had lattice work over the windows of their bungalow. Over this was a piece of thin calico, which was kept damp by water trickling from a vessel kept above it. The air which passed through the calico was thereby rendered cool and pleasant. Could not "J. W. N." try this? Ecnal.

[68507.]—**Safety Clutch for Pit Cage, for the Prevention of Over-winding.**—It would be presumption to say whose safety hook is the best whilst practical mining authorities are themselves disagreed. If your correspondent, "Miner," will give his address in Address Column, I will send him particulars of Walker's hook, about which I know most, and have seen most of.

Birmingham. W. Hall.

[68508.]—**Angle of Lathe Tools.**—In nearly all cases make the angle B from 3° to 5°, and the angle contained between A and B as follows—(1), 80°; (2), 60°; (3), 90°, or a little less.

Bristol. T. C.

[68509.] — **Battery.** — To Mr. Bottone.—If charged with dilute sulphuric acid (1 to 10 of water) in the porous cell, and strong nitric acid in the outer, your battery is called a "Bunsen," and the 12 cells will light a 24-volt lamp well for 10 or 12 hours at one charge, but will give off poisonous fumes. If charged with chromic-acid solution instead of nitric acid, it will act nearly as well at the beginning, but run down in less than nine hours. But there will be no smell. If you substitute for the nitric acid my new depolariser, you will easily get 12 to 15 hours' light, and no offensive fumes.

S. Bottone.

[68510.]—**Auticatelephor.**—As we have taken some interest in this query, we present to our readers such information as we have been able to gather, in the hope that others may know something more about the "invention." In 1820 M. Ampère described to the Paris Academy of Sciences his rough idea of a telegraph, in which the signals were to be indicated by the deflection of small magnets; but his idea was simply speculative, and does not appear to have been developed by him. In the *Mechanics' Magazine* for April 17, 1830, there is a short account of a lecture delivered by a Mr. Ritchie at one of the evening meetings of the Royal Institution, in which he commented on Ampère's suggestion, and the *Mechanics' Magazine* appended some comments, which may serve to point a moral for the benefit of modern "Finalities." Our venerated contemporary said: "We have no disposition to question the resources of science, but we apprehend there is experience enough on this particular point to justify us in considering M. Ampère's project as one which there is no chance of our ever seeing realised." This article attracted the attention of Mr. Wm. Sims, of Shoreditch, who, writing in the *Mechanics' Magazine* of May 22, 1830, calls the attention of its readers to a prospectus (which he had had by him some months) of a book "which is to contain an account of a mode of instantaneously conveying intelligence to any distance, discovered by a Mr. T. W. C. Edwards, M.A.," on a principle altogether different from every kind of telegraph or semaphor. The "prospectus," which follows the letter of Mr. Sims, is characteristic of such documents, for while it contains a good many words, it gives no clue to the nature of the "invention," which we may say here is not to be found in the records of the Patent Office. In the account, however, it is definitely stated that the inventor "has explained (in confidence) the secret of his invention to several very scientific men, and as competent as any to judge of its merits; among others, the Vice-President of the Royal Society; the Professor of Natural Philosophy and Astronomy in the University of London; and the President of the Mechanics' Institution. He had previously made an offer on the subject to His Majesty's Government, but without acceptance." The action of the Auticatelephor is said to be "totally unconnected with electricity, magnetism, galvanism, or any other subtle species of matter; and although the communication from place to place is instantaneous, and capable of ringing a bell, firing a gun, or hoisting a flag, if required, yet this is not effected by the transit of anything whatever to or fro—nor, in the operation, is aught either audible or visible except to the persons communicating." It appears, however, that a "channel or way must previously be prepared, by sinking a series of rods of a peculiar description in the ground, or dropping them in the sea; but these, after the first cost, will remain good for ages to come, if substantial when laid down." The "prospectus" further states that, "on a small scale, the Auticatelephor cannot fail to be a source of rational recreation and amusement to noblemen or gentlemen, living at short distances from one another, and disposed to converse together through the medium of a truly elegant and novel invention." Although Mr. Edwards's work was said to be in the press, there seems to have been no further notice of his invention. Ed.

[68511.]—**Dynamo.**—I am afraid your dynamo will not do much; there is too little wire on the armature in proportion to its size, and the F. M.'s are wound with too fine a wire and too much of it to act well as a series machine. I think you would get better results if you were to couple it as a shunt machine. You might then, if driven at 1,800 revs., get sufficient current to light the eight lamps. If not, add to the armature at least 2lb. of the same No. 18 wire. To the field magnets I should add 10lb. No. 22 d.c.c., and connect up as a shunt machine.

S. Bottone.

[68512.]—**Engraving on Steel.**—You ask, Must the plates be polished first or not? Yes, they must be polished first, and must be of a special kind of steel, which is a trade secret. John Gamble and Son, 38, Addy-street, Sheffield, supply me with these plates. Engraver.

[68513.]—**Engine Query.**—It will be better to let each engine drive its own portion of the work. Two separate belts to drive one shaft are not satisfactory.

Bristol. T. C.

[68513.]—**Engine Query.**—I would suggest the coupling of the boilers, and also the engines, as a better arrangement. In coupling the boilers do not use a straight pipe between the stop valves, as is sometimes done, but put in radial pipes from the stop valves to the back, or front, of the boilers, and join them into a large main. This arrangement makes the necessary provision for expansion; see also that there is provision for the water that accumulates in the pipes from condensation getting away. A good way to couple your engines is to lay them side by side, and couple the crank shafts with a face coupling, keeping the cranks at right angles to each other. This arrangement, with one belt to your counter-shaft, will give you a splendid steady drive, and your engines will have no dead centre. If you can run them at about 120 revolutions per minute, and cut off steam at half-stroke, you should get good results. If your engines are not right- and left-handed, one of them perhaps could be easily changed. If possible, arrange your drive so that the under half of your belt is the pulling side; the difference is marvellous. Sandy Dunn.

[68516.]—**Scarecrow.**—I have seen the figure of a cat cut out in tin, and painted to resemble an old tabby. This was placed in the garden to frighten the birds. Ecnal.

[68516.]—**Scarecrow.**—My Scotch terrier and cat are both excellent sparrow scarecrows, and are unobjectionable to human beings.

Plymouth. B.Sc.

[68516.]—**Scarecrow.**—Attach to a hop pole, sloped over the seed bed, by a long string:—(1) A piece of looking-glass; (2) an imitation hawk with outspread wings, made of cloth and cane; or (3) a blown bladder containing half a dozen hard peas. All these are efficacious for a time, but the sparrow is a "cheeky" bird, and the London variety is A 1 on the list. B. Harcourt.

[68517.]—**G.E.R. Doncaster Express Engines.**—These engines are of two classes: (1) 7ft. 6in. singles, with outside cylinders 18in. by 24in., which work at 140lb. pressure, and are stationed at Doncaster and Lincoln; and (2) 7ft. 4-coupled, with inside cylinders 18in. by 24in., which work at 150lb., and are stationed at Cambridge. There is also, as stated on p. 117, a new type of single now being tried on this traffic. These engines frequently run from 67 to 70 miles an hour as a maximum, and for average speed the best booked times are: Lincoln to Gainsboro', 15¼ miles in 19min. = 48·9 miles per hour; and Lincoln to Spalding, 38¼ miles in 47min. = 48·8 miles per hour.

East Anglian.

[68520.]—**Tea, Sugar, Milk.**—Sugar dissolved in infusion of tea alters its specific gravity, hence its action with milk differs. Frederick Davies.

[68520.]—**Tea, Sugar, and Milk.**—I think the following is a satisfactory explanation:—When the milk is poured into a cup of tea, without any lumps of sugar at the bottom, it flows down one side, being cold, and therefore heavier than the tea, and the reaction sends it up the other, causing it to mix with the tea. When, however, the tea contains lumps of sugar, they oppose the tendency of the milk to run up the other side of the cup, and the specific gravity of the cold milk being greater than that of the hot tea, the former remains at the bottom of the cup.

Lewes. M. Isader.

[68520.]—**Tea, Sugar, and Milk.**—When solid sugar is added to tea, and the mixture left undisturbed, the sugar sinks, and is dissolved by the bottom layer only of the tea. From the greater sp. gr. which the dissolved sugar imparts to this layer it remains at the bottom of the cup, and some considerable force is required to lift and mix it with the upper, lighter layers. When milk—especially cold milk—is added, its impetus and its sp. gr. (which is greater than that of hot tea) carry it to the bottom, where it expends the energy of its fall upon the sugar solution lying below; which, after being driven some way up the side of the cup, falls back, by reason of its superior weight, and oscillates to and fro, until the energy of the falling milk is thus expended. On the other hand, if the milk be poured into a cup of sugarless tea, its impetus is expended on sending the bottom layer, similarly, up the cup side; but, as this layer is not heavier than the rest of the tea in the cup, the motion is not checked, but goes on forward, and is spent in currents which transport various portions of the tea in varying directions. In other words, it mixes the tea up, and the milk gets carried away with it; hence the difference observed. If "Glatton" stirs his tea after the sugar is melted, and then allows the currents to subside again before he pours the milk in, he will find that it mixes up more as the sugarless tea does; but even now the sugared tea, having a higher sp. gr. than the unsugared, may have some idiosyncrasy left.

HAROLD G. DIXON.

[68521.]—**Dynamo and Motor.**—To S. BOTTONE.—The motor, Fig. 20, will develop, under favourable circumstances, ¼H.P.; with 8 or 10 cells it will drive a small lathe. The best battery to use is a chromic-acid one, each cell exposing about 64sq.in. of carbon surface. Driven as a dynamo, it will light five or six 8-volt lamps. The batteries that worked the motor would light eight or ten lamps if those were arranged in parallel.

S. BOTTONE.

[68522.]—**Engine.**—15 × 15 × ·7854 = 176·7sq.in.; speed of piston = 90 × 3 = 270ft. per minute; probable effective pressure = 33lb. per square inch;

$$\frac{176·7 \times 270 \times 33}{33,000} = 47\text{H.P.}$$

Bristol. T. C.

[68523.]—**Flywheel.**—Go to a foundry and ask them to cast you a ring ¼in. larger inside than outside of flywheel, and then put a couple of bolts through that and wheel, and make up with a "rust joint." This will cost less than the lead, &c., weight for weight, and look better. If it is a small affair, you might have a wrought-iron ring shrunk on by a smith.

Bristol. T. C.

[68523.]—**Flywheel.**—"J. C. S." might do as he suggests—use a leaded wood rim; but it should be in sections, I think, and with the lead inside; otherwise, in the event of lead becoming loose in the holes, the centrifugal force might cause the same to fly off, to the danger of his person or property. Another way would be to measure out the circumference into convenient sections, and then cut a wood model the required thickness of one, and get the same cast in iron, bolting them on the existing rim. Cast iron shrinks in cooling about ⅛in. to the foot. "J. C. S." must allow this in making pattern; a superficial foot of cast iron 1in. thick weighs 38lb. approximate. T. A. W.

[68527.]—**Paper Organ Pipes.**—A stopped pipe will always sound nearly an octave lower than a pipe the same size open. Is "F. W. D." not giving his pipes too much wind pressure, and thereby blowing fifths? ECNAL.

[68528.]—**Chemical Change of Colours.**—Cobaltic chloride. SM.

[68528.]—**Chemical Change of Colour by Heat.**—Use a solution of chloride of cobalt.

S. BOTTONE.

[68528.] — **Chemical Change of Colour by Heat.**—The salts of cobalt have this property. Try the chloride or nitrate of cobalt. NEPHESH.

[68528.]—**Chemical Change of Colours by Heat.**—Soak the linen in chloride of cobalt, and heat before a fire. It will turn blue, but will go back to pink when the linen gets cold. M. O.

[68533.]—**Cleaning off Old Lacquer.**—I have found a solution of borax in soft water very effective. Bring it to boiling point with the work immersed therein for a few minutes, remove, and rinse in clean hot water. EOS.

[68533.]—**Cleaning Off Old Lacquer.**—When brasswork has reached the stage indicated by "T. W. C." it is well to try and clear off the lacquer, simply because it has already gone. The next thing is to clean the brass to a new surface and "dip" or "pickle" it in the usual way, and relacquer.

Birmingham. W. HALL.

[68535.]—**Bicycle.** — Cut off a piece of good wrought iron or mild steel sheet, ⅛in. thick; heat and roll it up into a sleeve 2in. long, fit it into the back-bone, clean all joining parts and braze.

JOSELENE.

[68536.]—**Photographic Studio.**—The cheapest material in a mountain district you will find to be wood; and if it is only to be temporary, roof with roofing felt and tar over. The glass can be got for 1½d. per foot by getting it in 200ft. boxes. Can't say anything about position of lights unless I knew position of the "space" at your disposal.

Plymouth. B.Sc.

[68536.] — **Photographic Studio.**—The following numbers of the *British Journal of Photography* contain a complete series of articles on "Practical Considerations in Studio Building," which the querist may find useful: March 8 and 22; April 5 and 19; May 3, 1889.

SILVER PRINTER.

[68536.] — **Photographic Studio.** — I would advise C. R. Chaplin to make his studio of well-seasoned wood and give it three coats of light stone-colour Carson's anti-corrosion paint. Living in a wet mountain district, I have tested this paint thoroughly for twenty years. If possible, he ought to have his window facing north. H. A.

[68532.]—**Railway Mileage.**—The stations on the G.N. and G.E. joint line, from March to Doncaster, with their distances from Liverpool-street, are as follows:—

Miles.	Stations.	Miles.	Stations.
86	March	135¾	Nocton
89¼	Guyhirne......	137¾	Potterhanworth
92¾	Murrow	140	Branston
95	French Drove..	143¾	Lincoln
98¼	Postland	149¾	Saxilby
102	Cowbit........	154¼	Stow Park
105½	Spalding	157	Lea
107¾	Pinchbeck	159¼	Gainsboro'
110½	Gosberton	162	Beckingham
124	Donington-road	163¾	Walkeringham
119½	Helpringham ..	165	Misterton
127	Ruskington....	167	Haxey
129¾	Digby	173¼	Finningley
131¾	Scopwick......	180½	Doncaster
134¼	Blankney......		

Sleaford is 123½ miles, and Ruskington, viâ the Sleaford loop, 129. EAST ANGLIAN.

[68537.]—**Solubility of Hypo.**—I have heard or read that hypo. will dissolve in its own weight of water. SILVER PRINTER.

[68537.]—**Solubility of Hypo.**—Supersaturate a quart of distilled water with weighed quantities of the sample you wish to prove—filter, dry, and weigh the filtrate and deduct from weight of hypo. formerly used.

Plymouth. B.Sc.

[68538.]—**Pink Paper.**—Probably an aniline dye. SM.

[68539.]—**Nessler.**—Dissolve 35 parts pot. iod. in 100 of water. Dissolve 17 mercuric chloride in 300 water, add to former till permanent ppt. forms. Dilute with a 20 per cent. sol. sod. hydrate to 1,000 parts. Add merc. chloride until a permanent ppt. again forms. Stand and decant clear solution. It is used for estimation of minute quantities of ammonia. SM.

[68539.]—**Nessler's Solution.**—In estimating ammonia by this, the following solutions and apparatus are required:—(*a*) Nessler's solution: Dissolve 35 parts KI in 100 parts H_2O. Dissolve 17 parts $HgCl_2$ (mercuric chloride) in 300 parts H_2O. The liquids may be heated to aid solution, but must be cooled again. Add latter solution to former until a permanent ppt. is produced. Dilute with 20 per cent. solution NaOH to 1,000 parts; add $HgCl_2$ solution until a permanent ppt. again forms; let stand till settled, decant off clear solution. Solution is kept in an accurately-stoppered bottle, and a quantity transferred from time to time to a small bottle for use. The solution improves by keeping. (*b*) Standard ammonia solution: Dissolve 3·146grm. pure AmCl in 1,000c.c. of distilled water free from ammonia. For use dilute 10c.c. of this solution to 100c.c. with ammonia-free water; 1c.c. will then contain ·0001grm. NH_3. (*c*) Two narrow cylinders of colourless glass of perfectly equal height and diameter, holding 150c.c., and graduated at 100c.c.; stand them on perfectly white paper. (*d*) A pipette to deliver 1½c.c. (*e*) A quantity of ammonia-free distilled water: This is obtained by placing a litre of ordinary distilled water in a retort, attaching a condenser, and distilling until what passes over ceases to give any colour with "Nessler." The remaining water in the retort is cooled and bottled for use. The liquid in which ammonia is to be estimated is first made up to a fixed bulk. It must be so diluted that it only gives a colour, and not a ppt. with "Nessler"; 100c.c. of this solution are placed in a cylinder, and 1½c.c. of "Nessler" having been added by the pipette, and the whole stirred with a perfectly clean rod, the colour produced is observed. A little experience soon teaches the operator to judge the probable amount of ammonia solution required to produce a similar tint. Let us suppose, for example, that the colour is judged to be equal to 2c.c. of ammonia. Then we proceed to confirm our idea: 2c.c. of the standard ammonia solution are run from a burette into the other cylinder; ammonia-free water is added to make up to 100c.c., then the 1½c.c. of "Nessler," and stirred with clean rod. If now, after standing three minutes, the colours match, we are correct; but if not, then we must try again and again, with more or less standard ammonia, until we get an exact match between the colours in the two cylinders. This having been attained, the calculation is very simple, and will be best explained by an example. Suppose that we start with a distillate from a water analysis, containing ammonia, and made up to 200c.c., and that we employ 5c.c. of standard ammonia solution in the comparison experiment to match the colour produced by "Nessler" in 100c.c. of such distillate. Then 5c.c. × ·1 = ·5, and ·5 × 2 = 1·0; therefore the whole 200c.c. of distillate contained 1 milligramme of NH_3. Experiments with different amounts of standard ammonia are of great use in familiarising the colours to beginners. $\frac{1}{10}$ of a c.c. produces a very faint yellow, larger amounts increase the colour to orange, and finally to deep orange-red. Three minutes should always be allowed for the full colour to appear. W. G.

[68540.]—**Fehling.**—(A) Cupric sulphate, 69·28 grammes; sulphuric acid, 1c.c.; water, 1 litre. (B) Rochelle salt, 350 grammes; water, 700c.c.; dissolve, filter, add 100grm. soda in 200c.c. water; dilute to 1 litre. Take equal parts of A and B for use. SM.

[68540.]—**Fehling's Solution.**—Dissolve 34·65 grammes pure crystal $CuSO_4$ in 250c.c. water. Dissolve 173 grammes Rochelle salt and 60 grammes KOH in 500c.c. H_2O. Mix the two solutions, and make up when cold to 1,000c.c. Each 10c.c. of this liquid (Fehling's) will represent:—Glucose, ·05 gramme; maltose, ·082 gramme; inverted cane sugar, ·0475 gramme; inverted starch, ·045 gramme. The subs. to be tested is weighed and made up to a known volume, and poured into a burette graduated in c.c.'s; this is let into a boiling solution of 10c.c. "Fehling," drop by drop, until all the blue colour disappears and a brick-red ppt. is formed. The percentage of sugar can be readily calculated from the amount of liquid required to reduce the 10c.c. of "Fehling." W. G.

[68541.]—**To Mr. Bottone.**—The fact of your having laid the fine wire over the coarse, instead of by the side of it, will make no difference, provided that the winding has been always in the same direction. Remember, the end of the coarse wire must be carried to the same binding screw that the fine wire starts from. S. BOTTONE.

[68542.]—**Silver Waste.**—Cannot be profitably recovered from spent hypo. by an amateur.

Plymouth. B.Sc.

[68542.]—**Silver Waste.**—Photographers use generally potassium sulphide to throw down the silver. SM.

[68542.]—**Silver Waste.**—In a business using from 6 to 14 sheets of paper per day, it takes us some months to accumulate £5 worth of hypo. waste. Unless you do much printing, I should think it not worth the trouble. I use about 1lb. of liver of sulphur to a paraffin-barrel full of used hypo. The thick, muddy precipitate is filtered through an old soft felt hat tacked in an empty hypo. barrel; then dried, and sent to the refiner when sufficient has accumulated.

SILVER PRINTER.

[68542.]—**Silver Waste.**—Add dilute HCl to your solution until a further addition does not cause any precipitate to form. Allow the precipitate to subside, and wash it well by decantation. The wet precipitate may then be rinsed into a shallow dish, and a little sulphuric acid added; strips of zinc free from lead are then laid upon the precipitate, and the whole allowed to stand some hours. The precipitated silver is separated from any remaining zinc, and well washed. It is then dissolved in dilute nitric acid, the solution evaporated to dryness, and the residual silver nitrate dissolved in water.

Lewes. M. ISADER.

[68543.]—**Heating.**—What heat do you require: A Cornish boiler 12ft. by 4ft. will do the work, or a multitubular of equivalent power.

Bristol. T. C.

[68544.]—**Electric Fog Horn.**—To MR. BOTTONE.—I do not know myself. S. BOTTONE.

[68547.]—**Clock Gong.**—Recently I have fitted a fine-toned gong to a grandfather clock. I removed the bell and bell bracket and fixed by a central hole a horizontal wooden distance piece to carry the gong the required distance from the clock back. I lengthened the hammer tail, and adjusted it to its new striking position, but the gong had a heavy, "lumpy" sound. Thinking there might be a flaw in the gong itself, I screwed the flat brass lump into which the gong is fixed in the vice, and gave it a good grip. I then tried it with a light metal hammer shod with leather. The tone was very good, and I inferred from this experiment that the gong and the clock case should be firmly attached to each other through the medium of a solid lump of metal. Accordingly, I made my distance piece about 2in. diameter, 2¼in. long, with a hole drilled lengthways through. I passed a $\frac{5}{16}$ pin through the back of the case, the distance piece, and the brass block which carries the gong; put on a washer and nut, and screwed the lot well up. On trying it I found the tone quite satisfactory, in fact as good as can be desired. The *rationale* of the matter is, I think, that the vibrations of the gong are transmitted by the dense metal to the back of the clock's case, which has consequently a chance of exercising its resonant and reinforcing qualities much better than when a soft-wood pedestal or distance piece is made use of.

Birmingham. W. Hall.

[68548.]—**Pisa.**—The tower is cylindrical, 53ft. diam. at its base, 183ft. high. It consists of eight tiers or stories of columns of marble and granite.

H. A.

[68550.]—**Gas.**—Your gas company, similar to many others, will be bound by their Act of Parliament to supply gas for lighting purposes very probably not to be under 16c.p. To do this, the gas must be made comparatively good. A much cheaper gas can be made for cooking purposes; but to supply this they would require another set of pipes. This they cannot be called upon to do. Water gas is now made at the Leeds Forge at 4d. per thousand feet. This is used for heating purposes.

Ecnal.

[68552.]—**Maxima and Minima.**—The form of the section made by revolving plane is that of two equal and similar trapezoids on opposite sides of the axis, each having the longer of their parallel sides in contact. Let s be a side of the cube, and θ the angle made by cutting plane with the vertical. The perpendicular height of each trapezoid is $\frac{s}{2\cos.\theta}$. Now draw a perpendicular from centre of base to centre of that side of section lying in the base; this perpendicular produced will also pass through the adjacent edge of the cube, and its length is $\frac{s}{2}\tan.\theta$. Hence the length of the line joining the edge of cube with the centre of that side of section just referred to is $\frac{s}{2}(\sqrt{2} - \tan.\theta)$. Twice this is the length of the shorter of the parallel sides of either trapezoid $= s(\sqrt{2} - \tan.\theta)$. This is enough to determine the area of each trapezoid. It will also be obvious, on examining a figure, that the straight line joining the middle points of the parallel sides cuts them at right angles. From these facts we deduce—

$$\text{Area of whole section} = \frac{s^2}{2} \cdot \frac{2\sqrt{2} - \tan.\theta}{\cos.\theta}$$

Perimeter of do. $= 2s\sqrt{(\sec.^2\theta + \tan.^2\theta)} + 2s(\sqrt{2} - \tan.\theta)$. The maxima and minima values of these expressions are found from the equations—

$$\frac{d}{d\theta} \cdot \frac{2\sqrt{2} - \tan.\theta}{\cos.\theta} = 0$$

$$\frac{d\sqrt{(\sec.^2\theta + \tan.^2\theta)}}{d\theta} = \frac{d\tan.\theta}{d\theta}$$

From the first of these equations $\theta = \sin.^{-1}\frac{1}{\sqrt{3}}$ and from the second $\theta = \tan.^{-1}\frac{1}{\sqrt{2}} = \sin.^{-1}\frac{1}{\sqrt{3}}$. The former will be found to give a maximum, the latter a minimum. Does not "M.I.C.E." mean that the area is at maximum, and the perimeter at minimum for the same value of the variable?

Portsmouth. A. M.

[68555.]—**Dynamo.** — Armature, Siemens H, laminated, wound with 2lb. No. 18 d.c.c.; field magnets wound with 12lb. No. 26; connect up in shunt.

S. Bottone.

[68556.]—**Gramme, 20c.p.** — Armature 3in. diameter, 1½in. deep, wound with 1lb. of No. 20; field magnets 1½in. dia., 2in. wire space on each core; size of pole-pieces, 1½ wide; total height, 8½in.; length the same width at bottom, 4in. The wire on F.M.'s should be 7lb. No. 22; connect up in shunt. All the castings should be malleable; use No. 16 as lead.

S. Bottone.

[68559.]—**Preserving Dead Baits.**—The last and best mode is to get them very fresh, put them in a deep basin, sprinkle with salt plentifully, turning them over occasionally till salted; in a few hours remove them to a jar of methylated spirit.

Eos.

[68560.]—**Clothes.**—If "C. and T." want to go in for making their own, and they don't mind going to a *little* expense, I would recommend them to get a set of *James Hopking's graduated draughts and instructor*. Advertises in Sale Column. I purchased a set, and I find the method very simple, and, by following the instructions, I can measure and cut any clothes to any fashion I require at a little under two-thirds the usual price—that includes paying for making up.

J. E. F.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "B. L. W." has replied to 67816; A. F. Shakespear 68069.

67923.	Photographic View Lens, p. 17.
67928.	Arc Lamp, 17.
67939.	Superficial Viscosity of Liquids, 18.
67941.	Wind in Raising Waves and Minimum Velocity of Waves, 18.
67953.	Battery. To "Nedraw," 18.
67961.	Finding Areas, 18.
67987.	Horse Ball, 19.
67989.	Mandolin, 19.

68210.	Electrical Query, p. 100.
68211.	Apochromatic Lenses, 100.
68213.	Punch and Judy, 100.
68215.	Fastening Horsehair, 100.
68223.	Achromatic Condenser, 100.
68237.	Electro-Magnets, 101.
68238.	Press, 101.
68247.	Optical, 101.
68248.	Fixing Camera Fittings, 101.
68264.	Brick Making, 101.

QUERIES.

[68561.] — **Engraving Coffin Plates.** — Could I get some information how to construct a simple engraving machine, suitable for engraving coffin plates? — W. Kingdom.

[68562.]—**Incandescent Lamp.**—To Mr. Bottone. I have an Edison-Swan lamp, marked, "110 J K 16." Would you kindly explain the meaning, and also what c.p., &c., dynamo would be required to light three or four of them, or would batteries light them?—Wag.

[68563.]—**Cement for Glass.**—Could any reader tell me of any cement suitable for fixing squares of glass into a round earthenware pot to divide it into cells? Anything that will resist acid would do.—Wag.

[68564.]—**To Mr. Bottone or Others.**—I have a dynamo, 45 volts, 25 ampères. I want to send a current of 8 ampères through my arc lamp. I have a quantity of iron wire, 18 gauge. What length of this must I insert into the circuit? Please say what resistance this wire has per yard?—D. N. Y.

[68565.]—**Solubility of Chemicals.**—I wish to incorporate a powder (consisting of dried tannic acid and dried sulphate of iron) with a fluid which contains no element of moisture or water whatever, as otherwise it would turn the powder black. I have tried methylated spirit, and also benzine; but the difficulty is that it does not mix, but the powder sinks to the bottom leaving the spirit above perfectly pure. Varnish for several reasons will not do. Can any reader kindly help me?—Warwick.

[68566.]—**Diaphragm of a Dumpy Level.** — Would some of your readers kindly let me know how to fix the three threads, or cross wires, in a dumpy level?—S. B.

[68567.]—**Meat Preserving Solution.**—I have to buy large quantities of above for preserving meat (joints, &c.), and should be glad if any of our chemical friends can tell me how to make it. Liquid, water-white; on standing a few days, a deposit, say 1-20 of the whole liquor; there is a strong sulphur odour on removing the cork, nearly overpowering if too suddenly placed near the nose. Have heard bisulphite of lime plays an important part. Full particulars for making quantities will be gratefully received.—David Ferguson.

[68568.]—**Alum in Baking Powder.**—Can baking powder, containing alum, tartaric acid, and carbonate of soda, be sold over the counter in ½d. and 1d. packets by grocers (legally)?—David Ferguson.

[68569.]—**Electric Lighting.**—To Mr. Bottone.—We wish to light a hall, 80ft. by 40ft., with the electric light. Would you kindly say what probable H.P. of engine it will take to do this effectively? Also size of armature—slotted ring pattern—with quantity and sizes of wire wound on armature and F.M's.—Bazaar.

[68570.]—**Clock Dial.**—I have a long cased clock dial, which, at one time has been silvered, but now has turned yellow. Would some one tell me what to do with it to bring it to its original colour?—Country Clock Dresser.

[68571.]—**Calculus.** — In Williamson's "Integral Calculus," p. 185, ex. 2, the following problem is given:—Find the whole area of the curve $a^2y^2 = x^3(2a - x)$. Answer, πa^2. How is this obtained?—Ion.

[68572.]—**Power of Eyepieces.**—Please be good enough to give me the formula for calculating the power of an eyepiece—pancratic or other—of three and four lenses respectively.—T. M. C.

[68573.]—**Patterns for Ashpan Bars.**—Will any one tell me how to cut the bars for circular-front ashpans? Is there any recognised shop rule, and how to turn the feet down to proper angle?—Metal Worker.

[68574.]—**Polishing or Burnishing.**—Will some one tell me how the polishing is done we see on brasswork, such as fenders, ashpans, &c.?—Metal Worker.

[68575.]—**False Notes on the Violin, &c.**—What are these? On some violoncellos, when one string is sounded (notwithstanding that the other strings may be stopped), I can hear other notes simultaneously. Are these false notes? If so, does the presence of these notes prove poor tone and defective quality in the instrument? Also is the reverse—i.e., the absence of these extra notes—conclusive proof of good tone?—W. L.

[68576.]—**Engine for Lathe.**—I am making patterns for a vertical engine, 1¼in. bore, 2½in. stroke. Will two of these cylinders drive a 5in. centre lathe with slide-rest at 60lb. to 80lb. steam? If so, please state size of steam and exhaust ports, and what size and most economical boiler would suit?—Teeside.

[68577.]—**Vulcanite.**—Would some of your readers kindly inform me of the best way to polish vulcanite or ebonite?—B. S.

[68578.]—**Relay.**—Would one of our electrical friends kindly give me instructions how to make a relay for working with bell indicators?—B. R. W.

[68579.]—**Concrete Walls.** — Will any of your numerous correspondents, experienced in the above, give me a little instruction in the following particulars? 1. For a wall of store, say, 30ft. high, in three stories of 10ft. each, how thick should be the wall at each story to store goods of moderate weight? 2. What proportion of good Portland cement to broken stone clinkers, &c.? 3. What quantity of cement would be required for a wall 60ft. long by 30ft. high of the required thicknesses? 4. Are there any works that I could get that would give the information?—Inexperienced.

[68580.]—**Indiarubber Hose.**—Will some reader who has had practical experience with indiarubber goods tell me the best known method for keeping indiarubber delivery hose in stock with the least possible depreciation?—D. B.

[68581.]—**Electro - Magnets.**—I have to make several electro-magnets (in my case weight is of no consequence), so I wish to know if the efficiency is increased by having plenty of iron in the core, or should the weight of the core bear a certain proportion to the weight or length of wire on the core? Is there much difference in the efficiency whether I use both poles or only one pole?—Electro-Magnet.

[68582.]—**Medical Electricity.**—Will some fellow-reader kindly inform me of a book or books treating on the practical application of electricity to the human system, in order to cure disease and to strengthen the weak parts of the system?—Lumbago.

[68583.]—**Engine Brasses Cutting.**—I am in charge of a pair of 11in. Robey engines. The engines are running at the rate of 80 revs. per minute, and the length of the stroke is 14in. I have great difficulty in keeping the brasses of the crank pins cool, and they often cut and cause brass dust to fly about. I have had the brasses taken up recently, so that there is little or no play. The engine runs constantly for nine hours each day, and I am not allowed to stop it for oiling, as there is a siphon oil cup on each bearing, but in spite of this I find when the engine has been running an hour or two the crank pin bearings get very hot, so that I have to throw oil upon them when they are in motion. I shall be glad if any practical person can give me information as to the best way of keeping the bearings cool without stopping the engines for oiling more than once each nine hours.—W. W.

[68584.]—**Racquets.**—We have some tennis racquets that have become warped since last year's using, probably having been put away wet. Would any reader inform us of a way of straightening them without injuring gut, wood, &c.? Could steam be used?—Dui Fratres.

[68585.]—**Piston Rings.**—I have a cylinder, in which is a steel liner, the dia. is 5in. Will any of "ours" let me know of a metal for making piston rings, which shall be hard enough to wear for a considerable time, and also contain a good amount of spring?—Colombo.

[68586.]—**Model Locomotive.**—To "J. H."—In the "E.M." of the 26th. ult., I notice that in the driving-wheels (Fig. 21), the counter-weight is shown on the same side as the boss for crank-pin. Should not this boss be on the opposite side, as represented in Fig. 22? I notice that this is the case in the engines of the L.B. and S.C. Ry., where the two wheels are coupled.—W. J. B.

[68587.]—**Gramme Dynamo.**—I have made a Gramme dynamo, 150c.p., about 45v., 7 amps. I have also the use of an unsteady running gas-engine, which is at work only in the daytime. Will some experienced reader kindly tell me if I could use it to any practical purpose (incandescent lighting), if I made some accumulators so as I could store the electricity during the day for use at night? If so, how many should I require, and size, &c. And what is the best kind that an amateur might succeed in making? I understand very little about them. I have an idea that they are expensive and troublesome, *e.g.*, running down in half an hour or so. I have not met an amateur who has been successful with them. Any information how to proceed will be gratefully received.—Patience.

[68588.]—**Motor.**—To Mr. Bottone or Others.—Will you please give me dimensions, sizes of wire, number of cells, &c., for a motor of one man power? I have a Gramme armature, 8in. dia., 2in. wide, ⅜in. thick, made of iron wire; also 7lb. No. 18 B.W.G. d.c.c. wire, which I should like to use, if possible. Will you also say the power of motor described in your paper, "Motors: How Made, and How Used," April 26, '89.—Regular Subscriber.

[68589.]—**Making Tapered Round Key Ways.**—On a gunmetal nave, or boss, fits a steel wheel; round taper pins, or keys, are driven in between nave and wheel to secure them together. It is required to make a number of steel wheels to fit same nave. How is the half of the round keyway to be cut in wheel, so as to fit on nave with same keys. The wheel fits on tight, the nave has a flange on one side to prevent wheel going on too far. Keys go clear through, and are melted at small end.—A. F. Shakespear, Dresden.

[68590.]—**Portable Steam Bath.**—Could any readers inform me how to make a portable steam bath? I want to make one as cheap as I possibly can, as my capital is limited. Perhaps "Hinkley" will try to give me the necessary information.—Amateur Bath Maker.

[68591.]—**Tramway Gauge.**—Can one of your correspondents inform me the names of the tramway companies that run cars (worked by steam, or any mechanical power), on a 3ft. 6in. gauge?—Scotia.

[68592.]—**To Mr. Bottone.**—I have field magnets of small dynamo, wound with 2lb. 9oz. of cotton-covered copper wire, No. 20 B.W.G. I want dynamo for experimenting with small accumulators and propose to shunt wind. 1. What quantity of wire, B.W.G., should I put on armature H? 2. Would I be able to light one incandescent lamp? If so, of what voltage? 3. Please give revolutions.—PRATT.

[68593.]—**Dry Mangle.**—Can any correspondent tell me of any preparation or process for making dry mangle bowles, so as to keep them from splitting? Also the best kind of wood to use for them, as I cannot manage to get some perfect in the above respect, which I am making.—WOOD.

[68594.]—**Mending Glass Wheel.**—Would some kind reader help me? I have an electric machine with a large glass wheel to it. The wheel is 20in. diam., and I have broken it. I want to know if it can be mended again, and if it will work satisfactorily again. It is plate-glass, and it is broken in half. If it cannot be joined tightly, it is of no use at all.—YOUNG AMATEUR.

[68595.]—**To Mr. Bottone.**—I had, from a firm that used to advertise in the "E. M.," a 5c.p. dynamo as follows:—F.M. wrought-iron, wire space 2¼in. by 2¼in., ⅜in. thick; H armature, 2in. diam. by 2¼in. long. Wire on armature about ¼lb. No. 29, on F.M. 1½lb. No. 22, a shunt; but I can get no current from it. I work it by hand. Wheel 13in. diam. Is the wire right? I would like now to know if the wire as below is right for a 10c.p. dynamo. F.M., cast-iron, 3in. high by 2⅝in. wide, and 1in. thick; wire 2lb. No. 22. Armature 2in. diam. by 3¼in. long, six sections, Siemens; wire ½lb. No. 20 silk.—T. WILLIS.

[68596.]—**Tempering Hoes.**—Will one of your readers tell me the best way to temper hoes without warping them? I mean the common hoes that country labourers hoe the corn with, for when I put them into the water to harden them, they warp very much, and when I straighten them they fly, and my labour is thrown away, and if I warm them a little again it takes too much of the hardness out of them, and leaves them soft. I would gladly learn to temper them scientifically if you can help me.—W. F.

[68597.]—**Iron Melting.**—The cost of plumbago pots for iron melting considerably reduces the value of my labour as caster. I am led to understand clay pots, of one-fourth the value, are successfully used in the trade, and have heard of a special furnace for obtaining quicker heats with clay pots. I should be glad of any information as to iron melting in the quickest and cheapest way. Metal from an air furnace is said to be superior quality than from cupola. Which is the least expensive method of the two for small quantities, between 4 and 6 cwt. daily?—WESTWOOD.

[68598.]—**Electro-Magnets with Horseshoe Magnets.**—To MR. BOTTONE.—Some years ago I inherited a quantity of electrical rubbish. Amongst it I have picked out six horseshoe-shaped electro-magnets of almost identical make, but not quite. Some of these magnets are wound with copper wire, 1-10in. thick. Some while since there was a sketch in our paper of an electro-motor with two horseshoe electro-magnets, which gave me the idea of thus turning the magnets to account. There would be no great difficulty in doubling the machine and making the pulley work between the two sets of magnets. I have worked out the idea on paper, and it seems feasible; but before proceeding I am anxious for Mr. Bottone's opinion as to the probable power to be obtained from it. The magnets are 2in. apart from pole to pole, inside measurement, and are made of 6-10in. soft iron. I propose to use only four magnets, two stationary, and two rotating. The wire I propose to remove, as it is not very well wound. What would be the best size and quantity to rewind them with? The length of available shank to wind is 4in. What diameter pulley would give the best result? It would be possible to set the two sets of magnets at right angles, so that on the first set being half-rotated the second set would be opposite each other; but it seems to me this would lessen the power, and having all four magnets acting at one time be the better plan. The battery power I propose using for it is six chromic-acid cells, each cell holding 16oz. of fluid. Any suggestion of a better use to put six electro-magnets to would be gratefully received by—J. D. H.

[68599.]—**Compound Gearing.**—Will any of "ours" give me a rule to find the increase of power by the use of compound gearing? Example:—What would be the increase of power in a back-geared lathe with the wheels in the ratio of 5 to 1? There is a triple geared lathe illustrated in Lukin's book. How should you calculate increase of power? By using compound gearing instead of single for screw-cutting, how should you calculate the increase of power? Correspondents will see from my letter that I am not much acquainted with the principles of gearing, though I take a very deep interest in machines in general. I can speed pulleys and arrange the wheel for screw-cutting.—POOR ENGINEER.

[68600.]—**Annual Winding Clock.**—If any reader has successfully tried this plan (see p. 71 of last volume), will he kindly give details of the alterations? Is not the statement that "no change is required in the wheelwork" a mistake? I think it must be necessary to accelerate the motion of the hands if that of the escapement is retarded.—CAPE TOWN.

[68601.]—**Faulty Accumulator.**—To MR. BOTTONE.—I have made an accumulator, as described in "Electrical Instrument Making," and, after having formed the plates, I charged it for 10 minutes, and discharged it through an electric bell, ringing it for over 20 minutes. I then charged it again and left it for a few hours, but after that time there was not the slightest indication of a current. I then took the cover off it, thinking that the damp lid short-circuited the plates; but on charging it again I found that it was as bad as before, not giving a deflection after standing a few hours. I may add that I charged it with four good chromic-acid cells, and it is very powerful for about half-hour afterwards. Both compartments are perfectly watertight. I should be very much obliged if you would kindly say where I am wrong.—ELECTRIC-METER.

[68602.]—**Air in Water.**—When getting up steam in a boiler, it always seems to take a long time to boil the air out of the water before steam is generated. What quantity of heat is absorbed in performing this work? In other words, to raise 1lb. of water at 20° to 100° C., requires 80 units of heat; but supposing the water contains its full capacity of dissolved air, how does that affect the statement?—NO SIR.

[68603.]—**Organ at St. Thomas's, Salisbury—Sesquialtera Stop.**—Can any correspondent give me particulars of the organ that was in St. Thomas's Church, Salisbury, about the year 1844? It must have been very old, with single-action bellows, and the tone (as I recollect it) as nasal as the drone of a bagpipe. I should also be glad of information as to the old-fashioned sesquialtera stop. Is it now called by another name, or is it no longer in use?—A. S. L.

[68604.]—**Ellipse.**—Will some correspondent show me how to draw an ellipse by arcs of circles, the two diameters being given? I can draw an ellipse at random with compasses from four centres, but when the two diameters are given I fail. I can draw it by finding the foci and tracing with string and pencil, but what I want is how to draw it with the compasses by four arcs of circle. A sketch would oblige.—POOR ENGINEER.

[68605.]—**Electric Light.**—Can anyone tell me (1) which is most suitable for incandescent electric lamps, Bunsen or chromate of lime? 2. Which requires most batteries, two 5c.p. lamps, or five 2c.p. lamps, and how many Bunsens or chromate of lime batteries, with outer jar 6in. high, would each require?—M. O.

[68606.]—**Burnishing.**—Would some of your readers kindly oblige with hints on burnishing electro-plate, as to the tools required, with information as to manner of holding and using tools?—ELECTRO-PLATE.

[68607.]—**Tin Boiler.**—I wish to put a new bottom in an old tin boiler (which holds about 2gal.). It will have to be cut down a bit. Would some of your readers give me instructions how to do it properly? What tools I require, &c.—J. B.

[68608.] — **25in. Object-Glass.** — In Lockyer's "Lessons," p. 223, he says the pupil of our eye is 1-5in. in diameter; this object-glass will grasp 15,000 more light than the eye can." Is there not an error here? The area of 25in. is 490·87, the area of 1-5 diam. is ·31416. Then the former divided by the latter gives 1562·5 times. Is this correct?—H. A.

[68609.]—**Cutting Tube Holes in Tube Plate.**—Will some reader tell me the best kind of drill to drill them with—from 2in. to 3in. holes? A sketch will much oblige.—E. B.

[68610.]—**Hot-Air Engine.**—In 1886 a small engine was exhibited in Oxford-street, inclosed in the base of a fountain to which it pumped water, which water appeared to be used as the cooling medium. The cylinder was an oscillating one. I have now no opportunity of ascertaining the details of construction, and would be much obliged if some reader would give them. I expected during recent hot-air engines queries that this one might be alluded to, it seemed so compact. I think a paraffin lamp was used. CAPE TOWN.

[68611.]—**Land and Engineering Surveyor.**—Having a desire to emigrate to the Pacific Slope of the United States to practise in this profession, I should feel extremely obliged to any reader for any information regarding the amount of import duties levied upon professional instruments and textbooks, &c., and how they are assessed. Should feel grateful also for advice as to prospects of employment in that region.—M.

[68612.]—**Flattening Wood for Fretwork.**—I cannot get pieces of American walnut for fretwork perfectly flat. Sometimes they are much warped out of the level. Will any experienced reader kindly give me instructions how I may most easily and effectually make them flat?—L. C.

[68613.]—**Boiler.**—I am making a vertical boiler, ¼ steel plates. Length inside the boiler 42in., 18in. diam., with firebox 24in. high by 15in. diam., uptake 5in. diam., one cross tube 4in. diam. Will some one please say if this boiler requires stays, and what pressure would be safe?—A. C.

[68614.]—**Zincs.**—Would some reader kindly tell me how the zincs for Leclanché batteries are cast? I have plenty of zinc and can amalgamate them.—EXPERIMENTER.

[68615.]—**Lamps.**—Would Mr. Bottone kindly tell me whether four batteries with two carbons and one zinc, 2in. by 5in., and charged with chromic acid 3, sul. acid 3, and water 17, would light a lamp of 6 volts and 5c.p.?—EXPERIMENTER.

[68616.]—**Force of Explosives.**—An old reader wants to know the resultant force of a cubic inch of the various explosives. Perhaps some one of our many readers will help me.—PRO BONO PUBLICO.

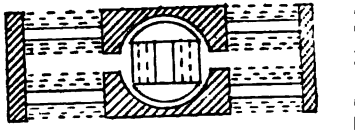
[68617.]—**Speaking Tube.** — Would any reader kindly inform me if they think a speaking tube would answer, overhead, for a distance of 80 to 100yds., slung on a telephone wire, and also what size tube would be required? I have been using a telephone, but have had to take it down, and think of thus communicating with my warehouse. Are there any other means of doing so?—C. W. GREENWOOD.

[68618.]—**Fixing Corrugated Roofing.** — Will some of "ours" kindly advise me as to the proper way to fix iron roofing, with the correct amount of lap to be allowed each way of the sheets, and how to proceed, or if they know of any book that gives information on this subject?—BRAZIER.

[68619.]—**Measuring Time.**—Would some of our readers give a description of an arrangement for measuring extremely minute intervals of time shorter than can be recorded by a chronograph watch?—HOBO.

[68620.]—**What is It?**—I picked up at a second-hand store what appears to be an optical instrument. Its outward appearance is that of a frustum of a square pyramid. The upper end is 2in. square, the lower 4in. square, and the height 6in. The sides and top are of mahogany, 1-16in. thick. On the top is inlaid the words "Boyle's Patent." The bottom is open. Inside the box one sees plane mirrors stretching from top to bottom along the sides, while to the upper end is attached a square piece of mirror, whose surface feels to the finger to be part of a spherical surface. On looking into the mirrors from the open end I see multiplied reflections, but I should feel obliged if anyone can tell me what is the purpose of this instrument.—MAC.

[68621.]—**To Mr. Bottone.**—Many thanks for your information with regard to the dynamo. I was afraid you would not understand my explanation of the motor without a sketch. So will you please give the smallest si motor, according to sketch, that would work a model tram-car 2ft. in length. The wheels of the tram are to be across. I am going to use a band to drive with. I ha the wheels geared down in the proportion of 1 : 4. The cel



I am going to use are six single-fluid bichromate dou carbons, 4in. by 2in. Will you also say if this is the be form of motor, and if it is not, do you mind telling me t best form? It must be small and compact, as it is to underneath the car.—W. S. TANKIN.

[68622.]—**Backgrounds in Photography.**—W any fellow-reader oblige by giving some informatio making a few scenes for small studio?—A. A.

[68623.]—**Storing Negatives.**—Wanted a syste atic method of storing negatives, so that they may preserved and any one got at when wanted.—A. A.

[68624.]—**Photographic.**—1. Will some one say h to paint calico for photo. background? I cannot get of brush marks. 2. What causes sensitised paper to covered with black spots after keeping for a few days buy the best I can get.—Y. Z.

[68625.]—**Arc Lamps.**—Would Mr. Bottone or other reader tell me the cause of the humming occasionally heard in arc lamps? I have several of th in series, and sometimes one or other of them mak humming noise, similar to the sound of the alternate cur machine. There is no defect in the light, and the carb are good.—M. F.

[68626.]—**Incubator Regulator.**—I have made incubator with a regulator of my own design, to w with a liquid bursting into vapour rapidly at 98° Fa Such a liquid is used in Hearson's and Hillier's incubat I have purchased ether, sold by a well-known chemis "·720 Rect."; but on immersing an open tube of it side side with a thermometer in water and gradually raising temperature of the water, the thermometer showed Fahr., before the ether boiled. Can any reader tell how to prepare, say, 2oz., of the liquid, whatever it that boils at 98° Fahr., as used in Hearson's and Hill incubators?—INCUBATOR.

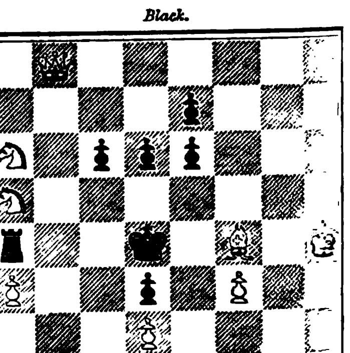
[68627.]—**Gassendi.**—Have any illustrations of lunar formation appeared recently in the "E. M Should like to have all references to any drawings of —C.

CHESS.

ALL communications for this department mu addressed to "J. PIERCE, Knollside, Uplyme, Devon."

PROBLEM MCXLVIII.—BY A. BOLUS.

Black.



White. [8 + 7

White to play and mate in two moves.

SOLUTION TO 1,146.

White.	*Black.*
1. R-K Kt 4.	1. Anything.
2. Q or Kt mates.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,146 by A. Dean, T. A. Pr R. T. Hood (excellent), Mendelssohn, F. C. Cook (good, but rather easy), A. Wheeler, Litho, J. C. Bre Retchford (a most excellent problem), A. W., J. Smith, Mrs. W. J. Baird, E. Sanders, and Hensing not difficult); to 1,145 by E. Sanders (triple), A. B (ditto), J. C. Bremner (ditto), J. Ough (ditto), A. Whe (ditto), F. C. Cook (ditto), W. Jay (ditto), Retchfo and Hensing; to 1,144 by Link and Litho.

As some correspondents seem to have understood 7 to mean that extra marks were only allowed for and not for triples, &c.—as the language is open to construction, we have thought it fair to allow those sent the duals in the solution of 1,141 full marks.

G. J. SLATER.—Many thanks for the problems.

FR. FERNANDO.—Why is 1,146 impossible of solutio a two-mover?

The *Holloway and Hornsey and North Metropolitan* has started a chess column, which is very ably con and contains interesting matter, especially in rela to the present International Tourney now going on New York.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 8, and unacknowledged elsewhere :—

F. A. COBBOLD—Horne and Thornthwaite—Jerry Wireman—Precursor—Founder—Practical—Glass Decorator—James Day—J. D. Watkins—The Lydney Dispenser—W. Preston—J. L. D.—G. T. C.—In the Dark—Gravity—R. A. R. Bennett—Edward M.—G. Dixon—Chas. A. Jones—D. B. L.—W. J. A.—E. E. B., Leicester—A. Caplatzi—Thomas Clarkson.—Rev. F. Carre.—M.I.C.E.—S. Bottone.—Student.—A Fellow of the Royal Astronomical Society.—P. Clifford.—J. T. Norman.

C. IRWIN. (The only directions for making American organs that we know of were given in Vol. XXVI.; but there is a great deal of useful information in subsequent volumes. You will find where to purchase these fittings or parts by consulting our advertising columns.)—W. H. NICHOLS. (The "flue" must be got from the chimney—the rain-water stack will scarcely do, when it rains! Why not connect the furnace to the kitchen chimney? See indices of back volumes for all about brass-casting.)—MASSEY BROWN. (If you want anything more than Bath-brick (and elbow grease) for cleaning your brass, use a solution of oxalic acid, swilling well in hot water and drying thoroughly.)—ONE IN DOUBT. (If in doubt about diabetes, consult a medical man. Surely it is folly to trifle with such a matter!)—SAVON. (See several recipes in back volumes. The grease is boiled with potash to make soft soap; with soda to make hard soap.)—GODIVA. (We really do not know, as we never heard of Queen Anna—surely it is Queen Anne; but it is well to be particular on so important a matter. The value, however, is exactly what anyone will give for it, and that can be discovered by advertising it in the Sale Column for offers. Many people seem to imagine that a fixed value attaches to old coins, whereas as much depends on their condition as on their age, and more still on their rarity. If your coin bears the date of 1710 that is not even "old.")—J. JONES. (When flowers and vegetables are growing freely you may give as much as 2oz. of sulphate of ammonia or nitrate of soda to the gallon of water, but it is better to scatter it on the beds at the rate of 2oz. or more to the square yard, and leave it for the rain to wash in. Don't understand about the "uncivil" answers. You have taken the paper for fifteen years, that is thirty volumes, and the above information has been given many times in them.)—ANXIOUS. (Unless you want a considerable quantity you will find it cheaper to purchase any silver solder you may want. However, here are two good solders—the hardest being 5dwt. of shot copper to the ounce of fine silver, while a common solder consists of equal parts of fine silver, "composition," and white arsenic. The "composition" is a brass which may consist of two parts copper to one of zinc.)—SILVERSMITH. (How can anyone answer such a question without a sketch of the article? Cut a piece of wood, or use a tool that will fit, and polish with rouge. Corners and under-edges are not easily polished without labour.)—TONBRIDGEAN. (Articles on electric motors appear in Nos. 1,236, 1,238, 1,242, 1,246, 1,251, and 1,257.)—SHAH JEHAN. (Hydrokinone is well known, and is generally called "hydroquinone." See back volumes, or some such book as Wall's "Dictionary of Photography.")—W. B. (As its name implies, wholemeal bread is made of wheat ground to a fine meal and unbolted.)—G. AND M. BARNES. (It has been decided by the Courts that all telephones possessing carbon-contacts are infringements of the patents.)—A. G. BEALE. (We imagine not, for although some acids, when very strong, do not attack iron, we imagine they would do so very freely in the presence of brass or copper.)—SCIENTIST. (Better procure the "Calendar" from the Registrar of the University if you cannot refer to back volumes. The number of books of Euclid have very little to do with such an examination. Better inquire about the matriculation first.)—LANGDON. (You were answered last week on p. 207.)—YOUNG ELECTRICIAN. (Not unless it is the subject of a patent, and that would be mentioned if it is the case.)—W. J. C. (Get some labels from a bookbinder and stick them on, or, failing that, get a printer to print in varnish or gold size the lettering required, and then dust on bronze powder or cover with gold leaf.)—J. P. D. (Answered many times, even in recent numbers.)—ONE WHO DOES NOT SMOKE. (The only way to prevent gnats biting you is to keep them away, which can be done by the use of some strong-smelling preparations—chloride of lime, carbolic acid, or some of the special preparations sold by druggists.)—PHOTO ENAM. (See indices for several methods of enamelling photos. Perhaps those in No. 1,207, p. 243, will suit.)—R. A. R. BENNETT. (The secretaries of the Royal Society are Prof. M. Foster and Lord Rayleigh, but for ordinary purposes it is usual to address the assistant sec., Mr. H. Rix, B.A. A candidate for admission must be proposed by six Fellows, three of whom have personal knowledge of him. The entrance fee is £10, with an annual subscription of £4. The advantages are the right to attend the meetings, &c., the use of the valuable library, and copies of the *Transactions* and *Proceedings*. As you mention "Member," there is just a suspicion that you mean the Royal Institution: the members of the Royal Society are all Fellows.)—E. Y. P. (Quite impossible to reproduce sketch of negative sent.)—B. (Guildford is a fairly mild and healthy town.)

Rupture Sufferers should call at the MEDICAL BATTERY COMPANY'S INSTITUTE, 52, OXFORD-STREET, LONDON, W. (corner of Rathbone-place), and personally inspect Mr. C. B. Harness' valuable Hernia Appliances, which have been so strongly recommended by the medical profession. An experienced and skilful surgeon attends daily, and examines patients free of charge. Pamphlets gratis and post free.

Saccharin as an Antiseptic.—Dr. Fourrier, of Compiégne, writes that since it has been asserted that saccharin hinders the action of the digestive fermentations, and that clinical observation has shown that its ingestion is susceptible of troubling more or less profoundly the functions of digestion, it has been prohibited as an alimentary substance. But saccharin remains a medicament, and, according to the experiments lately undertaken by Dr. Constantin Paul, it may be placed in the class of antiseptics. As such, Dr. Fourrier thought it rational to try it in the treatment of aphthæ, and clinical experience fully confirmed his theoretical previsions. The author treated ten cases of aphthæ following measles by paintings with a solution of saccharin. Eight times the milky patches disappeared in twenty-four or thirty-six hours. Twice only they resisted for three days. But in these two cases the paintings were evidently not properly executed. The following solution was employed: Saccharin, 1 gramme, alcohol at 60°; a teaspoonful in half a glass of pure water, with which five paintings should be practised per day. A more concentrated solution would be hurtful, as has been shown by several cases.

THE *Sheffield Telegraph*, referring to a proposal to erect a memorial to the late Mr. Charles Markham, chairman and managing director of the Staveley Coal and Iron Company, recalls the service rendered to the railway interest by the deceased in two matters. One was the invention by which coal could be used in locomotives instead of coke, saving £50,000 a year to the Midland Company alone; the other in the grip or guard attached to the engine, known to every driver as his "Markham," by which hundreds of lives are believed to have been saved.

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The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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6s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post Office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

Vols. XXVI., XXX., XXXII., XXXIV., XXXVI., XXXIX., XL. XLII., XLIII., XLIV., XLV., XLVI., XLVII., and XLVIII., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

Holloway's Pills.—The chief wonder of modern times.—This medicine increases the appetite, cleanses the liver, purifies the system, invigorates the nerves, and re-instates sound health, and a single trial convinces the most sceptical that no medicine equals Holloway's Pills in its ability to remove all complaints incidental to the human race.—[Advt.]

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Self-acting Planing or Shaping Machine wanted. Would exchange SAW BENCH, with two saws, and part cash.—JAS. SPENCER, Wilton House, Bournemouth.

"**English Mechanic,**" volumes XVI. to XLVIII. (33 vols.), 1873 to 1889, unbound, in good condition. What offers?—Apply, CLARKE, Advertising Agent, Market Hall, Dumfries.

Wanted, old Postage Stamps, especially those of the Colonies. No English excepting high values. Very good exchange offered.—COLLECTOR, 125, Coltman-street, Hull.

Wanted, Juvenile Tricycle, in exchange for new DYNAMO to value.—HELLYAR, Electrician, 144, Dalling-road, Hammersmith.

Two manual **Organ Soundboard**, for pair light, good 6in. Lathe Heads, back-geared.—324, Kennington-road.

"**Cassell's Technical Educator,**" latest edition, new, unbound, cost 13s. What offers in Electric Bells, or parts, or gas fitter's Tools?—J., 13, Brook-street, Wycombe.

Motor, armature 8in. dia., 1⅞in. wide, reversing gear, polished baywood base, 12in. by 11⅞in. Brass terminals, adjustable brushes. Wanted, Lathe Castings, or offers?—SUNDERLAND, 33, Hendham-vale, Manchester.

Air Gun and **Electric Bell, Bobbin Winder**, given in exchange for ¼-plate Camera and Accessories.—J. R. PYBUS, West Burton, Bedale.

52in. **Bicycle**, as new, offered for Lathe, with iron bed. 56 Bicycle, Gun, Oil Paintings, Banjo, Violin, Coins, Books, Camera, Lathe with wood bed, &c. Offers.—9, Dingle-road, Tranmere Park, Birkenhead.

Strong, well-made, horizontal, slide valve **Engine**, 2in. bore, heavy flywheel, 13in. dia. Exchange for Portrait Lens.—ED. DILLISTONE, Royston, Herts.

Large **Ratchet Brace**, 8 fluted Rimers, one ⅜ fluted Drill, one pair of ⅜ taps, Whitworth's. Offers.—37, Freeth-street, Jordan Well, Coventry.

Wanted, Violoncello, in exchange for fine shaped old VIOLIN, with case and bow, value about 30s.—UFFINDELL, 5, Park Villas, Carlton-grove, Battersea.

"**English Mechanic,**" 4 Vols., XI., XII., XIII., XIV., clean, well bound, condition as new. Offers.—HAVORY, 15, Union-square, New North-road.

Bicycle, value £4. Will exchange for Furniture, or Jewellery (Coventry 50in. ball bearings).—A. PITMAN, Marlborough House, Knockholt, Sevenoaks, Kent.

Wanted, Kneehole Table, or something useful for Office, in exchange for splendid TARGET or Look-out Telescope (by West, Strand), tripod stand.—GOAMAN, Bridgeland, Bideford.

Hull of model steamer, mahogany built, 3ft. by 5in. beam. Exchange Travelling Bag or offers to £1 8s. value.—COOKE, Elm Brewery, Southsea. Below.

Back geared **Drilling Machine**, drills ⅜ hole, highly finished. Vertical Engine, cylinder 2⅛in. by 4in. stroke. Castings of two 2⅛in. by 3in. stroke cylinders and standards. Exchange.

"**Cassell's Technical Educator**" to date, "Bottone's Electrical Work for Amateurs," new; model Steam Boiler and Engine. Wanted, small Dynamo or offers.—Below.

Foot Lathe, 18in. between centres, 4 speed, for wood or metal. Wanted, 52in. Bicycle, Safety, or offers.—YOUNG, Thompson's-lane, Cambridge.

Five-light dry **Gas Meter**. Would exchange for anything useful to the value of 25s.—MCINERNY, 69, Nine Elms-lane, Vauxhall, London.

⅝in. by 1⅛in. brass **Horizontal Engine**, link motion, reversing gear, 10in. by 5in., copper boiler, with fittings. Exchange, with cash, for Safety Bicycle. Offers.—CALDWELL, Dock Works, Preston.

Wanted, small **Slide-rest** for 2½ lathe. Must be a good one. Will exchange either CORNET, Banjo, or Watch.—KEAR, 26, Parliament-terrace, Nottingham.

Wanted, small shunt wound **Dynamo** for plating purposes. Will exchange small ENGINE and BOILER on stand, horizontal, perfect condition.—KEAR, 26, Parliament-terrace, Nottingham.

Wanted, ½-plate Suter or Beck wide-angle **Doublet** Lens. Exchange DYNAMO, recently fitted with laminated armatures by Mr. Bottone.—NEWBOULD, Belgrave-square, Sheffield.

Medical Coil, in good order, battery, and all complete. Excellent for doctors or market purposes. Exchange for anything useful to value of seven guineas.—Apply, J. GOWLAND, Middlestone-moor, Spennymoor.

Microscope, magnifies 5,000, cost 7s.; Electric Battery, Motor, and Shocking Coil, complete, cost, new, 5s. What offers? Watch preferred.—E. CLIFFORD, 127, Upper Dorset-street, Dublin.

Exchange **Electric Bell**, 2½in., with gold plated gong, Leclanché Cell, ebony push, for working Model Engine, or Telescope.—MARTIN CARR, Wilton-crescent, Glasgow.

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Genuine **Wolver Safety**, rear-driver, high class, by Jones, Wolverhampton, equal to new, 1888 Pattern, balls throughout. Offers.—The Field House, Wightwick, near Wolverhampton.

Medical Coil, very powerful, six powers, regulating tube switch, handles, improved bichromate battery, complete, quite new, highly finished. Offers to 50s. value.—Address, below.

Wimshurst (pretty) **Machine**, new, 17in. discs, 4 jars, latest pattern, photo and particulars, 4 stamps. Exchange to £4 value.—RANDLE, Melton-street, Kettering.

Set Tricycle Wheels, new, balance gear, chain, cranks, pedals, &c. amateur could easily complete. Want drilling machine, lathe accessories.—HUBBELL, 58, De Beauvoir-road, N.

Record Cyclometer, 12s. 6d., suit any size cycle, serviceable M.I.P., 7s. 6d., both good as new. Wanted, two induction coils, 3 or 4in. long, insulated wire, magneto machine, Fuller's or Leclanché cells, or offers.—JOHN BARNES, Carrick-on-Suir.

Splendid **Vertical Engine**, about ¾H.P., new, good design and workmanship, reversing gear, suit lathe or launch. Exchange to value £5 in small vertical boiler.—55, East-road, Stratford, E.

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Vertical Engine, 2in. bore, beautifully finished, principally gunmetal and steel, suitable for shop window. Offers to value of 70s.—H. Berry, Church-street, Sudbury, Suffolk.

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Excellent **Double Bass**, machine head, perfect, complete, with bow and bag, 6gs. Exchange Violoncello, or other suitable instrument entertained.—Henry Wilson, Football Field, Yeadon.

Bright copper riveted loco. type **Boiler**, ⅛in. thick, with chimney and safety valve, water gauge cocks, will work at 100lb. pressure; also Model Beam Engine, 2½in. bore cylinder, complete, all bright. Exchange to value of £10.—279, St. Philip's-road, Sheffield.

Besson's B flat **Cornet**, in case, 55s.; Besson's Soprano, 45s.; Oboe, 80s.; Clarionet, 14 keys, rings, 55s. Bargains, all as new. Exchange. Double prices cost.—Hirst, 13, Greaves-street, Little Horton, Bradford.

American Organ, best makers, just new, 13 stops, including couplers, swells; nothing superior, 24 guinea instrument. Cash, 14gs. Part exchange, Gold Watch, or small Harmonium for learner.—John Wood, Harper Rock House, Yeadon.

American Organ, with Vox Humana knee swell and 7 stops, perfectly new. Cash and useful exchange.—Address, T. W. W., Post Office, Bourton, Dorset.

18in. continuous **Electric Bell**, with silk-covered bobbins, and 4 Leclanché Cells.—Sidney Lush, Bourton, Bath.

Model **Launch Engine**, cylinder 1 by 1½in., for Boat 5ft. long, good repair and working order, reversing motion; will exchange good Chuck for 3in. Lathe.—B. Fairthorne, Shrivenham, Berks.

Wanted, **Garden Tent**, useful exchange given.—Clarke, Applegate-street, Leicester.

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Half-horse power **Water Motor**, in perfect order. Wanted, offers in exchange to 20s. value.—Walton, 9, Queen Anne-street, Shelton, Stoke-on-trent.

Photography (Hunt), latest processes, with illustrations. Published at 6s. For good Bicyle Bell.—4, Collison-street, Nottingham.

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Wanted good Brass-finisher's **Lathe**, Large Parallel Vice, Large Emery Wheel on Frame. Metal-polisher's Spindle 36in. long, Hand-power Drilling Machine to ⅜in. Have for exchange, Electrical Pneumatic and other Appliances too numerous to advertise.—Address, W. B. 166, Queen's-road, Bayswater, W.

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Unbulky **Scientific Goods** wanted for fine old tenor Violin, 13 keyed Clarionette, Concert Flute, a Piccolo, and Drum.—Caplatzi, Chenies-street.

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Mineral Water Machinery, like new, third price, for Surgical, Drawing, or Surveying Instruments, value £5.—Caplatzi, Chenies-street.

Weighing Chair and Dial, Street Polyramas, Lung Tester, Large Telescope, for small scientific goods.—Caplatzi Chenies-street, London, W.C.

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Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—Harger Bros., Settle, Yorks.

New Illustrated Price List of **Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp—Morris Cohen, 132, Kirkgate, Leeds.

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Brass **Door Plate**, 9in. by 4½in., free, 4s. 6d. See specimens.—Gilkes' Engraving Works, Reading.

Stencils for sack, box, and ticket marking. Price and quality unsurpassed.—Gilkes' Engraving Works, Reading.

Diamond Drills, from 1s. Spring Drill Stock and postage, 1s. 3d.; Pump, do., 4s. 1½d.—Below.

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Glaziers' **Diamonds**, from 6s. 6d.; re-sets, 2s. 6d. Circular Cutting Diamonds, Diamonds for Lapidaries.—Below.

Diamond Sparks, for China riveters, from 6d.—Woods and Toussaint, 54, Spencer-street, Clerkenwell, London.

Gut Band (Lathes), best, per yard, ⅛, 6d.; 3-16, 8d.; ¼, 1s.; 5-16, 1s. 4d.; ⅜, 1s. 11d. Hooks and Eyes (Steel), to ¼, 6d. 5-16, 7d.; ⅜, 8d.; 7-16, 1s.; ½, 1s. 6d. Postage extra.—Lunt's.

Taps (Engineers'), Whitworth, plug or taper, ¼, 5-16, ⅜, 8d.; 7-16, 10d.; ½, 1s.; ⅝, 1s. 3d.; ¾, 1s. 6d.; ⅞, 2s. 3d.; 1in., 3s. each, postage extra.—Lunt, Tool Merchant, 297, Hackney-road, London.

Microscopic Mounting Materials.—All kinds of requisites supplied at Norman's, 178, City-road, on the lowest terms.

Wheel-cutting and Dividing to 12 inches diameter, in brass only.—Clegg, Belinda-street, Hunslet, Leeds.

Write for **King, Mendham and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

100 Packets of genuine, freshly-saved, hardy **Flower** Seeds for 1s., post free, 1s. 2d.; all named and every packet different Probably the most extraordinary shillingsworth ever offered in any advertisement. If not considered worth four times the amount they can be returned, and the sum paid will be at once refunded in full, or the parcel can be sent without prepayment if satisfactory references are given. Fresh genuine vegetable seeds also for disposal. Respectable men wanted, to add to their income by selling above on commission.—T. Richards, 5, Cranham-terrace, Oxford.

Smokers, don't buy pipes before seeing the "**Medical** Patent," illustrated particulars, post free.—Address, Patentee, 52 Cotham Hill, Bristol.

Microscopy.—Instructive list of really high-class botanical preparations, with sample, 2d.—Walter White, Litcham, Swaffham.

Boats, 14 by 4½ft., Hardwood Frames, carvel or clinker, £6; cash with order.—Harrison, Devoran, Cornwall.

Electric Bells, 2½in., 3s. 6d.; 3in., 4s. Indicators, large variety of presses, &c., stocked for prompt delivery.

Cheapest House in the Trade.—Send four stamps for our illustrated catalogue.—J. Sunderland and Co., Electrical Engineers, Halifax.

Ejector Steam Jet Pump, will throw 350 gallons per hour, new.—Particulars, F. Elliott, Playden, Rye.

Propeller Stern Tube, &c., 18, 16, and 12in., three bladed, shaft and coupling complete.—F. Elliott, Playden, Rye.

Headstock and Poppet Castings, sets 5in. and 3in.—F. Elliott, Playden, Rye.

Turner's **T-Rests and Tees**, suitable for any lathe, 3in. centres and upwards, with every adjustment.—F. Elliott Playden, Rye.

Drilling Machine, for hand or steam power, to 1½in. holes, complete with drills, as new.—Below.

Safety Valve, 1in., with lever and weight, two cylinder lubricators, and quantity steam fittings.—F. Elliott, Playden, Rye.

Fluid Malt is the best aid to digestion known.

Fluid Malt is invaluable in all cases of debility, exhaustion, consumption, convalescence, and weakness.

Fluid Malt is a powerful fattening agent, containing all the best principles of the choicest English Barley Malt.

Fluid Malt is the best and cheapest preparation of malt sold. Post free for 1s. 9d. and 3s. 6d. of Reffell Bros., Bexley, Kent.

Organ, metal dulciana tenor C, 54 pipes, 28s.; Flute, 15s.—Mr. Reid, Talbot-street, Whitchurch, Salop.

"**Sheet Metal Worker's Instructor**" (Warne's), few copies cheap, covers slightly soiled.—94, St. Augustine's-road, London, N.W.

Military Brass Band Instruments, part of a band, perfect condition, no dents, best make. Will send any on approval before purchasing. To be disposed of at less than half price.—For list of instruments address, Band Secretary, Lewanick Lodge, Granville-road, St. Alban's, Herts.

Equatorially mounted 8½in. **Reflector**, by Berthon, With's speculum, sidereal clock.—C., Franklands, West-end-lane, N.W

Electric Wire of every description, cheap and good, best quality only.—Chas. Silver, Manufacturer, 11, Hayling-road Stoke Newington, N.

Dynamo Wire, double cotton-covered, all sizes to No. 18 B.W.G., 1s. 4d. per lb. Sample 2d. Line Wire from 3s. 6d. per ¼th of mile.—As above.

Indiarubber and cotton-covered **Line Wires**, No. 22 B.W.G., 6s. 6d. per 220 yards, carriage paid. A few job lines of silk-covered Wire, new, cheap.—As above.

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Photographic Catalogues, free. "Aptus" finder, 2s. 6d.; Self Lighting Burner, 2s. 6d.; Shutters, 2s. 6d. Dropping Tube, 4d.; Head-rest, 5s.—Below.

Half-plate Double Extension **Camera**, guaranteed equal to any sold at £5, price 66s. Approval.—Vevers, Market-street Leeds.

Water Meter (Siemens), 1½in. tinned unions, dial cover, working order, 60s.—H., 55, Calverley-grove, N.

Duplicate **Micro-Slides**, 3s. 6d. per dozen. Conditional approval. List (returnable) for stamp.—Microscopist, Mottram, Manchester.

Wood-turners **Foot-Lathe**, 5in. centres, 4ft. 6in. cast iron planed bed, T-rests, £4.—Lazenby, Tiverton, Devon.

Telescope, O.G. 3½in. diameter, and 5 eyepieces, all by Dolland, length of tube 5ft., stands 5ft., all fittings, &c., best brasswork, in complete order in all respects, cost £80, price £30.—Address, W., 139, Bury New-road, Higher Broughton, Manchester.

Cheap **Rubber Stamps.**—Name, 1s. 3d.; address, 1s. 9d. Warranted best make. Lists free. Agents wanted. White and Co., New Wimbledon.

Organ Soundboard, two manual, complete, with action ready for keys. Description for stamp.—324, Kennington-road

Boilers, all kinds and sizes.—Vertical, Portable, Cornish.—The Grantham Crank and Iron Company, Limited, Grantham.

Capital 4H.P. second-hand **Engine**, nearly equal to new, low price taken.—Crank Co., Grantham.

Vertical Engines, newest designs, with or without boilers.—The Grantham Crank and Iron Company, Limited, Grantham.

Dynamo Wire, best quality, cotton-covered, high conductivity. Sample, stamp.—F. Holloway, 35, Summerfield-crescent, Birmingham.

Piles!—Palmer's "Indian Ointment" cures agonising cases, 13½d., 2s. 6d., internal remedies included.—Chapel-terrace, West Auckland, Durham.

Palmer's Renowned Prescriptions, 2s. 6d. Curing quickly Chronic Losses, &c. Thirty years' celebrity. Blood purifying remedies included.—Above.

Dancer's New Micro-Photos.—Sample and list 500, 1s. 2d., free.—10, Granville-street, Moss-side, Manchester.

Catgut, a quantity of good, 7-16 thick, good condition, 2s. 9d. per yard.—Green, 11, Sutherland-terrace, Pimlico.

Booth's **Mitre Machines** to be disposed of cheap, a bargain. Small size, 11s. 6d.; large, 20s. each.—Green.

The Handy **Parallel Vice**, No. 1, 8s. 6d.; No. 2, 13s. 6d. each.—Green.

For **Cycle Fittings** of every description, Safety and Tricycle Frames.—Write, "Pentagon" Cycle Co., Holloway-road, London.

A number of **Microscope Objectives** at greatly reduced prices.—A. Dancer, 3, Monton-street, Greenheys, Manchester.

Heft Band.—Self-adhesive bandage, 3 yards, in case, 7d. free.—Cassell, 16, Rutland-street, N.W.

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Smoke British Herb Tobacco.—Quarter pound (nearly), 7d.; half-pound, 1s., post free.—Knight, Druggist, Portsmouth.

Fretwork.—Tools, Materials. New catalogue, containing 400 illustrations, free, 4 stamps.—J. Howard and Co., East Dereham.

Mixing Paints.—A new book, containing trade recipes, with instructions and details for mixing, making, and using all kinds of paints, oils, colours, &c., free 1s. 3d.—C. King, 28, Churchfield, Barnsley, Yorkshire.

Model Engine Castings, Parts, &c. Catalogue 4d., 83 Illustrations.—Butler Bros., Bentham-road, South Hackney, London.

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Brass Model Engine Castings, rough and finished. List stamp.—Wood, 15, Dalley-street, Broughton, Manchester.

Zinc **Stencil Plates** for marking sacks, boxes, &c. Estimates free on application.—Deacon and Son, Ramsgate

Brass **Door Plates**, 9 by 4, any size, sent free 4s. 6d.—Deacon and Son, Ramsgate.

Brass **Memorial Tablets** designed and engraved. Estimates and sketch free.—Deacon and Son, Ramsgate.

Launch Engines, 6in. 4½ and 3in. bore. Boilers, Lathes, all kinds of Machinery at reduced prices.—S. Smith.

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Toned Sensitised Paper, only requires fixing, universal satisfaction; sheet, 22 by 17, free 1s.—Brandon Medland.

Platinotype Paper, no developing, no toning, 1 dozen free, ¼, 10½d.; cabinet, 1s. 5d.; ½, 1s. 8½d.—Brandon Medland.

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Cyclists.—Use "Graphine" on your chains; no grease, will not hold dust, 8 stamps, free.—Wolff and Son, [illegible] Pencil Works, Battersea, S.W.

Amalgamating Brushes, Scratch Brushes, Polishing Sand, Calico Mops, Rouge, and Lime Composition, Nickel Salts, and Anodes.—Henric.

Gold, Silver, Copper, and Nickel-plating **Solutions**. Practical Hints, 1 stamp.—Henric, 234, Great Colmore-street, Birmingham.

Use Henric's **Scratch Brushes**, each brush warranted.—Henric, 234, Great Colmore-street, Birmingham.

Popular Microscope Slides, 5s. dozen. Microscopes, Accessories, Mounting Requisites. List.—Henry [illegible] 344, Caledonian-road, London.

Dynamo Wire.—Best double cotton-covered, to 18 B.W.G., 1s. 1d. lb.—F. Holloway, 35, Summerfield-crescent, Birmingham.

Half-horse **Engine and Boiler**, complete £5 10s. sacrifice; ask particulars.—Clarke, Sunnyside, Berkhamsted.

Nickel Silver Watch, a good timekeeper, only 6s. 6d.; also good Telescope, only 5s., a bargain.—Below.

A good first class **Cornet** in case with books, only 25s., bargain.—Mack, New-street, Cromer.

Plumbago Crucibles for melting 4lb. of brass 1s. 6d. post free.—Geo. Wells, Needham Market, Suffolk.

Lathe, 6in. centre, 4ft. bed, standard, wheel, crank, [illegible] iron, £5 10s.—R. Alderton, Walton-on-Thames.

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A lot of **Organ Parts** and pipes, new and second-hand, cheap. New list, stamp.—Burton, Winchester.

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Castings for making a half-man power gas-engine complete, 44s. Working drawing, 3s. Lithograph, 3 stamps.

Complete Castings as above including forgings, piston rings, bolts, nuts, and working drawing, £3 7s.

Half-horse power **Gas Engine Castings**, £. Working drawing, 7s. 6d. Illustration, 3 stamps.

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Our Patent **Benzoline Gas Lamp** for workshops, &c., is a marvel; 33s. per dozen; sample, 3s.

Steam Engines, Pumps, Boilers, Hand or Power Hoists, &c. Send 4d. stamps for lists and illustrations to The Engineering Supply Company, 15, Plymouth street, Plymouth-grove, Manchester.

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Say Boss! if you want a good book, one worth reading, write to E. May, 60, Buckledge-avenue, Harlesden, London, N.W., for catalogue.

The English Mechanic
ND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 17, 1889.

LECTRIC-BELL CONSTRUCTION.— X.

By F. C. Allsop.

Relays.

RELAYS are of two kinds—the "ordi- dinary" or "unpolarised," and the polarised." The *unpolarised* relay consists an electro-magnet, above the poles of hich is supported a soft iron armature rrying at one end an arm fitted with a itable contact. Below this arm is another ntact piece, with which, whenever the mature is attracted, the arm makes con- ct. The armature is attracted, and the al circuit through the relay closed when- er a current circulates in the coils of the ctro-magnet, no matter in which direction flows.

In the *polarised* relay the soft iron arma- re (which is inductively magnetised by a rmanent magnet placed in close proximity it) works between the two poles of the ctro-magnet, the one pole repelling and e other attracting it, according to the rection of the current. As in the un- larised form, a contact arm is fitted to one d of the armature, which moves between o contact-screws, the arm making contact th either screw, according to which direc- n the current is flowing. The essential fference between the two forms consists, it ll be seen, in that: whilst in the un- larised form the same action takes place, ether the current is a positive or a nega- e one; whereas, in the polarised form a verse action is obtained with a negative to at with a positive. As the unpolarised rm is the one always employed in electric- ll work (the other form being chiefly used telegraphy) we shall confine our remarks it.

Relays are required in electric-bell work r two purposes—1st, for use on long lines d high resistance circuits, where the line rrent is not strong enough to work the ll or other electrical apparatus, but quite fficient to attract the delicately-poised mature of a relay; and 2nd, for fixing in dicators, &c., where it is not desired to ork the bell through the indicator move- ents. In either case, the duty of the relay the same—viz., to close a local circuit hen actuated by a current circulating in its ils. In the first case, it will be seen that, the line current is generally very feeble, the relay must be designed to work with the minimum of battery-power, and must also be capable of a delicate adjustment. In the second case, however, there is generally plenty of battery-power available: thus a relay for use in an indicator is generally designed more with a view to compactness than efficiency. In a well-designed relay, where sensitiveness is an object, the armature of the relay should have but little play, consistent with the magnets getting a good pull on the armature, and the armature having sufficient movement to properly work its contacts.

Figs. 60 and 61 show the form of relay best adapted for electric-bell work. Fig. 61 being an end view of Fig. 60. It will be seen that the two electro-magnets *a a* are screwed to the iron frame *b* by the two screws *c c*. To the upper part of this frame is fixed, by means of the spring *d*, the armature *e*, which carries at the other end the contact arm *f*, with the platinum-contact *g*. From the right-hand side of the iron frame *b* springs the post *h*, which carries at the upper end the two screws *m* and *n*. The bottom screw *n* is platinum-pointed, and with this screw the arm *f* makes contact, when the armature is attracted by a current circulating in the magnet-coils *a a*. The top screw *m* is not platinum-pointed, being merely a stopscrew serving to regulate the distance of the armature from the poles of the magnet.

The iron frame *b* can be either forged or cast; but should, preferably, be forged. Two holes must be drilled at the bottom of the frame to allow the threaded part of the screws *c c*, that hold the iron cores, to pass through. These iron cores, as well as the boxwood bobbins that slide on them, are of the same size as those shown in Fig. 38, Article VI. The iron cores, however, have a screw at one end only, the other being drilled to receive a brass stud which prevents the armature sticking to the magnet-poles. The armature *e*, which is also shown in plan in Fig. 62A, should be cut off some French iron rod of the section shown. Two holes are then drilled and tapped in it for the two screws, which hold the spring *d*, made out of a piece of thin watch-spring. For the arm *f*, a thicker piece of watch-spring is used, one end of which has a hole drilled in it for the platinum-contact made by passing a short piece of platinum-wire through the hole, and riveting it over. In order to fix the arm to the armature, the end of the armature is cut down with a fine saw for about a ¼in., and the end of the spring slipped in and secured by soldering. This method of placing the contact on a thin spring projecting out from the end of the armature, is much to be preferred to the practice generally adopted of prolonging the armature and placing the contact on it, as the elasticity of the arm gives a wiping action to the contacts, tending to keep them bright. When the contact is placed on a prolongation of the armature, the action in the contacts is merely dotting, and a relay with the contact so placed is not so reliable as one with the contact carried on the end of a spring, as shown in the drawing.

The next thing is to make the post *h*, the three different parts of which are shown in section in Fig. 62, B, C, and D. The part B is turned up out of a piece of ¼ brass rod, and has a hole drilled and tapped in one end to receive screw *o*, by means of which it is fastened to the frame *b*. The hole in the frame through which passes the screw *o* is bushed with an ebonite or boxwood bush, and an ebonite washer is placed above and below the frame, in order to completely insulate the post from the frame. The part C is also of brass, and has a hole drilled and tapped in the top for the screw *p*, and another in the arm for the contact screw *n*. This part solders on to the top of the piece B. The top arm D has a hole drilled in one end, and bushed through, which passes the screw *p*, this screw fastening the top arm D to the part C. An ebonite washer is slipped above and below the arm D, in order to insulate it from the rest of the post. A hole must be drilled and tapped in the frame *b* for the screw *v*, and another in the post *h* for the screw *w*.

The relay is now complete save the winding of the bobbins, which, if the relay is for use in an indicator, should be wound with No. 24 or 26 B.W.G. double silk-covered copper wire; but if for use on long lines or high-resistance circuits, should be wound with No. 32, making the resistance of the two coils, when joined in series, about equal to that of the rest of the circuit. The two free ends from the electro-magnet must be connected in the main circuit, while the two screws *v* and *w* are the terminals for the local circuit.

Much of the satisfactory working of a relay depends upon its proper adjustment, and the following is the right way to set about adjusting a relay:—First, screw up the screw *n*, so that when the contact *g* makes firm contact with the point of the screw, there is just room to place a piece of writing-paper between the armature and poles of the electro-magnet. Then adjust the screw *m* till the contact *g* only fairly leaves the screw *n*. The tension of the spring *d* should only be such as will just bring the armature back against the stop-screw *m*. If the relay is adjusted according to these directions, it will be found very sensitive even on high resistance circuits. If, however, the relay is for use in an indicator, as there is plenty of

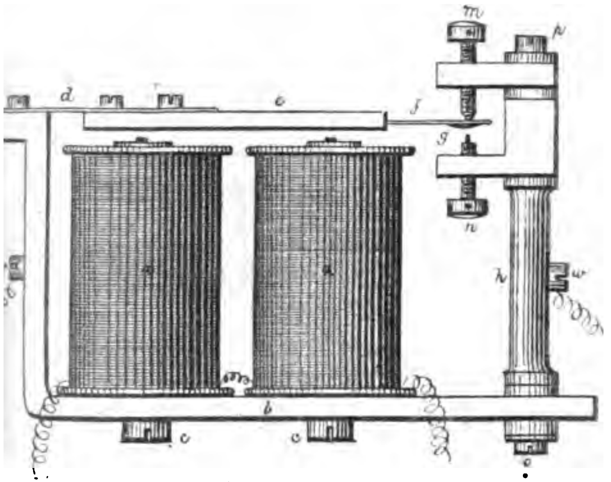


Fig 60

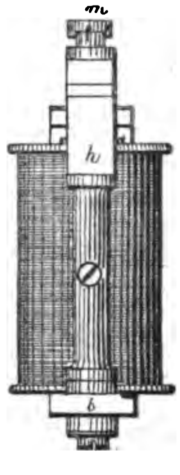


Fig 61

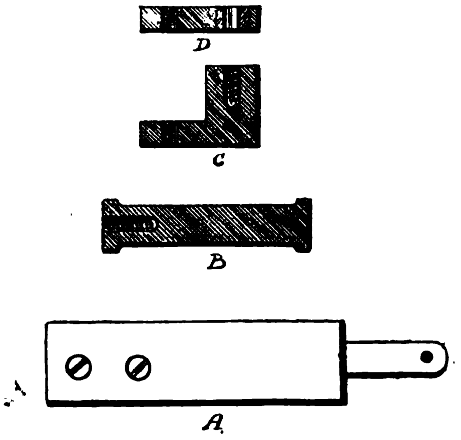
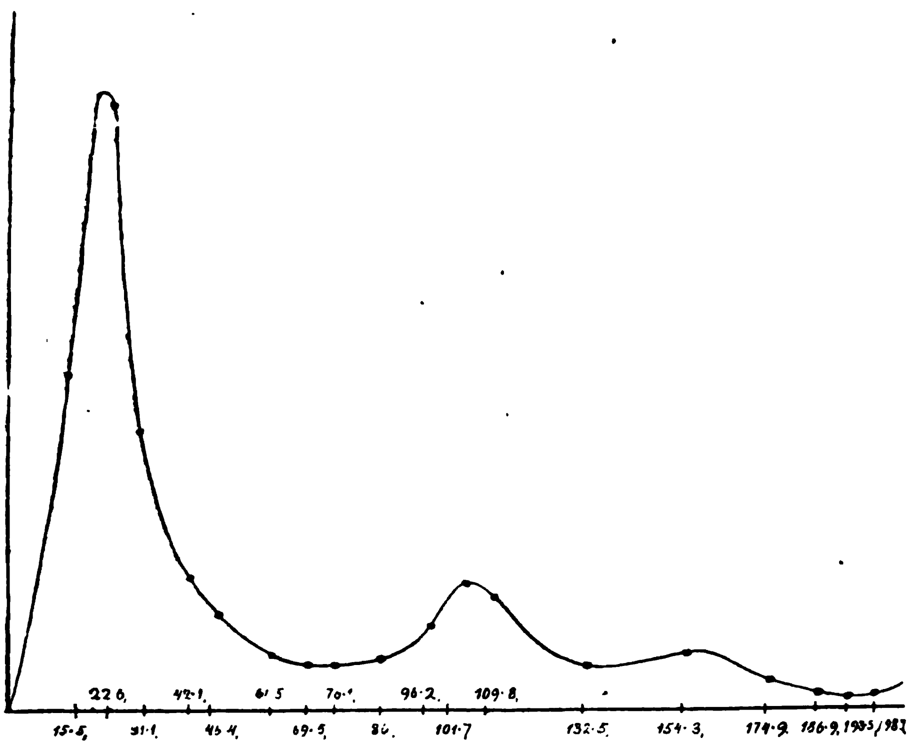


Fig 62

VOL. XLIX.—No. 1,260.



battery power, it is as well to allow a little more movement to the armature.

(*To be continued.*)

THE INTENSITY OF TELEPHONIC EFFECTS.

THERE are many causes which influence the effects of the telephone; for instance, the intensity of the magnetic field; the resistance, or, rather, the length of wire in the coils which surround the poles; the number and form of these poles; the thickness of the diaphragm, &c.

These causes produce complicated results, which are difficult to unravel. M. Mercadier has recently been devoting himself to the solution of the problem. He has commenced by studying separately the influence of the thickness of the diaphragm for a telephone of a particular kind, and for the same variation of the magnetic field.

The instrument with which the experiments were conducted was one made by d'Arsonval, in which the membrane is fastened into an ebonite mount in such a way as to isolate it completely from the rest of the apparatus.

To eliminate as much as possible the strengthening due to the harmonics of the fundamental note of the membrane, it was made to reproduce not a musical sound, but a harsh noise, arising from a metronome fixed to the table of a microphone, and which was maintained constant. The primary wire of the induction coil of the microphone was connected with an ampère measurer, registering millionths, and then the whole joined up to the poles of a battery, and the current maintained constant.

The telephone thus reproduced the noise of the metronome placed in a distant room so that it was impossible to hear it. Then the waves of sound issued from a very small aperture made in the lid of the telephone in such a manner that they might be considered as approximately spherical. These waves were received by the ear placed against a fixed support, and the telephone was supported in such a way that it could be moved slowly along a graduated rod.

In all the experiments which were performed, the distance between the telephone and the ear was adjusted till the intensity of the noise, as perceived by the ear, became *nil.* It was necessary to conduct them under conditions of great quiet. The measurements were made extremely carefully, and the mean taken only after a large number of observations, in which the possibility of error was reduced to a minimum. It was found that the intensity of the noise reproduced is proportional to the square of the distance at which the noise ceases to be perceived.

M. Mercadier selected iron as a common material for the diaphragm, and he experimented on no less than 18 of thicknesses, varying from 0·148mm. to 2mm.

The preliminary experiments having shown that with a current of 0·3 ampère the noise of the metronome was reproduced by the telephone, and perceived by the ear at very great distances (10m. to 15m.), it was found advisable, in order to facilitate the work, to reduce the strength of current to 0·15 ampère, and to introduce into the circuit a resistance of 17,000 ohms. Under these circumstances, the distances at which the intensity of the sound became *nil.* varied between 15cm. and 84cm.

The following curve indicates the results of the investigation:—

The abscissæ represent the thickness of the diaphragms in hundredths of a millimètre. The ordinates represent the squares of the distances at which the intensity of the sound is *nil*, the unit being 0·5cm.; for the sake of convenience in plotting the curve, this number is divided by 5.

An examination of the curve shows that the intensity increases very rapidly at first, attains a maximum corresponding to a thickness of diaphragm of about 0·20mm., then decreases rapidly, exhibiting again two partial maxima: this gives a curious undulatory appearance.

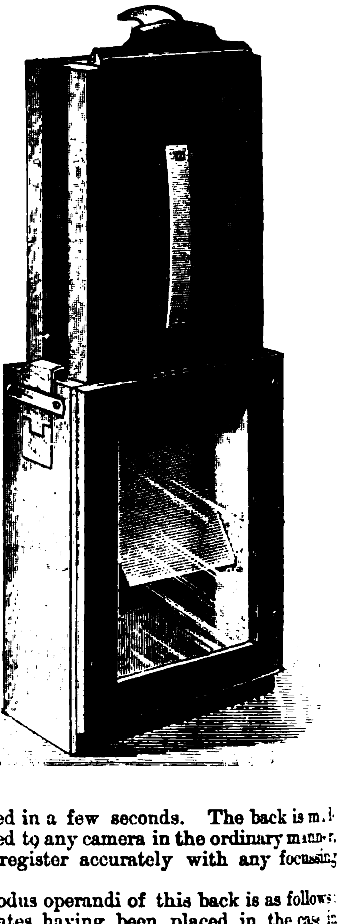
The existence of the first and principal maximum is explained by the consideration that there must necessarily be a certain mass, or thickness, of iron, in order that the lines of force of the field of the telephone magnet may be absorbed. But, apart from the increased thickness, it would seem that the increased mass of the iron ought to be rather detrimental than advantageous, regarding the question from the point of view of the intensity of the effects produced by the variation of the field. Nevertheless, it was thought desirable to verify the results which were brought out by the form of the curve, with regard not so much to the reproduction of a noise as to the reproduction of an articulated word.

The verification of this result was carried out with telephones in which the form of the magnet, and therefore the nature of the magnetic field, was very different. The result was conclusive, and M. Mercadier was able to demonstrate that for every telephone possessing a given magnetic field there *is a certain thickness of iron diaphragm which gives the maximum effect.* This thickness must be ascertained by trial. A few experiments would be sufficient in practice, and the result would be increased capacity for work in the instrument, and satisfaction to the operator.

M. Mercadier is pursuing this subject further, and will shortly read a paper before the Academy of Science at Paris upon a series of experiments that he is making with diamagnetic diaphragms.

HERBERT'S "ECLIPSE" PATENT CHANGING BACK AND DETECTIVE CAMERA.

A NEW automatic changing back for photo. cameras has just been brought out by Messrs. Shew and Co., of Newman-street, W. It is constructed on new principles, and occupies only the bulk of the plates themselves, and the thin wood cases which contain them (one dozen in each), without any metallic sheaths being employed. These cases being made in duplicate, any number of plates can be carried and changed automatically in full sunlight, each dozen of which as exposed may be withdrawn and another



substituted in a few seconds. The back is made to be fitted to any camera in the ordinary manner, so as to register accurately with any focussing screen.

The modus operandi of this back is as follows: —The plates having been placed in the case in the dark-room, and (we will suppose) the first plate exposed, the shutter is withdrawn and returned while in a horizontal position, and then, the back being held upright, the inner case is withdrawn and returned. This operation may be performed so quickly as to be practically instantaneous. As regards portability and general efficiency, it would be difficult to conceive of a more convenient apparatus.

We may add that this back has for some three years been in use by the inventor, Mr. H. Herbert, of Wimbledon, who has throughout bestowed that great attention to detail which goes far to gaining public favour. The silver medal (highest award) was obtained at the late Richmond exhibition, the only place where it has yet been shown.

WHITNEY'S IMPROVED TREADLE MECHANISM.

THE object of the invention which Mr. J. H. Whitney, of New York, has patented in this country is to make the treadle motion of various machines completely elastic in its fulcrum bearing and action under all circumstances whatever the pressure applied thereto, and to secure all the necessary and incidental benefits of such a construction. Elastic treadles have been made before, but they are elastic only under a limited amount of pressure; but as the pressure is increased they finally reach a solid bearing like that of the ordinary treadles, long in use, because they rest upon or are supported by a spring interposed between the treadle and a fixed and solid fulcrum or bearing. This invention differs from these in being so constructed that

FIG. 1

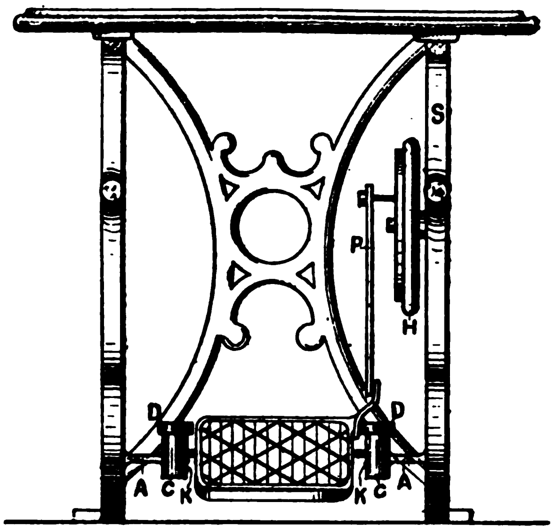


FIG. 2

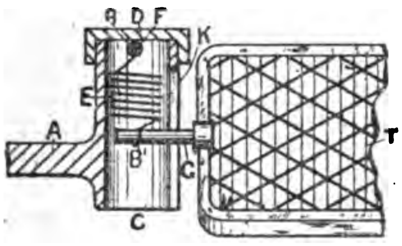


FIG. 3

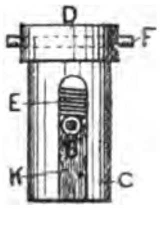


FIG. 4

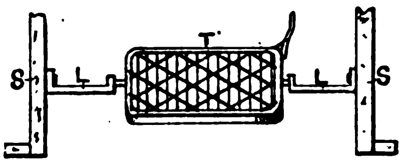


FIG. 5

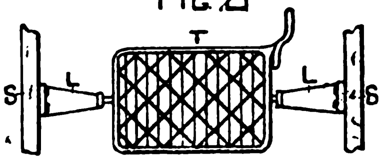
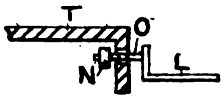


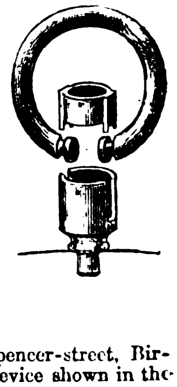
FIG. 6



there is no solid fixed or rigid fulcrum or bearing; that no amount of pressure will bring the treadle to a solid bearing; and that to whatever extent pressure is applied thereto, the resilient action of the spring, or a portion thereof, may be realised and utilised—first, to assist the action of the feet and limbs in the act of recovery, and, second, to contribute an appreciable amount or proportion of the original pressure taken up by the spring to the operation of the mechanism intended to be driven by the treadle and its pitman—as, for instance, in a sewing-machine. In other words, the treadle has no solid bearing, but only an elastic one. Fig. 1 is a front view of a stand having a treadle, a balance-wheel and a pitman connecting the two. Fig. 2 is a detail view, in part sectional, showing one side of the treadle provided with a projecting arm or trunnion suspended in and by a spring. Fig. 3 is a front view of the spring and its chamber, case, or cover; and Figs. 4, 5, and 6 are detail views showing a modification. Similar letters refer to similar parts throughout the several views. S is an ordinary sewing-machine stand, H a balance-wheel, T the treadle, and P the pitman. The two legs or sides of the stand are provided with arms or brackets, A A, which may be of any desired form, and attached to the legs of the stand in the usual way. Each one of the arms, A A, is provided with a tubular spring chamber or case C, which is provided with a cover, D. In each one of these spring chambers a coiled spring E, Figs. 2 and 3, is suspended from the pin F, which is preferably made to pass through the walls of the upper part of the chamber C, through the cover D, and also through an eye, B, at the upper end of the spring E. The lower end of the spring E is also provided with an eye, B', to receive the trunnion G of the treadle T. The tubular spring chamber C is slotted on the side adjacent to the treadle as shown at K, and the trunnions G pass through the slots to engage the eyes of the springs, being made of a size to fit easily, but not loosely, therein, and so as to permit the treadle to rise and fall, while the trunnions being held by the sides of the slots K K are permitted to move vertically therein, and thereby hold the treadle T in proper relations to the pitman, the machine, the other mechanical parts, and also to the feet of the operator when actuating it without at any time or at any point of their action reaching a solid bearing, or bearings, the trunnions being held by the spring and suspended from above. Of course the trunnions fit the eyes of the springs E E, not too tightly on each side of the treadle, but so as to allow the proper vibratory motion of the treadle. The balance-wheel H has the ordinary fixed bearing, but may have any other suitable bearing. The patentee says that, starting with the highest and in fact the normal position of the treadle, as fixed by the weight of the treadle and the stiffness of the springs on each side, when the foot of the operator is placed upon the treadle the amount of depression or the position of the treadle will depend upon the weight and the pressure bearing upon the treadle, and will therefore vary as they vary; but in whatever position the treadle will be held in place by the joint action of the springs E E and the sides of the slots K K in contact with the trunnions G G; and at whatever point the vibratory motion may be given to the treadle, motion will be transmitted through the pitman to the balance-wheel, to the driving-wheel, and to the sewing-machine or other mechanism to be operated. When the weight or pressure of the foot upon the treadle is diminished, the treadle will rise under the action of the springs, and thereby contribute a certain amount of force and motion either in raising the forward part of the treadle, the pitman, &c., together with the toes of the operator, or to aid the operator, whenever the pressure on the heel is relaxed in raising the heel and to some extent the leg preparatory to the succeeding vibratory action of the foot. Consequently the operator will be assisted by the springs to a greater or lesser extent in both the toe and the heel motion, and an appreciable portion of the weight and pressure brought to bear upon the springs will be recovered, returned, or contributed to the operator of the mechanism, and also to the movement of the foot and leg of the operator without subjecting the operator to any shock receivable from, or caused by, a fixed bearing, the effect of which is not only to cause a useless expenditure of muscular force to be taken up by the machine and the floor, but through repeated shocks thus given to the muscles and the nerves to cause an earlier consumption or exhaustion of the power of the operator, or, in the case of a vigorous operator, the employment and waste of an excess of power. Figs. 4, 5, and 6 show a modification which consists in the substitution of flat springs, L L, secured to the legs of the stand, in and by which the trunnions G G of the treadle T are supported, as shown in partial sectional view in Fig. 6, wherein the pin O is shown passing through a lug on the treadle, or through the side of the treadle, and as held there by a pin or nut, N. As the treadle T has an upward and a downward motion permitted by the flat springs L L, as previously described in the case of the springs E E, it is necessary that the nut or pin N should be so located as to permit such motion, and it must not be in absolute contact with the lug or side of the treadle when in its normal position; otherwise the treadle would be practically held firmly and rigidly, and the vibratory spring action could not be obtained. In this modification the treadle T vibrates on the pins O O, one on each side—but as the pin O is supported on each side by a spring, the treadle is still without any fixed bearing whatever, or it has a completely elastic bearing and will operate in the manner described. It will be observed that the treadle T is a balanced treadle, and that the fulcrum is central as well as elastic, thus equalising approximately at least, or alternating, the leverage of the treadle for the heel and toe. It will also be observed that, strictly speaking, the treadle is not supported as from below, but is suspended as from above; and therefore, however much pressure may be put upon the treadle, it can never reach a solid bearing; but as the pressure increases the spring opens or expands instead of becoming compressed.

PATENT SAFETY WATCH BOW.

WATCH bows for the stem-winding patterns are well known to be insecure in consequence of the stem preventing a screw being inserted to hold both ends of the bow. Messrs.



Ashwin and Lawrence, of Spencer-street, Birmingham, have patented the device shown in the annexed illustrations, which effectually overcomes the difficulty. At each end of the bow there is a grooved head, and in the pendant attached to the watch there are two longitudinal slots which end in circular recesses, so that when the bow is pushed down the slots, it is only necessary to put the filling-up piece in, and to secure it with a screw to the pendant at the point marked by a dot, to fasten the three pieces firmly and strongly together. It will be seen that the filling-up piece has a dove-tailed projection at each side to work into the pendant, and is curved at the bottom, so as to fit neatly on the bow. The result is a fastening which defies violence, and is at the same time strong and sightly. Although this device is peculiarly suited for keyless watches, it can be used for key-winders. An advantage, too, is that the cost of making will not be more than in the old way. While this arrangement prevents the watch and pendant from being wrenched from the bow, it allows of their being readily taken apart when required for repairs. This useful article can be attached to any watch with the old style of pendant at a small cost. It is patented in this country and abroad.

SOME USES OF THE YIELDING OF METAL TO PRESSURE.*

I THINK that an expansion shell reamer like Fig. 1 would work well. A A is the shell whose ends are bevelled as at D D′. The hole in the shell is tapering, and fits on the shank at B. A slot E is cut through the body of the shell, and across the end D are two slots C C, that fit over the screws G G. On the end of the shank is the nut F.—Both the nut and the shank are bevelled at D D′, to fit the ends of the shell. When the nut is screwed up tight, the shell is rigidly held in upon the shank by both the bevelled part of the nut D, and the shoulder D′. The screws G G keep the shell from slipping. In place of the screws a plain pin can be used. To expand this reamer the shell must be moved up on the taper shank towards D′. Before this can be done, something must be taken off, either from the shoulder or from the shell at D′. Though not, perhaps, very convenient to expand, yet, because it will be so rigid, I think this will be a good form of reamer whose size is to be changed only to take up wear.

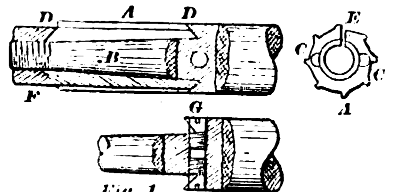


Fig. 1

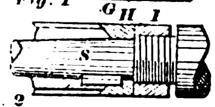


Fig. 2

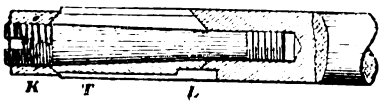


Fig. 3

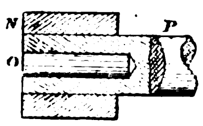


Fig. 4

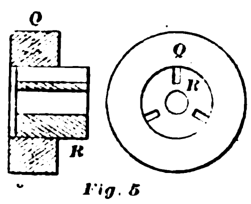


Fig. 5

Fig. 1 is not an adjustable reamer, as it can be only expanded. It can be made adjustable by adding a shoulder sleeve, and a nut, I, Fig. 2. A key is let into the shank, and a key-slot is cut inside the shell. The sleeve can be moved endwise in either direction, thus permitting the shell to be held in different positions upon the shank. By fastening the shell upon a larger or smaller part of the shank, the reamer can be made to cut larger or smaller, as required. I do not think this reamer would be so rigid as Fig. 1.

Fig. 3 is a variation of the taper shank principle, applied to an adjustable reamer. A screw, S, having a tapering body, is threaded into the shank. The large end of the screw is threaded, and carries the nut K. Upon the screw is held the shell T. Unlike Fig. 1, the hole in the shell T is smallest next to the shank. If the screw S be set deeper into the shank, the shell will be adjusted to cut larger. The reamer will cut smaller as the screw is drawn out of the shank. The key L, fastened into the shank and fitting into a slot in the shell, keeps the shell from slipping. Generally, the weakest part of a shell reamer is the pin or key that is intended to keep the shell from slipping on the shank.

My acquaintance over the way, Gascon, does not think much of these expansion reamers. He is of opinion that he can by a new reamer at a less cost than he can expand Fig. 1. As in many other things, I suppose that neither he will change his opinion, nor I mine, without experimental proof. He also thinks that a man shows a weakness in suggesting so many ways of doing a thing, and that one who is so fruitful in methods is himself not sure that any of them are good.

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* By "Jarno," in the *American Machinist.*

THE "NATIONAL" OPEN-CIRCUIT BATTERY.

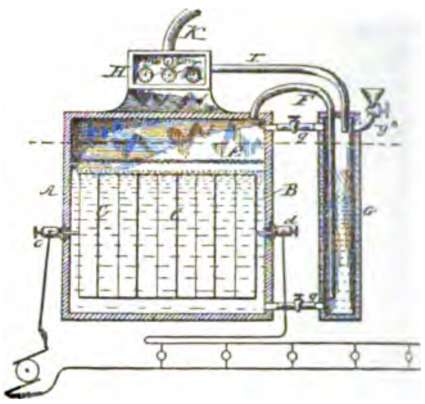
WITH the object of increasing the efficiency as well as the life of the ordinary Leclanché, the National Galvanic Battery Company, of New York, have recently introduced an improvement of the porous cup heretofore employed. The new cup, which is shown in the accompanying illustration, consists of a vitrified body, which is perforated; and all the cups are perforated alike so as to obtain uniformity of action. Through the network thus formed the solution thus formed circulates freely, and current is available immediately upon the immersion of the cup in the liquid. In addition to the usual lead terminal head is a supplementary piece of platinum wire, which, being unoxidisable, allows the cell to work until the crushed carbon and oxide of manganese is thoroughly reduced. Tests of the battery, made by Mr. John A. Seely, electrician of the Metropolitan Telegraph and Telephone Company, show that after a short circuit of over five hours the current which was originally 1 ampère had still a strength of ·2 ampère. In another test the cell was placed in circuit with a resistance of 150 ohms for over 13 hours, after which it was at once connected with a vibrating bell, which it rang continuously for 137 hours.

SMITH'S ELECTRIC METER.

ELECTRIC meters have been devised in the past depending for their action on a variety of principles. Thus we have the electrolytic meter, which depends upon the deposition of metal by the current; the various forms of motor meters in which the number of the revolutions of the motor is registered; and, again, meters depending upon the heating properties of the current, and a variety of others. The list has recently been augmented by a curious arrangement, designed by Walter F. Smith, of Philadelphia. Mr. Smith's arrangement may be called a combination of an electrolytic and a gas-meter, and its operation will be readily understood from the accompanying illustration, which shows the meter in section.

As will be noted, the electric-light circuit is connected to the binding posts *cd*, so as to place the meter in series in the circuit, and thus cause the entire current to pass through it. The binding-posts are connected to two series of plates, C C, which are immersed in a solution of caustic potash, the plates themselves being of iron, or iron nickel-plated. Directly above the electrodes there is arranged a screen of iron wire gauze, E, for the purpose of preventing the overflow of bubbles of gas which are formed on the passage of the current.

As the gas is formed on the passage of the current, it passes out through the pipe F into the vessel G, which acts as a sort of condenser and receives any froth or entrained moisture which may come from the vessel E. After passing out of the bottom of the spout F, the gas rises in the vessel G and is forced into the pipe I, which leads directly to a gas-measuring apparatus, H. Here the quantity of gas passing through is measured and indicated on dials, exactly as on the gas-meter, after which the gas is passed out to the atmosphere through the pipe K. As the quantity of gas generated is directly proportional to the current, and the latter to the number of lamps in circuit, it is evident that the meter H will indicate directly the total amount of energy passed through the circuit, which can be read off on the dial.—*Electrical World (N.Y.)*



SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

FRIDAY, May 10th, W. H. M. Christie, Esq., President, in the chair. Mr. Edward Carpmael and Mr. J. G. Petrie were elected Fellows.

Mr. Isaac Roberts read a paper on a photograph of the nebula 51 Messier (Canes Venatici) taken on the 28th of April, 1889, with an exposure of four hours. He said this nebula is well known from numerous descriptions and drawings of it by Herschel, Rosse, Lassell, and others. The drawing of Lassell seems to me to agree best with the general outline shown by the photograph, and I can bear testimony to the fact that Lassell's drawings generally agree better than those of other observers with the photographs. But all drawings alike fail to represent to the eye the details and true outlines as shown in a photograph. Mr. Wesley has kindly made a drawing for me on the black board, showing on a much enlarged scale the curious spiral streams about the centre of this nebula. It will be noticed that lines of stars seem to follow the general trend of the spiral streams, and there is a great likeness between this nebula and the spiral nebula in Andromeda (31 Messier), and the spiral nebula in Ursa Major 81 (Messier), which I described at the last meeting. It seems to me that they represent different stages of nebular condensation, and that they are only explicable on the theory of the nebular hypothesis as the early stages of a solar system. A photograph enlarged ten diameters from the original negative was handed round the meeting.

Mr. E. J. Stone said: We know that the sun has a great amount of gaseous or nebulous matter round it, and we may reasonably assume that there is a similar corona or nebulosity about the stars, and it seems to me that if we have a stream of stars, or a group of stars relatively near together, that we ought to expect to find a general nebulosity about them, and that it is as reasonable to suppose that the nebulosity is the product of the stars as that the stars are condensing from the nebulosity according to the ordinary assumption of the nebular hypothesis. I cannot say, therefore, that I feel that these photographs prove the nebular hypothesis.

The President said: While I fully appreciate the great advance which Mr. Roberts is making in our knowledge of the nebulæ by the splendid photographs which he is taking, I think that we can hardly speculate usefully as to the character of the phenomena we are observing until we know something of the scale of these nebulæ. Mr. Roberts' theory rather assumes that we have here something comparable with the scale of the Solar System. I am sure that all astronomers will join me in cordially congratulating Mr. Roberts on the great success he has attained in this branch of astronomy.

Mr. F. McClean read a paper, entitled "Parallel Photographs of the Spectra of the Sun, of Iron, and of Iridium, from H to near D; also separate Photographs of the Spectrum of Titanic Iron Ore." The photographs were exhibited to the meeting, and have been presented by Mr. McClean to the Society. They represent the solar spectrum and the spectrum of iron and iridium on the scale of Angstrom's charts. They are divided, as in the case of Angstrom's charts, into six sections, which makes the comparison of wave-lengths of lines easy. Angstrom's map of the normal solar spectrum is the only one in which the scale of wave-lengths has been determined by direct observation, and the easy comparison with Angstrom's chart is, therefore, a matter of importance. The iron spectrum has been selected on account of its close correspondence throughout with the solar spectrum. The iridium and air spectrum is also shown below as far as Kirchoff's iridium lines, with wave-lengths 5299 and 5450. More apparent coincidences between solar lines and the iridium and air spectra are recognised than are shown on Angstrom's map, and the coincidences of the iron lines with the solar lines is very remarkable. The definition is so sharp that the E line is shown as double.

Mr. Ranyard said: I think Mr. McLean is very much to be congratulated on the work he has accomplished. No other metallic spectra on such a scale have yet been published, and the sharpness of the coincidences is certainly very remarkable. I hope he will continue the series for the other metallic spectra.

The President said: The results of these beautiful photographs can only be appreciated by a careful study of them, which cannot be made at this meeting.

Mr. Stone temporarily occupied the chair during the reading of a paper by the Astronomer Royal, who laid before the meeting a paper on the "Collated Results of Measures of Sunspots made from the Greenwich Series of Photographs, commencing with the Year 1874." He said he thought the communication would be interesting now that we are approaching the period of sunspot minimum. These collated results enabled a comparison to be made of the state of the sun in the present cycle with the preceding cycle. The results obtained at Greenwich in 1874 and up to the present time had been since supplemented by photographs taken in Aberdeen and in India, and in this way, since the beginning of 1882, the record of the spotted area of the sun had been made practically complete, so that they had now both the area of spots and of faculæ. The tables accompanying the paper gave the daily areas for each rotation of the sun, and there were added two tables—one giving the results for the mean heliographic latitude of sunspots and the mean distance from the equator of spots for each rotation. Prof. Spöer had pointed out that there was a diminution of latitude from the time of passing the minimum to the next minimum, passing through the period of maximum, that was to say, that immediately after the minimum which occurred at the beginning of the year 1879 the spots broke out at some considerable distance from the Equator, but there were very few of them. We have recently had a spot with a latitude of 36 degrees. It is very rare for the latitude to exceed 35 degrees. Then the spots gradually approach the solar equator, becoming much larger and more numerous till about the epoch of maximum. As we approach the minimum they get close to the solar equator. This law of Spörer's has been well borne out during the past cycle. We have recently observed one very short-lived spot with a high northern latitude, which renders it probable that we are approaching the end of the minimum period, and that spots will soon begin again to break out in higher latitudes. A diagram was exhibited to the meeting showing the amount of spotted area in the various parallels of solar latitude during the last sunspot cycle, which illustrated the law discovered by Spörer in a striking manner.

Mr. Matthieu Williams asked if any diagram had been made illustrating the variation in the number of solar prominences, and their distribution in latitude corresponding with that exhibited for sunspots.

Mr. Ellis, of the Magnetic Department of Greenwich Observatory, made some remarks with respect to magnetic disturbances as compared with sunspots. He said that Sabine first recognised the connection between the development of sunspots and magnetic disturbances from a record extending over only six years; but the connection had been amply proved since, both as regards the intensity of the magnetic disturbances, and the range of the horizontal and vertical forces. There could be no doubt that many of these storms took place simultaneously over the whole earth, and sometimes there was an evident connection between such magnetic disturbances and outbreaks upon the sun; but the connection was rather general than specific—that is to say, that he could not bring forward any other remarkable coincidences similar to that observed by Carrington, when an outbreak upon the sun was observed at exactly the same instant as a considerable magnetic disturbance. There was great danger in assuming a connection from a single coincidence, or from a coincidence of the curves over a short range. He illustrated this by showing two curves—one representing the velocity of the wind, and the other representing magnetic variations, which appeared to coincide for a period of six years, but were otherwise quite dissimilar.

The Astronomer Royal said: With regard to the remark made by Mr. Mattieu Williams, there could be no doubt that there is a connection between sunspots and prominences, but the climate of England prevents one observing prominences in a satisfactory manner. We must rely more for such discussions on Prof. Tachini and the other Italians.

Mr. Common read a paper on "Dr. Terby's White Spot on the Ring of Saturn." It is very easily seen, but did not rotate with the ring; it was always seen adjacent to the shadow of the ball of the planet. He was of opinion that it was only due to contrast, and was an optical illusion.

Mr. Downing and Mr. Taylor both corroborated Mr. Common's opinion that the white spot is an optical illusion due to the large extent of shadow which is now seen to be thrown upon the ring.

The following papers were taken as read:—A. Marth, "Ephemeris for Physical Observations of the Moon." Communicated by E. J. Stone, "Observations of the Planet Iris and Comparison Stars made with the Transit Circle of the Radcliffe Observatory, Oxford, during the Opposition of 1888."

ASTRONOMICAL SOCIETY OF FRANCE.

THE April meeting took place on the 3rd; the following were elected officers for the ensuing year:—President, M. Faye; vice-presidents, M. C. Flammarion, Colonel Louissedat, General Parmentier, and M. Trouvelot; secretary, M. Gerigny; vice-secretaries, MM. C. Detaille and E. Bertaux; treasurer, M. Hentsch; librarian, M. Mabire; council, MM. Bischoffsheim, Bossert, Charton, Gunziger, Hérnan, Hirn, Moussette, Secretan, Oppert, Trepied, Admiral Cloué, Armelin, Bardeu, Moureaux, Schmoll.

M. Flammarion gave a *résumé* of the progress of astronomy during the past year.

In taking the chair, M. Faye remarked that this society must necessarily be prosperous, for it has been founded by men united by the love of science, and that it answers a want felt for some time in France. As a rule mathematical astronomers only considered the planets as material points describing orbits under the influence of gravitation; but we can place ourselves from a higher point of view. We know now that they are other worlds, and that they are animated with life. The diffusion of these new notions was due to M. Flammarion, and had obtained him a most sympathetic popularity, and in founding the Astronomical Society of France he and his collaborators had rendered a real service to science.

M. Faye proposed that the society should meet exceptionally in September this year on account of the presence of numerous foreign astronomers during the Paris Exhibition. This proposition was adopted.

M. Hentsch, treasurer, read his report on the finances of the society.

M. Guiot sent observations of shadow cast by Venus.

M. Dumesnil observed Venus with the naked eye on March 6, 9, 15, 23, and 28, between 3 and 4 p.m.

M. Duponchel sent a theory of sunspots based on the actions of the planets.

M. Junod, experiments on the attractions and repulsions produced by the rotation of two spheres.

M. Faye made some remarks on the Samoa cyclone, and explained the parabolic path of cyclones in both hemispheres.

WESTERN MICROSCOPICAL CLUB.

THIS club met on Monday week at the house of Prof. G. S. Boulger, F.L.S., when the host introduced the subject of "Vitreous Rocks, their Structures and Devitrification." Though sometimes containing infused crystals or fragments of earlier formation, these rocks have, in the main, consolidated from a perfectly molten condition, in which they have closely resembled ordinary molten artificial glass or slag. Whilst ordinary glass, however, is cooled so rapidly as to be optically homogeneous, the natural glasses seldom are so. Such bad conductors of heat are these mixtures of silicates that one can walk over a lava which is molten but a few feet beneath the surface, and consequently the mass may cool sufficiently slowly for at least incipient crystallisation to occur, even at a much smaller depth. The *tachylyte* on basaltic dykes, for instance, is often literally nothing more than a superficial glaze. As a mineral species is defined by crystalline form as well as by definite composition, these rocks cannot be certainly referred to any one species; but their chemical composition, of which the silica percentage is the main point, and the minerals which originate in them as "microliths" by "devitrification," suggest to which crystalline rocks they are most closely related. *Obsidian*, *pitchstone*, and the variety *perlite* are acidic, containing over 60 per cent. of silica; *tachylyte* is the chief basic glass, with less than 60 per cent., and the frothy *pumices* may belong to either group. Reference was made to the artificial production of devitrification as an opaque cloudiness, caused by the development of microliths, in glass kept for some time at a temperature sufficient to soften it. Passing to the structures exhibited by vitreous rocks, these were divided into two groups: the merely mechanical, independent of composition, such as *fluxion-structure*, *damascening*, and *perlitic* structure; and the crystallising, varying with composition, *spherulitic* and *axiolitic* structure being somewhat intermediate. It was pointed out that the formation of microliths had often preceded rigidity as they were carried along in the streaming, which produced the slag-like fluxion-structure so general in obsidians. It was suggested that "damascening" might be due to the mixing of various streams of glass producing the appearance compared by Rutley to that of mixing solutions of different density. Perlitic structure, as due to strain in consolidation, was compared in its crossing fractures to Daubrée's experimental production of joints in glass under strain, the concentric shelling being due to subsequent radiation and recalling the rounded surfaces in basalt columns. Spherulitic structure, though consisting of radiating crystallites, often with a distinctly crystalline nucleus, was apparently not therefore of late origin in the rock, as the spherulites were often carried along in streams, and in *axiolites* were drawn out in the direction of flow. In conclusion, while pointing out the unfathomed mystery of the connection between chemical composition and crystalline form, the host called attention to the drawings in Prof. Heddle's article, "Mineralogy," in the "Encyclopædia Britannica," of crystals of native silver, rock-salt (the well-known "hopper-shaped" form), cuprite, and pyrite, in which the crystallographic axes are shown by lines of miniature crystals to be no mere mathematical abstractions, but natural directions of molecular strain.

At the request of the host, Major-General McMahon made some remarks on the influence of pressure upon crystallisation, pointing out the gradual passage of strictly plutonic rocks into volcanic lavas; and, in answer to questions by the Hon. Secretary, describing Dr. Sorby's repetition of Sir James Hall's experiments on the fusion and slow cooling of rocks.

Among the slides exhibited were Messrs. Crouch's "Kensington" set of igneous rocks, and others by Messrs. How. Various members contributed microscopes and rock sections.

The next meeting will be on June 3rd at the house of Rev. Prof. Henslow, M.A., who will treat on the subject of "Floral Structures as Modified by Insect Agency."

A Fast Train.—One of the vestibule trains from Savannah to Jacksonville ran the distance of 172 miles at the average rate of 52·4 miles per hour. Several runs aggregating 60 miles were made at the rate of 60 miles per hour or over, 12 miles at over 70 miles per hour, and one run of five miles was made at 75 miles per hour. This run was made by Savannah, Florida, and Western engine 80, built by the Rhode Island Locomotive Works, Providence, R.I. Cylinders, 18in. by 24in.; driving wheels, 72⅝in. diameter; gauge of track, 4ft. 9in.; driving-wheel base, 9ft. 1in.; fuel, coal; boiler, of steel, 62in. diameter; number of tubes, 239, 2in. diameter by 11ft. long; firebox, 78in. long, 34in. wide, 66in. high; weight on drivers, 71,300lb.; weight of engine, 105,400lb.; weight of tender, 76,420lb.; total weight, 181,820lb.; is thoroughly equipped with the Westinghouse brake for the whole train, steam brakes on the drivers, weight of train without the engine being about 340,000lb., a total, including the engine, of 521,820lb.

Prof. R. Threlfall and Mr. A. Pollock find, contrary to ordinary ideas, that Clark cells can be used to send currents of considerable magnitude without the E.M.F. being appreciably changed, and have constructed cells which give 0·001 ampères steadily for half an hour. This result has been obtained by increasing the size of the cell so that each electrode is about 5sq.in. in area, and the internal resistance is about 6 ohms. For the ordinary small test-tube cell, the resistance of which may be 1,500 ohms, the current ought not to exceed 0·00001. On closing the circuit the P.D.—potential difference—drops almost instantaneously to its steady value, and, when the circuit is opened, rises equally rapidly to very nearly the original electromotive force. The cells completely recover in time. If the current sent be too large, the P.D. falls time, and afterwards rises and tends tow fixed value. In this respect Clark's ce greatly superior to large Daniells, sendi rents through the same resistance. The pa tains several tables and curves, as well as results respecting the close agreement betw electromotive forces of a great number of cells.

SCIENTIFIC NEWS.

SOME more observations of variable stars have been communicated to the *Astronomische Nachrichten* by Prof. Peters, of Clinton, New York State. He finds the period of R R Libræ to be about 277 days, and that of Z Scorpii about 362 days. Prof. Krüger publishes in another number of the same serial elements of Barnard's comet of March 31. The perihelion passage will be about June 13. The comet is, however, very faint, round, with a nucleus of about the 14th mag.

The death of Lord Sidney Godolphin Osborne, at the age of 81, removes from our midst a typical Englishman of the old school. As a writer on social and philanthropic topics, "S. G. O." was well known, and what he had to say was listened to or read with respect, for his letters were full of genuine enthusiasm, and marked by a tone and a treatment which indicate the man who thinks for himself. "S. G. O.," as one of our correspondents, mainly on microscopical matters, will be remembered by many. Since his retirement to Lewes, after resigning the rectory of Durweston, Dorsetshire, he had devoted himself mainly to work with the microscope, and to the study of natural history.

On Friday last Prof. Dewar discoursed at the Royal Institution on the "Optical Properties of Oxygen and Ozone," and, in the course of his remarks, said that it is well known that gases give different spectra at different pressures, and some of the most interesting problems have sprung out of a comparison of the spectra of the same gas under the heavy pressures and in the "high vacua" we can now command. To secure a good, continuous, broad, well-focussed spectrum of large dispersion, a large spectroscope had been mounted in a wooden "hut" in the corridor, the spectrum falling on a screen at a distance of the whole depth of the theatre. A tube for holding oxygen had also been carried down a distance of 60ft. to one of the lower laboratories. Prof. Dewar first illustrated how a spectrum altered in character with alteration in pressure. This having been successfully done, the varying lines coming out very clearly, he proceeded to speak of the effects of atmospheric absorption on the solar spectrum, dwelling on the history of the study of it at periods varying from noon to sunset, and comparing the results of the observations of Angstrom working in a cold, dry climate with those obtained in our own country. There is no doubt that many of the lines seen are due to aqueous vapour. In 1881 the subject was studied at St. Petersburg, where the light passed over a long distance of ice. After showing spectra influenced by pressure diminished by the vacuum pump, Prof. Dewar passed on to increased pressures, and explained the way of observing with pressures that led to liquefaction, pointing out that there was nothing in common in the spectra of oxygen and of ozone. Whatever may be the connection chemically between the two, we get the very complex problem of the dissimilarity of the spectra, a problem which he hoped at some future occasion to again bring under notice.

Mrs. De la Rue has presented to the Royal Institution the philosophical apparatus of the late Dr. Warren de la Rue, which will be preserved there in the historical collection as commemorative of the important scientific work of Dr. Warren de la Rue, and of the eminent position he so long occupied as a promoter of science and of the special objects of the Institution. A fine portrait of Sir Humphry Davy has also been presented by Mr. James Young, grandson of the late Dr. James Young, of Kelly, the distinguished chemist, and former owner of the portrait, which makes a valuable addition to the collection of historic portraits now in the Royal Institution.

At the *conversazione* of the Royal Society the fine collection of instantaneous photographs belonging to Mr. Muybridge attracted considerable attention; but perhaps the most remarkable exhibit was that of Mr. C. V. Boys, F.R.S., who seems to do with that intractable material, quartz, exactly what he pleases. By the aid of one of his quartz filaments he constructed an apparatus for demonstrating the attraction of gravitation, and subsequently showed the extraordinary insulating properties of quartz. Mr. Shelford Bidwell, F.R.S., showed the effect of light in the magnetisation of iron, a subject of which he is a master. Another interesting exhibit was that of Mr. Brereton Baker, of Dulwich College, showing that when oxygen is perfectly dry, such substances as finely-divided carbon and sulphur may be heated to high temperatures without combustion taking place. Even phosphorus is not ignited in dry oxygen when actually boiling. We believe it has been previously pointed out that iron does not rust in a dry atmosphere so quickly as in the presence of moist air.

The meeting of the Royal Geographical Society on Monday last was attended by a large and distinguished company, the "subject" being a discussion on Mr. Stanley's latest letters. After a paper had been read by Mr. J. R. Werner, on the Congo, Sir F. de Winton commenced the discussion, stating that Stanley's mission had been highly successful, and that nothing the Society knew of his movements had been kept back. Sir S. Baker and Col. Grant eulogised Stanley, as did Mr. Horace Waller, who, however, pointed out that it was a singular thing that not a line from Emin Pasha had reached Europe, although he was an excellent correspondent, and must have had a large number of letters for his numerous friends awaiting an opportunity for despatch.

The spring (or annual) meeting of the Iron and Steel Institute was held last week at the Institution of Civil Engineers, when Sir J. Kitson, Bart., the new president, delivered an interesting address, in which the method of forging by squeezing, instead of by blows from a hammer, formed an important topic. There are now several hydraulic presses capable of exerting a squeezing power of 4,000 to 5,000 tons, and it appears, from a paper recently read by Mr. W. H. Greenwood before the Institution of Civil Engineers, that the press erected by him at the Abouchoff Works, St. Petersburg, is up to 10,000 tons. The Bessemer medal was presented to Mr. J. D. Ellis, of the firm of John Brown and Co., Sheffield, and the Hon. A. S. Hewitt then spoke in support of the invitation of the American Institute of Engineers to the members of the Iron and Steel Institute to visit the United States next year. That invitation was presented by the Hon. E. A. Burke, and was cordially accepted. It goes almost without saying that the autumn session of the Iron and Steel Institute will be held in Paris.

Amongst the congresses to be held in Paris this year is one of "spiritualists." Some curious views and experiences are expected to be promulgated and related.

An electric railway has been laid down between the house of Mr. J. Monteith and Carstairs Junction, a distance of a mile and a quarter. The power is obtained from the Cleghorn Falls, some three miles distant on the River Mouse. A turbine transforms the power of the falls into electricity by means of a dynamo of the Goolden type, giving 400 volts and about 40 ampères. The current is carried by four bare copper wires run on poles and supported by liquid insulators. The metallic circuit is complete throughout, no earth connection being used. The conductors laid along the line consist of rectangular rods of very pure iron, placed, one on each side, about a foot from the rails. They are supported on special insulators on an elastic fastening of steel, which allows of no side oscillation, and permits the rods to expand freely. These insulators are in turn supported upon iron rods, ten inches high, planted on the sleepers. The gauge of the line is 30in., and a handsome carriage, capable of running at a speed of 35 miles an hour, has been provided. The line can be run direct from the dynamo, or through the agency of accumulators, of which there is a supply at Carstairs House for the electric lighting installation. The line is built for private purposes and chiefly for transit between the mansion and the railway station.

The new Inman steamer, *City of Paris*, has broken the Transatlantic record by steaming from Queenstown to Sandy Hook in 5 days 23 hours 7 minutes, this run being 2 hours 48 minutes less than the shortest previous voyage. Her daily log was as follows: 445 knots (part of a day), 492, 504, 505, 511, and 398 (part of a day). On three of these days she beat the day record, 503 knots being the longest run previously made in twenty-four hours.

The mail steamer *Arawa* (of the Shaw, Savill, and Albion Company's Line) has made a remarkably fast run to Plymouth from New Zealand. She had previously made the fastest passage on record, but on this voyage has excelled herself by 4 hours 26 minutes, her net steaming time being 34 days 23 hours, 18 minutes, and the elapsed time, including stoppages at Rio and Teneriffe, only 36 days 11 hours 48 minutes.

A Pasteur Institute was founded at Rio de Janeiro on February 9th, 1888, and out of 1[illegible] persons treated between then and January 8th, 1889, only one died—i.e., a child, who only attended ten times out of twenty-three attendances ordered. In sixty-two instances the dog biting these people treated at Rio was recognised as undoubtedly rabid.

Drs. Prudden, Briggs, and Loomis, pathologists, of the Health Department of New York, have been requested to state the evidence with reference to the contagiousness of tuberculosis, and also the simplest means of protection.

MM. Dubief and Bruhl have communicated to the Paris Academy of Sciences the results of their researches on disinfection by sulphurous acid. They conclude that gaseous sulphurous acid has an evident microbicide action on the germs contained in the air. This action is particularly manifest when the medium is saturated with watery vapour. Sulphurous acid acts upon the germs of bacteria. Employed in a pure state, it may, when its action is prolonged, destroy germs, even in a dry state.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE CITY AND GUILDS OF LONDON INSTITUTE—THE WHITE SPOT ON SATURN'S RINGS—THE METEORITIC THEORY AND "F.R.A.S."—VELOCITY IN ELLIPTIC ORBIT—THE PLANET MARS—THE CORONA, THE ZODIACAL LIGHT, AND THE AURORA—PHRENOLOGY—THE MASS OF A BINARY STAR—AREAS OF A 25in. OBJECT-GLASS AND OF THE PUPIL OF THE EYE.

[29928.]—A very instructive piece of reading lies before me as I write in the shape of the "Report to the Governors of the City and Guilds of London Institute, April, 1889," which gives, in effect, a detailed account of the expenditure on the Technical College in Finsbury, the South London School of Art, and that delightful job the "Central Institute" at Brompton, together with the results obtained for the money. Let us, in the first place, glance at the amount expended, before seeing what results have accrued from the sum disbursed. Beginning with the "Central Institute," I note that the gross expenditure on this part of the scheme amounted, in 1888, to £10,242 18s. 5d.—or, deducting students' fees, to £8,381 6s. 8d.—in connection with which it is worthy of remark that, while the school fees received at Brompton amounted to £1,725 8s. 3d., at the real working centre of Technical Education in Finsbury they reached the sum of £1,908 5s. 6d., the expenditure at the "Institute" being, as I have said, £8,381 6s. 8d., while that at the Technical College was only £6,092 0s. 1d. A glance at the salaries paid at these two places respectively will go some little way towards the explanation of this discrepancy, for, to begin with, it is noteworthy that each "Professor" receives £1,000 a year at South Kensington, while the Principal and Professor in Finsbury has only £[illegible], the Professor of Engineering £600, and the Professor of Chemistry £500 (exactly one-half of the sum paid by his luckier confrère at Brompton). There is, further, some person who nets the charming annual salary of £1,000 as "Educational Adviser." When, however, we come to the South London School of Art, we find "the Superintendent of Studies munificently rewarded with £85 a year! But, then, if the Central Institute is to be kept up in all its magnificence, there must, of course, be screwing and cheeseparing somewhere. In their report, the Council deplore the withdrawal of the annual subscription of £4,000 hitherto given by the Drapers' Company. Now, it is abundantly evident that a great guild would not sever its connection with such a scheme as that of the Institute lightly, or save for some grave and excellent reason. It would be curious to inquire exactly what that reason is. That it is one of the greatest importance is evidenced by the words of the Council themselves, who, after making apparently an urgent appeal to the Drapers to resume their subscriptions, confess that "it is with great regret that the Council have to report that the Company have not seen their way to reconsider the decision arrived at in March, 1888." By the bye, turning to *Whitaker's Almanack* for a list of the City Guilds, I observe that three of the "great" Companies, the Merchant Taylors, the Haberdashers, and the Vintners, have never contributed anything towards the scheme, and now that the Drapers have dropped out of the list of contributors, one third of these "great" Companies are holding aloof from it. Perhaps their clerks are indifferent about knighthoods and the like.

Passing to results, it appears that since the opening of the Central Institute in 1885, 98 students have matriculated. Many of these seem to have secured remunerative appointments, more than one of them excellent ones. How far, though, it is either necessary or justifiable to pay four "Professors" £1,000 each, to say nothing of an army of lecturers, demonstators, an assistant in a "Research" Laboratory, &c., &c., to attain the results tabulated, may very reasonably be a matter for discussion. That good and valuable work has been done in Finsbury, at the South London School of Technical Art, and through technical classes and examinations, is undeniable; and if the £92,958 6s. 9d., which the Brompton building and fittings have cost up to December, 1888, had been devoted to similar uses, a notable addition might have been made to the technical education of those to whose instruction the nation is entitled to look for beneficial results. But the curse of South Kensington broods over the scheme. The mere contact with (what the spelling-book calls) "that noble animal the horse," has an obviously demoralising and degrading influence upon all who are subject to it. No more pitiful scoundrel than the "welsher" or the horse-couper exists. Upon a cognate principle the very air of South Kensington reeks with jobbery, and as surely as a man catches malarial fever in the Pontine Marshes, just so surely does the neighbourhood of Brompton appear to convert corporations and individuals alike into jobbers of the most pronounced type. No greater blessing for *real* technical education than the collapse of the "Central Institute" could well be imagined.

The white spot on Saturn's rings contiguous to the shadow of the planet, referred to in letters 29834 (p. 153), 29864 and 29865 (p. 176), and 29884 (p. 195), presents a very perplexing problem for solution. If it be merely an optical phenomenon and an effect of contrast, how is it that it is now perceived for the first time, and has never previously arrested the attention of the scores of observers who have for so many years past sedulously studied Saturnian details with all sorts and conditions of telescopes? On the other hand, assuming it to have an objective existence, why does it remain stationary? Because if it were a colouring or bleaching of a portion of the component particles of the ring, rotation ought to change its place. Photographs taken by the aid of a mirror or lens of very great focal length might throw some light on this subject.

No! Mr. Arman, I did *not* call you a fool (as you insinuate in letter 29886 on p. 195) for "wanting to know" what the inaccuracies were in the meteoritic hypothesis. My quotation from Pope was apropos of your attribution of motives of private pique and animosity against Mr. Lockyer, as inspiring my criticisms on that gentleman and his discoveries (?). But the cat is out of the bag at last, and you now pose before the public as another contributor to those puffs and advertisements of which Mr. L. is so persistently the subject. I see now, clearly enough, through the whole end and object of your letter. It never occurred to me, on reading your original communication, that you were such a past master of what Sheridan's hero in "The Critic" calls "the puff preliminary, the puff collateral, and the puff oblique." In letter 29792 you say, with reference to the exploded "magnesium fluting," that you have "no doubt that, in due course, Prof. Lockyer will reply to Dr. Huggins." Well, on the 2nd of this month this "reply" reached the Royal Society. At the conclusion of letter 29792 you "challenge" me "to point out where Prof. Lockyer has gone wrong." I reciprocate the attention, and dare you to publish in these columns a report, *verbatim et literatim*, of the discussion which followed the reading of the reply on the 2nd inst. at Burlington House. You may readily make an affidavit that neither the remarks of Prof. Dewar, nor those of Dr. Huggins himself, will be reproduced in *Nature*. It would really almost seem as though Mr. Lockyer had never heard of Watts' classical work on spectra at all! "Lockyer dixit" may satisfy some folk; but I happen to be an astronomer, and, rightly or wrongly, astronomers do not take his utterances as inspired. Possibly the fiascos from which "A Sympathiser with 'F. R. A. S.'" made a selection in letter 29815, on p. 131, may render them, as a class, cautious in this matter. I merely state the fact without attempting to theorise upon it. I do not feel called upon to discuss the curiously rash assertion that "the theories of cosmogony propounded by Kant and La Place, and Herschel and Proctor, are all very similar to that held by Tycho Brahe more than 300 years ago." Anyone curious on the subject may compare the excellent précis of La Place's theory, which appears under the title of "Nebular Hypothesis" in Nichol's "Cyclopædia of the Physical Sciences," with the article on "Meteors and Comets" in Proctor's "Other Worlds than Ours," as a preliminary exercise. When Kepler sent a copy of his "Mysterium Cosmographicum" to Tycho Brahe in 1598, the latter "advised him to lay aside speculations, and apply himself to the deduction of causes from phenomena." Is this advice wholly inapplicable in the present day?

"Light" (query 68496, p. 205) is quite right; + is a misprint for −.

The discrepancy which puzzles Mr. Tom Moore (query 68524, p. 205) has its origin, first, in the different values of the angular diameter of Mars obtained by micrometrical measurement, a source of error almost insurmountable in the case of any bright disc on a dark background; and next in the various amounts of the solar parallax adopted by different authors. Chambers ("Descriptive Astronomy") talks of the angular diameter varying between 4·1″ and 30·4″, while Young, in his "General Astronomy," limits this variation between 3·6″ and 24·5″. With a solar parallax of 8·848″ and the *Nautical Almanac* datum of 5·55″ as the equatorial semidiameter of Mars at mean distance, his linear diameter would be 4972·4 miles, very nearly indeed.

In connection with the questions mooted in letter 29909, p. 218, Mr. Penny should, if possible, obtain and read Vol. XLI. of the *Memoirs* of the Royal Astronomical Society, in which he will find an excellent and exhaustive discussion by its editor of the phenomena exhibited by the Sun's Corona at periods of greatest and least solar activity. Its highly complicated structure suffices at once to indicate that it is not, as your correspondent appears to imagine possible, merely the visible æther! The Zodiacal Light is apparently either a vaporous or, more probably, a meteoritic appendage of the Sun within the orbit of the Earth. The Aurora would seem to be a terrestrial phenomenon, having its origin wholly in the higher regions of our own atmosphere.

I must still venture to differ from Mr. Mark Moores (letter 29910, p. 218) in his assumption that Mr. Bridges' principle can be applied to the measurement of a drawing or engraving of any mere full or three-quarter face, save, of course, in the sense that you may read *anything* into a portrait on which the angle cannot be laid down with a protractor. As a lad I was much impressed by the perusal of Combe's "Phrenology," and devoted some time to the study of (what I then believed to be) that science. But modern research on the physiology of the brain has so perfectly upset the systems of Gall and Spurzheim, that no one familiar with the details of recent investigations can for an instant continue to believe in a scheme which mapped the cerebral convolutions in so symmetrical a way into areas of the size of a fourpenny-piece. Vivisection may or may not be justifiable; but, at any rate, it has enabled such able and skilled experimenters as Ferrier to show the utter fallacy of the location of the so-called phrenological "organs." That, in a rough way, the possessor of a head of small dimensions will, *cæteris paribus*, exhibit less intellectual capacity than a man with a capacious brain, and that when such smallness reaches a certain point, the subject of it is idiotic, may be granted. To say, though (to take a single instance), that the cerebellum is the seat of "amativeness," has been conclusively shown to be the veriest stuff and nonsense. I do not speak as one ignorant of phrenology. I have investigated it carefully, and seen upon what a hollow and baseless foundation it rests. Perhaps it may not be superfluous to add that I have studied both sides of the question.

I gave "Finsbury" (reply 68362, p. 222) Jupiter's actual period of revolution, and also the period in which the Earth (with her practically insensible mass) would occupy in going round the sun at Jupiter's mean distance from him. If he is not satisfied, I cannot help it.

Mr. Lockyer is quite right, and "H. A." (query 68608, p. 228), of course wrong. The areas of circles vary as the squares of their diameters. The square of 25 is 625; the square of ·2 is ·04; and if we divide 625 by ·04, we get 15625, and not 1562·5, as "H. A." curiously infers. The area of a circle 0·2in. in diameter = $0{\cdot}1^2 \times 3{\cdot}1416$. Now $0{\cdot}1^2 = 0{\cdot}01$ and one-hundredth of $3{\cdot}1416 = 0{\cdot}031416$, and not 0·31416.

A Fellow of the Royal Astronomical Society.

VENUS—34 BOOTIS—R CORONÆ—U ORIONIS — THE WHITE SPOT ON SATURN'S RING.

[29929.]—I WOULD very willingly have tried, in as far as possible, to comply with the request of "F.R.A.S." to observe Venus with reference to the phosphorescence of the dark side by stopping out the illuminated disc, but it has unfortunately happened that, since the date of his letter, I have not been able to secure another telescopic view of the planet. On March 30 I saw Venus, but could see nothing of the phosphorescence. My previous observations were made in 1884, and published in *Transactions* No. 4 of the L.A.S. On the recent occasion (March 16) when the phenomenon was so plain, the appearance exactly resembled that of the "old moon in the new moon's arms"—just the appearance it presented to the Rev. Mr. Perkins on June 23, 1884, as mentioned by him in his contribution in the *Transactions* referred to. I would like to know the experience of "F.R.A.S." in this connection.

The following are the only observations I have secured of 34 Böotis since the last given in my letter to the "E. M." of May 27, 1887:—

1887.	June 28.	Large 5, or 5—4.	
	July 15.	....	Orange.
1888.	Feb. 8.	....	Fine orange.

But though I have not made any other regular estimates of magnitude, I have noticed the star from time to time in observing ε Böotis, and have also glanced at it occasionally; but I have never seen anything to cause me to change the opinion expressed in the letter referred to, to the effect that it is not variable. The observation of June 28, 1887, above, may support the observation of April 14, 1887, given in the previous letter, and showing a mag. of 4·7. Some observations of the magnitude of this star during March to May of last year are given in Major Markwick's paper in the *Journal* of the L.A.S. for March of the present year, but do not, in themselves, show much sign of variation; nor does the estimate, in the majority of them, differ substantially from the estimate in the majority of my own. It is noticeable, though, that the extreme difference between the highest of my own estimates (4·7) and the lowest of Major Marckwick's (5·4) is greater than would likely result from errors of observation; but as my estimate would need to be altered to 5·0 if reduced upon the H.P. mag. of my comparison star (ϕ Böotis), which, as Major Markwick's observations are upon a H.P. standard, it would require to be, the difference is a good deal reduced. Can anyone furnish the original data from which Schmidt concluded the variability of this star?

R. Coronæ.—The following are the only observations I have got of this star since the date of last included in the list given in my letter in the "E.M." of May 4 of last year:—

1888.	May	11	......	6·5.
,,	Sept.	10	......	6·4.
,,	Oct.	3	......	6·5.
,,	,,	5	......	6·4.
1889.	March	26	......	6·6.

As before, π Coronæ is rated = 6·0, and taken as standard. Except the first, they agree very well with Major Markwick's, given in the paper alluded to above. I would like to know whether all the observations of this star given in that paper are correctly printed, because they have a bearing upon the question of minor fluctuations of light exhibited by it, raised in my own letter referred to. That this star exhibits minor fluctuations seems pretty plain, and I have a suspicion that some law regulates them.

This question of minor fluctuations in the light of variable stars, comes again to the front in "E. E. M.'s" letter in the "E. M." for April 19, *re* "Nova" Orionis. The question is there asked, "Can other observers corroborate these apparent irregularities in the diminution of the star's light?" I drew attention to these apparent minor fluctuations in the light of this star in my letter in the ENGLISH MECHANIC for May 13, 1887; and I think I may say that my observations since that date confirm the suspicions then formed, and I referred to the matter again in the "E. M." for Nov. 9 last. The question of the existence of minor fluctuations in the light of variable stars is one that deserves investigation, for it can hardly fail to have a bearing upon the physical causes of variation, implying, as it does, an intermittence, a waxing and waning, in the energy of the forces at work. But such minor fluctuations are not likely to be detected or investigated by the ordinary method of treating variable-star observations, up which all discrepancies and irregularities are too to be looked upon as errors of observation, have their "curves smoothed," &c. I sus that very few of the variable stars in truth hibit the beautifully regular "light-curves" which seem to be the *beau ideal* of some. I have often thought that the tendency of various methods in vogue is to obscure the evidences of interesting phenomena in the search for periodicity and regular curves. I suspect that more or less *un*periodic variation is more frequent than is often supposed. The question of minor fluctuations has a special importance in the case of this star, for if they exist, they dispose at once of one of the theories put forward to account for its phenomena—that of their being due to parallax alternately bringing the star into view, and partially hiding it behind the edge of a mass of light-absorbing matter. (This theory, it will be remembered, has been extended to some 18 other variable stars). I have seen other observations which confirm the existence of these fluctuations, but have not got them beside me just now; so I may take another opportunity of adverting to this question in connection with this star.

Not much notice seems to have been taken of the circumstance that it cannot *always* be the *same* white spot which is seen at the edge of the shadow of the ball upon Saturn's rings, inasmuch as the rotation of the ring is bound to carry it away from that position. If, therefore, this is a real phenomenon, and not an optical one, it ought only to be visible at such intervals as the rotation of the rings brings it into that position where the contrast of the shadow permits of its being seen. It might, then, enable the period of rotation to be properly determined. It is difficult to see how the phenomenon can be an optical one, seeing it has been observed by so many different trustworthy observers at different stations, and with telescopes of each kind. It is difficult to see, too, how it can be *optical* and yet new. If optical, it ought surely to have been visible before when conditions were similar. The behaviour of the phenomenon—sometimes visible and sometimes not, and yet the visibility not seeming to be periodic (at least, so far as I have noticed from the accounts) — suggests that it is not a *spot*, but a longish, narrow marking not discernible upon the general surface of the rings, but brought into view by the contrast of the shadow. It is not very easy to make out the account given of the Lick results obtained with the great telescope. "A kind of yellowish deformation or lump was indeed noticed close to the shadow on two or three occasions, but it proved to be due partly to bad definition, for it was only seen when the air was unsteady; and partly to contrast, for a similar appearance was produced in any part of the ring by the use of an occulting bar." Surely the two arguments are not quite harmonious. But the statement as to contrast producing a similar appearance elsewhere on the ring would rather bear out the conjecture put forward above.

S. Maitland Baird Gemmill.

Glasgow, May 8.

VENUS.

[29930.]—Has anyone noted the minimum aperture with which Venus was visible at conjunction? I see by your notes in "E.M." that Miss E. Brown observed the planet with her 6¼ Calver, and T. R. Clapham with a 5¼ Grubb. My instrument is a 6¼ Calver equatoreal, in which it was, of course, a very beautiful attenuated crescent, easily measured in full sunshine. At 2 o'clock in the afternoon its *crescent form* was clear and palpable in the finder of *less than an inch* aperture. I observed Venus on about the 25th April at her brightest, but it was far more difficult to steadily see the crescent form in the finder. **Easy.**

[29931.]—I was not so fortunate as Mr. E. Brown (letter 29882, p. 195) in following Venus so near inferior conjunction, on account of cloudy weather here; but on Saturday evening, April 27, using an exquisite $2\frac{1}{16}$in. three-draw telescope, with a power of about 25, by Wray, I turned it at 7.40 p.m. near the place in declination where I expected that Venus would be setting over a mountain 1,000ft. high, lying two miles N.W. of this, and at once found her in the field as a beautiful thin crescent of light. I followed her for five minutes, when she disappeared behind the mountain, the two horns were extinguished simultaneously, and being uppermost, they were the last features seen of the planet.

Belfast, May 7. **I. W. Ward.**

ASTRONOMICAL.

[29932.]—There seems to me to be a decided want in astronomical matters of a critic. Even if of the kind described by Mr. Franks as "cold-blooded," he might do much good by putting to the torture all assertions of wonderful discoveries, and perhaps still more by taking a brief against all inferences and explanations and theories. If founded on fact and reason, he could not shake them permanently. If not so founded, the more he could shake them the better.

This idea has suggested itself to me at the present moment because, after a long series of "discoveries" upon the planet Mars, we appear, now we are happily rid of him for a time, to be menaced with another series of marvellous "discoveries" upon Saturn.

In *L'Astronomie* of the past 18 months or so has been a considerable number of drawings of Mars showing the doubled lines, &c., which it pleases M. Schiaparelli to call "canals." These lines are straight in most instances, but the most marvellous thing about them is that *they remain straight in all positions on the disc of the planet.* Is not this fatal to any notion of their objective reality! A straight line on the meridian of Mars would necessarily become an apparent curve when near the border of the disc. The lines supposed to be seen do not so become curved. What is the legitimate inference?

Mr. Flammarion regards these "canals" as rivers. Now as the surface of Mars is cut up into mincemeat by the network of lines, I think one may fairly ask how, where, and by what means a few dozen rivers to which the Amazon and Mississippi are driblets from a teapot, can possibly rise and run their course on such a small globe as Mars?

But I started more especially to refer to Saturn, and while I endeavour very ineffectually to "objec," allow me to say I accuse no one of manufacturing observations or of want of good faith; nor have I any personal feeling except of a wish to be on good terms with the gentlemen who, I think, deceive themselves.

We have quite a number of observers testifying to seeing a new white spot on the rings of Saturn. They differ in minor particulars as to shape, for instance, and size, and while some find the spot obliterates the Cassini division, others see it plainly through it, but in one thing they all agree—the position. All place it adjacent to the shadow of the ball on the rings. It has not moved. It does not move. Now is there any hypothesis of Saturn's rings which does not suppose that the rings rotate round the planet? Can we conceive they are immovable? If, then, motion is conceded, then a white spot *upon* the rings must of necessity change its position. We cannot then regard it as real. Well, what is the probable explanation?

If we look at a dark object on a bright ground under some conditions of illumination, and then slightly alter the axis of the eye, in a short interval a light image of the object appears—then fades, and comes back again. Apply this to the shadow of globe of Saturn on the rings. The black shadow is gazed at intently, and then unconsciously, or almost so, the eye is diverted to the adjacent part of ring, and a faint image of the dark shadow appears to be superposed on the ring. An observer eager to discover, and working to the utmost limit of his instrument and sight, sees this as a white something, and trying the same look at dark shadow and bright ring alternately, and again obtaining same result, is satisfied of the reality of his observation. There is abundant proof that once told a thing is there even many eminent observers can see it, and, in fact, by the same course of observation and slight motion of eye, they do see it, although not there. Let anyone try the experiment of making a drawing of portion of Saturn exhibiting the shadow of globe, and look at it in not too bright a light, and they will have no difficulty at all in seeing a white spot where they know none exists. I have tried it, and can produce the ghost at once.

We have another supposed observation resuscitated in *L'Astronomie*, that of seeing the crescent of Venus with the naked eye. Let anyone make a crescent of a bright piece of wire ¼in. from cusp to cusp, and place it in the sunshine 25 yards away, and try what he can make of the crescent. It would be instructive to try at what distance people who claim to see this crescent can read a page of print not familiar to them. Unless they can see to read at four times the distance an average sight permits, it is scarcely likely they can recognise the crescent of Venus.

I wish some able hand would undertake the attack on similar statements. **Edwin Holmes.**

THE MOON'S ALBEDO, &c.

[29933.]—I have again to thank "F.R.A.S." for his remarks in 29737, and will get Nasmyth's and Carpenter's "Moon."

Regarding the relative darkness of Grimaldi, cannot some reader of "Ours" help us with photometric measurements in this difficult and interesting series?—taking Aristarchus as the white, and a lunar shadow as black. Until we compare the "half-tints" with black and white *on the moon itself*, it seems to me we shall only have guesswork. I have had thirty years' practical experience as draughtsman, also painting in oils and water-colour, drawing on wood, &c., yet cannot see Grimaldi as anything like even half-way between white and black. By scale it seems to me a pale grey or fractured steel tint, and not as "darker than dark-grey syenite," which, as "F.R.A.S." truly says, we should certainly call *black*.

I do not gather from Proctor's "Moon" that Zöllner used a lunar shadow as his standard of black on the moon. Can "F.R.A.S." say? Of course, I foresaw that it would be admitted that portions of the lunar surface are as bright as (newly-fallen) snow, and that possibly such places may be actually snowed; but I cannot understand the remark "I see no more reason why Aristarchus should not have snow upon its highest peaks than I do why the Himalaya should be similarly covered." The words "highest peaks" seem misplaced, inasmuch as the "brightest" peak of Aristarchus is sunk thousands of feet *below the general surface level* of the globe, while our Himalayan snow-peaks are all so conspicuously raised above the surface 13,000ft. to 15,000ft. at least. There seems confusion here of some sort. Many of the brightest portions of the lunar surface—presumably those that are snowed—are not raised at all, as enclides and nimbi generally. Some are even sunk thousands of feet below the general surface-level. Hence I cannot see where the reference to "highest peaks and Himalaya" apply, especially on a globe so destitute of atmosphere.

But I hope "F.R.A.S." will not only look into this, but give more than a cursory glance at the cause of the abnormal brilliancy of inclines and cliffs. The case seems to me well worthy of his attention, as being *primâ facie* evidence that gravitation, at such places, removes, by avalanche, this coating and stain of meteoric or cosmic dust, which I presume "F.R.A.S." will admit falls all over the moon's surface as it does over ours. This brightness of the lunar cliffs, compared to levels, is apparently the reason why, at full moon, we see the limb so bright all round compared to the centre of the disc. (See Proctor, pp. 162-4.)

As to the rays, I have never seen the electrical experiments referred to. The solution I offer for these also, as "F.R.A.S." will observe, depends on the presence of a stain or coating of meteoric dust, especially on the levels.

I assume that this coating or stain is removed over lines of electrical surface discharge taking place from active *centres*—discharges that possibly take place at long intervals, each forming a ray, by revealing the cleaner snow surface and removing the dust, the snow being a non-conductor—a maximum of optical, with a minimum of physical, effect. The fact that many rays end abruptly at craters led me to look on such as guided thereto by electrical induction.

Surely "F.R.A.S." will admit, 1st, that the rays are evidence to us of the passage outwards of some "force" radially, that also does not influence or deform the surface modelling. 2nd, that rays, as a rule, proceed from conspicuous craters—quasi, or cold volcanoes as I should call them—and that at such centres, when active, electrical discharge is likely to occur. 3rd, that meteoric dust is of a semi-metallic nature, while snow is a non-conductor.

I feel certain that he will also admit that the solution I offer is not a whit more incredible (when examined) than the so-called "solutions" offered for these unearthly features before.

As to the P.S. in my letter, I ask "Why has the moon got no distinct polar caps?" Because it seems to me an anomaly. She *should* have polar snow caps if there had been formerly air and water, for, as "Neison" truly says, on the poles "solar heat is nil" (p. 37, the "Moon"), and hence the snow caps must be permanent. The sun's heat could not melt them off if once formed.

What I maintain is, that the snow caps are *there*, and have slowly extended to and closed over the equator, the entire globe being thus cased in snow forms, and hence we see no distinct marking or caps as in Mars. Can anyone say why the moon should *not* have polar snow caps?

Sibsagar, Asam. **S. E. Peal.**

AN OLD AMERICAN LOCOMOTIVE.

[29934.]—The interesting contribution by Mr. Stretton of "Old Ironsides" in letter 29895, induces me to inquire if any details are known respecting the reversing gear of this early locomotive, as from the short description this is not quite clear.

In the "Rocket," which preceded the "Planet" type of engine, the cylinders and valves being near the footplate, the valve-rods were temporarily disconnected from the two loose eccentrics, which latter were independent of each other, and the valves reversed by hand. This appears to have been the primitive mode of reversing when eccentrics were used, and in which arrangement there is properly no *reversing lever*. In what appears to be the next improvement the two eccentrics were fixed permanently at right-angles to each other on the ends of a short tube or sleeve, the whole being loose on the axle, and movable also in the direction of its length. The eccentric rods were hinged to their straps to allow of this movement. At each end of the sleeve, and near to each eccentric, a *driver* was permanently fixed to the axle, and furnished with a projection or pin; an aperture or eye corresponding to it was provided in each eccentric plate in which this pin could enter when the sleeve with the two eccentrics was shifted towards it: one driver was fixed in position for forward, the other for backward gear; the sleeve with its eccentrics was shifted to the one side or the other, and thus into gear with one or other of these drivers by a lever on the footplate. This appears to be one of the earliest applications of a *reversing lever*.

The foregoing arrangement was described by Pambour, and seems to have been much used in the engines on the Liverpool and Manchester Railway at an early period. It, however, did not obviate the necessity of moving the slide-rods by hand to reverse the engine when it had stopped in the usual way, unless the right aperture and pin chanced to be opposite each other; but it admitted the possibility of reversing during movement, and this without any alteration of the slides by hand, as the sleeve and eccentrics could be moved out of gear with one driver, and caused to drop into gear with the other while the axle was revolving. Semi-circular slots in the eccentrics would not admit of this, for the engine would then require to actually reverse its motion before the pins could take up their new position in the slots.

As the eccentrics of "Ironsides" are described as having semicircular slots which appertain to the more primitive arrangement where there was no reversing lever, and the engine was reversed by "changing the position of the eccentric by means of a lever from the foot-plate," which seems to imply something more resembling the sleeve arrangement last described, it is not quite clear what the gearing actually was.

On account of the interest attached to the evolution of reversing gears, I am tempted to take this opportunity of inquiring whether it is known to whom the credit is due of fixing the two eccentrics on a sleeve and applying the *reversing lever* in the arrangement above described. **A. Marson.**

ORGAN MATTERS—GENERAL DESIGN IN ITS RELATION TO TONE-COLOURING.

[29935.]—I HAVE already replied to Mr. Audsley's request, showing type and anti-type, *re* himself and the great New York firm, and as regards the St. Barnabas organ—of which, I suppose, we shall never hear the last—why, I have already admitted (*vide* my letter in your issue of the 3rd May) that Lord Dundreary *most certainly* had a cousin who played the German flute, and I will now gladly add that it reflects the greatest credit on Lord Dundreary!

Mr. Audsley has dragged me into a position of prominence to which I did not aspire when I responded to Mr. Dixon's invitation to criticise his chamber-organ scheme. He has publicly committed himself to an unqualified admiration of my work, the merits of which he tries to explain away by saying that it is *not* my work, though, inconsistently enough, he can name nothing so good, *in his own estimation*, not bearing my name.

Well, in reply to that, I thank him in the name of the firm which I now represent, for his useful advertisement, and so will my late partner, Mr. Thynne, who is still my co-worker, and so long as he recommends that firm, which he must do now or compromise himself, I care nothing of what he thinks of me, or what my supposed merit may be in connection with work already executed.

Mr. Audsley rightly quotes my motto: I have tried to act upon it for some 40 years. It is an honest one, for it wrongs no one, and it expresses good, broad, Christian sense. "Compare for yourself, and then give honour where honour is due!" Thus I close this correspondence.

Carlton C. Michell.

Woodstock-road, Shepherd's Bush. May 11.

[29936.]—WOULD Mr. Audsley and Mr. Robinson be kind enough to give me their opinions as to the age of an old instrument which has lately come into my possession? I can find no date or name, but think about 100 years old. Also a description of the stop "Tacett" (see below), which I think does not now exist. The specification was as follows:—

1.	Open diapason	Ten. B to D	metal	8ft.
2.	Stopped do.	B B to D	wood	8ft.
3.	Principal	B B to D	metal	4ft.
4.	Stopped flute	Ten. B to D	wood	4ft.
5.	Fifteenth	B B to D	metal	2ft.
6.	Cornett	B B to D	?	?
7.	Sesquialtra	B B to D	?	?
8.	Tacett	Cannot trace it	?	?

I see that it has been altered, but evidently some years back. Stops Nos. 6, 7, 8, are left out entirely now; Nos. 1—5 still remain. The manual has thick white ivory lines centred in the black keys, and the white keys are over ¼in. thick, bevelled edges and scalloped fronts. The names of stops appeared on brass plates, 1¼ by ¾ (in my possession), above their respective knobs, which, I presume, were small blank ones. The case is of Spanish mahogany, with angels' faces and wings carved in bold relief at each corner. Gilt speaking front. A pedal organ CC to F = 18 Bourdon pipes have also been added — when, I do not know; also lowest B removed from manual. The design is bold and grand, and is much the same as what may be found in an old City church, but, of course, smaller. I should be very glad to see any opinions on it. **Tacett.**

ORGAN NOMENCLATURE.

[29937.]—WHEN I wrote my former letter I was trusting entirely to a (for an Englishman) very intimate knowledge of German. The remarks of Mr. Audsley and of "Organon" have caused me to look up several dictionaries. In every one I find the word gedackt applied technically to an organ stop, and to *nothing else;* the word gedeckt being added as an explanation. Either is, therefore, correct—the one philologically, and the other by user, and the other variations employed by your correspondents are clearly inadmissible. But the curious question arises, Whence comes this word gedackt?

I can read all kinds of German, right away back to the "Niebelungen Lied," and I fail to remember a verb dacken anywhere. There is Dach, a roof; and dachen, to roof in, the p.p. of which would be gedacht—i.e., *h* and not *k*. Why and how did gedeckt become gedackt? and why is this variation only met with when alluding to organ-stops? We have Deck, a deck; Deckel, a cover, lid; Decke, a covering; decken, to cover; all spelt with an *e*, and the only case where the *e* is replaced by *a* is Dach, a roof; but here the *k* at once changes to *h*. I confess to being very puzzled. Perhaps amongst the readers of "Ours" may be a German who can help us, as I am reduced to consider the introduction of gedackt as probably due to some local patois. **G. W. S.**

HYDRAULIC ORGAN-BLOWER—WATER MOTORS.

[29938.]—I AM glad that our old and valued contributor, "F. A. M.," has opened the subject of water motors, as I was about to write on a somewhat kindred subject for the last few weeks, but native modesty, or something else, prevented me.

I have lately become the possessor of a small single manual organ, from which I derive a good deal of pleasure. There is one drawback, however, and that is the blowing. As a friend expressed it, "The continual pumping at the bellows takes away a good deal from the poetry of music." Add to this that the pedals cannot be used except when another person is employed to blow, which is not always possible or convenient, I therefore propose making an hydraulic blower, the details of which I submit to the kind readers of the "E. M." for criticism and advice.

The organ has but a single feeder, and requires twenty motions of the foot through a space of 10in. with a pressure of 28lb. per minute. This represents 466ft.-lb. per minute. For the hydraulic blower I would require, say, 700 as the maximum working power. I live in a country house far away from the conveniences of water-works and town pressure; but, still, I have certain conveniences of my own. The house is double, with a valley between, a shoot conveys the water from the valley through the attic to the back of the house. In this attic I propose placing a number of empty petroleum casks, as being a cheap and substantial form of cistern.

From that to the dining-room where the organ is placed I could get a fall of 20ft., or by placing the blower in the kitchen immediately underneath, say, 25ft., with still enough to spare to conduct the water away. This fall would be vertical almost, having no more than, say, 3ft. horizontal. This would represent an effectual pressure of about 11·7lb. per square inch—neglecting friction, say, 10lb.

Now to come to the motor. This would consist of a cylinder something like a steam-engine cylinder, but with only two ports—viz., an exhaust and lower supply port. There would be no cover, and consequently no stuffing-box. The dimensions of the cylinder would be 3in. diameter by 5in. stroke, which, working at 24 strokes per minute at a pressure of 10lb., would produce the 700ft.-lb.

The chief thing that troubles me is the means of moving the slide-valve. I thought of having a stop on the piston-rod, so that when it reached to within about an inch of the stroke it would strike against a lever which would push the slide-valve in one direction, and, on its return, would push it in the other, something like the stop in a planing machine. This, I am afraid, would not do, for, as water is inelastic, the moment the valve covers the inlet port the whole thing would come to a standstill. By having the exhaust open a little sooner than the supply closes I might avoid this; but I can conceive a case in which the machinery would stop just at this point and let all the water run to waste. The only alternative appears to be a weight falling from side to side and opening and closing the valves almost instantaneously; but the bump of this, even when 5ft. under, in the kitchen, and when well padded with felt or indiarubber, would, I think, take away considerably from "the poetry of music."

Will some one who has had experience in such matters kindly advise me?

Now for a governing apparatus. I could have the supply-pipe passing very close to the wind-chest, and the starting-cock attached to the top board of the wind-chest in such a manner that when the latter is full it shuts off all the water from the cylinder, and thus stops it, until the wind running out again opens the cock, and starts afresh. Thus the supply of water and wind would vary according to the character of the music and the number of stops used.

As to the quantity of water required, the area of cylinder is 35·343c.in.; multiplied by 24 by 60, gives 50,894c.in. nearly, or 183 gals. an hour. This is when working at full pressure; but I think 100gals. would be nearer the mark. (The area of the supply pipe was to be ¾in.)

I meant to ask a little advice about a small windmill to help the rain-water for this blower; but I think our indulgent Editor has been tried enough by my long letter, and so I will postpone my inquiries to another time.

I may be permitted to point out to "F. A. M." that the screwing down of the valve certainly would save water in any engine. The cylinders must fill, but they do so more slowly, and the motor would consequently move more slowly, but apparently with undiminished power or pull.

"F. A. M.'s" plan appears to be useful in small powers for varying the velocity with the greatest nicety; but it would scarcely affect the prime motor. This is my impression; but, of course, may be wrong. **J. L. D.**

ROSE ENGINES—ORNAMENTING IRREGULAR SURFACES—CUTTER-BARS.

[29939.]—I WAS glad to find from the letter of "Cape Town," that I am not alone in my desire to hear more about rose engines. "Cape Town" may be interested to know that I have made a rose engine attachment on the principle of the eccentric disc connected by change-wheels; and on p. 350, Vol. XLI., he may see prints from blocks cut in it. I have now undertaken a straight-line chuck to be used in connection with it, which will, I think, enable me to do some very pretty work, including the patterns in imitation of watered silk, &c. As to the rose cutter, I am told it is slow in its action when deep cutting is required, and no doubt that was why Mr. Evans added a driller to work in its little tool-box. I have used my apparatus, as "Cape Town" suggests, to make some wooden rosettes, and it would make them in brass, but they would only have plain waves, and these can be as well produced by the eccentric disc, with the great advantage that, by altering the eccentricity you can regulate the depth of the wave. I am inclined to think, however, that the introduction of gearing, though so convenient, detracts from the absolute precision of the movement obtained by means of the copying principal. Perhaps the best plan would be to mount the rosettes on a rocking headstock in such a way that they and their rubbers could be moved nearer to or further from the centre of oscillation, so as to give a greater or less angle of vibration from each rosette, as might be desired. Perhaps Mr. Maclean will say a word on the subject.

Since my last letters I have paid a visit to the workroom of "C. C. E.," and learnt from him many matters of interest. One was that a nutshell of irregular shape can be ornamented without first bringing it to truth. And, again, I saw a piece of boxwood which had been ornamented without having been turned up; it was of an irregular oval section, and curved longitudinally; it had also been hollowed out, so as to leave an equal thickness all round.

Now that "O. J. L." has given us a description from Bergeron of the rose engine as it was, surely someone will be moved to tell us something of the improvements that have since been made. Is there any maker of rose engines left in this country? It is unfortunate for us that the men who know most of these matters do not care to write.

I am surprised to find there are still some who do not believe in the Haydon bar. I like it very much, also Hines' "Eclipse" internal cutter-bar; but Hines' "Universal" (Haydon) bar, with a joint and a nut on the top, I consider a failure—the joint gives way sideways, however tightly you screw the nut, and the strength downwards is of necessity less than in the solid bar. **F. A. M.**

CUTTER-BARS.

[29940.]—I HAVE just received my cutter-bar from Mr. C. Taylor, of Birmingham, and, according to promise, I send a sketch of it. I think there will be no difficulty in understanding it from the three views I give. However, one or two points about it are worth noticing.

It is a *solid bar*. The cutter resting in the groove cut in the solid lump underneath the bar, *it must be firmer* than any bar in which the cutter is carried either by a sling, or by a bolt with a slot in the head, as both bolt and sling have to bear the whole strain of the cut.

I know that Smith's bar is, in some points, more convenient, as the cutter can be swivelled to either side, which for some purposes is a decided advantage.

The bar I have figured is not the only form made by Taylor; but I have chosen it as the most suitable

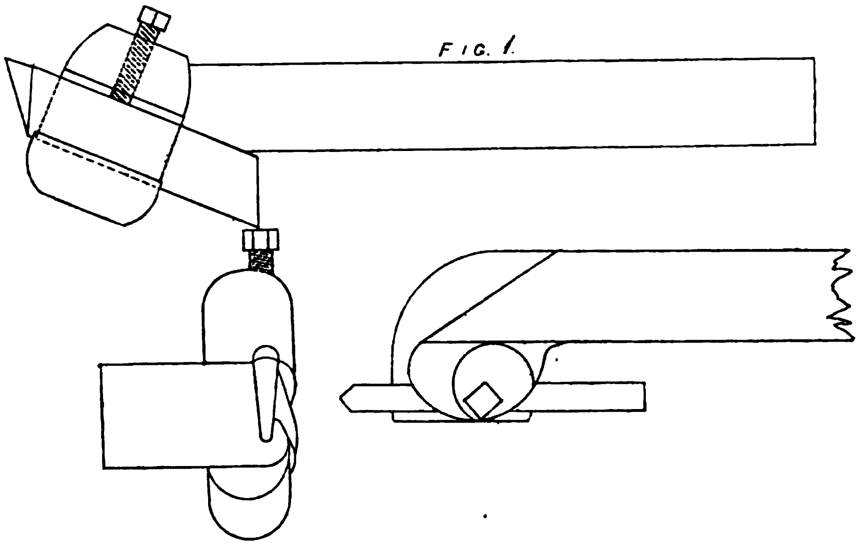


FIG. 1.

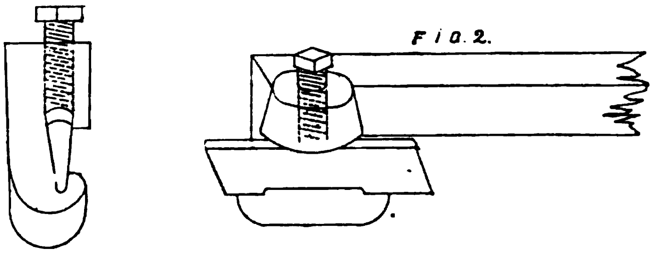


FIG. 2.

for my present circumstances, and not because I think it the best. It will be seen from the front view that its formation admits of the tool having any amount of overhang you please, from ½in. or less, to 2in. or more.

I know of no other bar in which this is possible, and I do know that in my lathe it is of considerable importance to reduce the overhang.

In the other form the difference is simply that the cutter comes directly under the shank, and the bar becomes then a cranked tool. The cutters must then be shorter, and the overhang at its least is about 1½in. I give a sketch of this, which is hardly correct in some points, but will sufficiently give the idea.

Of course, though the tools shown are round-nosed, the double-edged forms can be as easily formed in this as in the Haydon, and for getting into a corner the side of the tool, if it has been ground for the purpose, will do, or else the front angles may be made 80°, and then by setting the shank angularly the same cutter will cut into either a right or left corner; but properly the bar is only a right-hand tool, though it will work well in either way. But now to come to my heading—What is the best cutter-bar.

"Tuebor" gives his voice in favour of Tangye. I have heard it said that in it the cutters sometimes shift sideways. Would he say if he has ever found them do so, and if he is not afraid of sharing the vials of wrath which have been poured out on me, would he also say what are the faults he found in his Haydon? I am curious to know how far our experience may be alike, and also whether in theory he agrees with what I have advanced, as against the Haydon *overhang*.

It must be admitted that in a well-fitted lathe, and with cutters of certainly not less than ½in., the Haydon bar will do good work in both planer and lathe. "J. K. P.'s" evidence is enough to set this at rest for ever, and he tells us he never uses any other bar; but he uses it only for plain turning and planing, having solid tools for right and left work *on* ends or corners.

I do not know whether I am quite right in saying he has discarded, or even condemned, it for such purposes; but, at any rate, he does not use it in this way, and I presume, if its work was equally good, and equally convenient as solid tools, he would so use it. Therefore its non-use may fairly be taken as a qualified condemnation.

Now, I am sure there must be many besides myself who would like to be able to use a bar for *all* purposes in the lathe or planer, and this evidently the Haydon cannot be. What other bar, then, presents greater conveniences and a wider range of real practical uses? If one bar does not combine all, how many, and what kinds, will be found the most useful?

What work will the Haydon do *better* than any other bar? If the answer is, None; then what other bar will do as good work as the Haydon's best, and do, in addition, work the Haydon will not attempt? I have *heard* the Haydon is useless as a screw-cutter. I have failed utterly with it when so used; but, then, that may be regarded as nothing. I know Taylor's bar will do my plain turning and planing 50 per cent. better than my Haydon, and I know it will do *screw-cutting perfectly*. For this purpose a stiff tool is most important, and I find it is as stiff as any solid tool. Therefore, I feel inclined to say I have now got a tool which counts *two* as against *one* for Haydon.

Perhaps "Tuebor," or some one who has had experience of several bars, will give particulars of the work done, and what each was found most suitable for, and in this way we might arrive at some suitable result.

There ought to be nothing offensive to anyone in candidly criticising the performance of any tool; and even though a tool has passed muster some years past. There are so many improvements in tools of all kinds, that really it should not be regarded as unreasonable to require even old and well-tried favourites to submit to impartial examination to see whether they can hold their own against new claimants for favour.

Yet though this seems reasonable, to see the way some people resent a word said against the Haydon bar, you might think there was something sacred about it, and that it was mechanical heresy to question its title to the universal admiration—if not adoration—of all amateurs. But in such matters I am not afraid to admit I am a free-thinker.

Fred. Carre.

[Our engraver has done his best with the sketches, but they are really very difficult to make out—Fig. 2 especially, so that any mistakes must not be laid to our charge.—Ed.]

THE HAYDON BAR.

[29941.]—One sentence of Mr. Carre's, which, to my mind, explains the unsatisfactory behaviour of his Haydon bar, seems to have escaped notice. It is line 10, col. 3, p. 94, and is as follows:—"I have got much better results with the Haydon by putting a ½in. packing-piece under, so as not to allow more than about ½in. of the cutter to project from the sling."

Now a properly-made bar not only would not have required, but could not have been used, on the lathe it was made for with such an amount of packing; and that Mr. Carre's bar worked the better for it shows at once that it is ill-designed—first, in its excessive overhang, which, secondly, entails an undue protrusion of the cutter to make up for it; and thirdly, in a cutter unfairly small for the work demanded of it.

A $\frac{3}{16}$in. cutter in a properly-designed bar, which supported it as close as possible up to the point, might have stood; but it is hardly to be wondered at that one of that size, protruding ½in. from its sling, and used in a 5in. lathe, driven *vi et armis*, should have chattered and snapped, especially when the slide-rest beneath it was not a very firm one.

It would be interesting if Mr. Carre would give dimensions of his bar, as the tracking home of a failure is always instructive.

It has always appeared to me that the gauge used to fix the height of the tool in the Haydon is not quite satisfactory. It has an angular opening of 124°, so that when one limb is applied to the upper arris of cutter, the other is horizontal, and at lathe-centre height.

This is all very well if the cutters are absolutely alike; but if in shaping them the arris gets rounded off, or if a cutter of any other section than a square is used, the gauge is not applied precisely in the same spot, and the horizontal line is elevated or depressed.

A much better plan is to make the gauge of a Z shape—i.e., with the upper and lower edges parallel, and at such a distance apart as that, when when the lower edge is applied to the sloping surface of the bar, the point of tool protruding to centre height shall touch the upper. In the one case the datum gauged from is the arris of cutter, a position possibly variable, or even absent; in the other, it is the invariable surface of the bar.

I should be glad to know the best angle for the "sacred orifice," and also the best speeds to be provided for in designing an overhead to be chiefly used for driving metal-cutting tools.

I am afraid Mr. Sandwell (letter 29917) will find himself forestalled, for I recollect seeing, in one of the exhibitions at South Kensington some years ago a potter from Doulton's working at a wheel driven by this friction gear controlled by a pedal.

May 11. **Faber.**

GEOMETRICAL LATHES — ROSE ENGINES — WAGNER'S UNIVERSAL ROSE ENGINES.

[29942.]—In reply to the letter of "Cape Town" (29920), I have to answer that Perkin and Heath's improvement has long been an accessory to the modern rose engine, as the beautiful work of the late celebrated engine-turners, G. J. Fieldhouse and Alfred Deacon, will testify. I do not mention the above names for any special reason, but simply because I have seen their work, and also their private working notebooks. For everyday work, both artistic and commonplace, the Messrs. Bacon, of Gough-square, E.C., will turn out work above the average. Of course, other firms have their special type of rose engine; amongst others that of Mr. Bradbury, and used for special purposes. These classes of rose engines are specially designed to meet some peculiar line of business, and it would be unfair to think that one individual could successfully describe the whole. But a man who has been thoroughly grounded in the art of rose-engine turning will, with less difficulty than others, see his way more clearly, and thus make a more successful exponent of the views of a builder of ornamental lathes than an ambitious amateur. I must, however, say that rose engines of the above type are superseded by an improvement bearing the date of 1886, which geometrical engraving lathe I have had the honour and pleasure of working. As a gentleman amateur is trying to gain information from one journal, while writing for a rival weekly, I trust, Mr. Editor, you will see the reason of my reticence. With regard to "Wagner's universal rose engine," if "Cape Town" will write to me—my address may be found in the Address Column of the same date in which I defined the various classes of rose engines—I will put him in the way of gaining further information.

I have a word or two to say to amateurs. They do not take up engine-turning thoroughly, and for a sufficiently long period: the art of engine-turning requires to be thoroughly learned, like any other trade. **Norman Maclean.**

117, Harwood-street, Sheffield, May 13.

AMATEUR GLASS-BLOWING.

[29943.]—I send herewith sketches of two simple arrangements for working blowpipes, which I have found very useful. They are cheaply and easily made, and a great deal of useful work may be done with them. Of course, they are merely modifications of well-known apparatus.

Fig. 1 shows any ordinary bellows fitted to a water-regulator. The dimensions may, of course, be varied to suit individual requirements. A [illegible] trough, 18in. deep and 8in. square, is divided into two parts by a diaphragm, indicated in the figure by a dotted line. This does not quite reach the bottom, and is soldered in at the sides and top, so that A is a closed chamber, cut off from all communication with the outside, except under the diaphragm. B is left open at the top: C D is a piece of gas-piping soldered into the angle of the trough, and passing up nearly to the top of [illegible], having a tap at D for convenience, though [illegible] really required. E is the escape-pipe, to which the blowpipe is attached by means of an india-rubber tube.

A valve is necessary on C D to prevent back pressure. This may be placed at the [illegible]

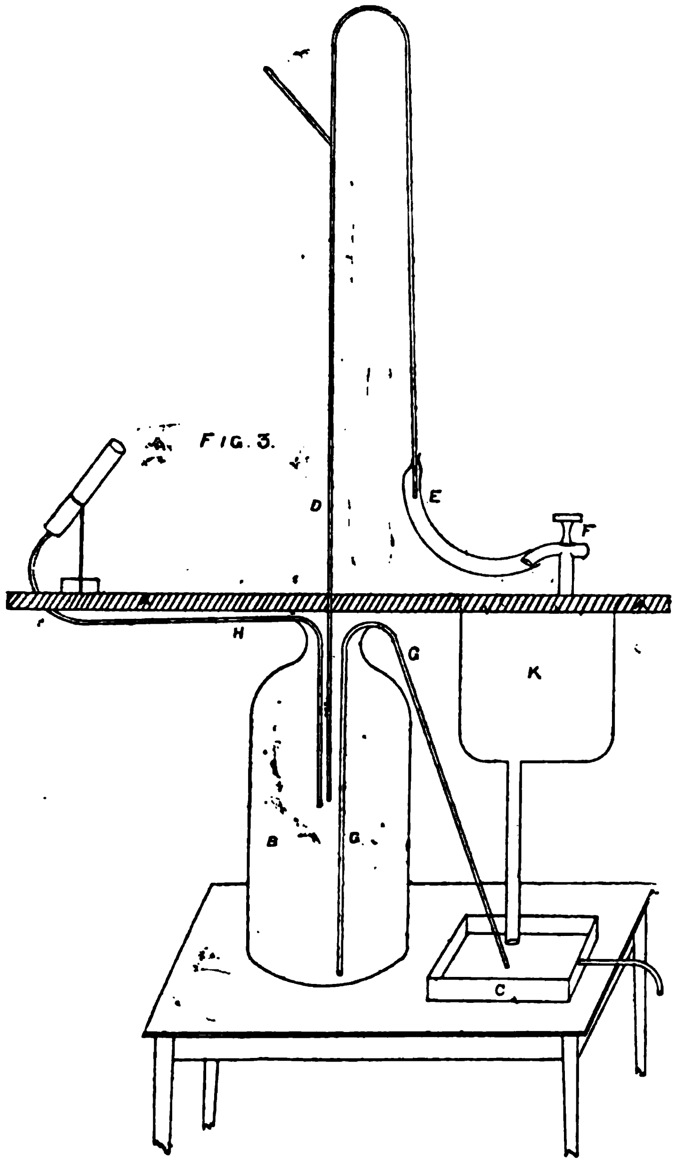


FIG. 3.

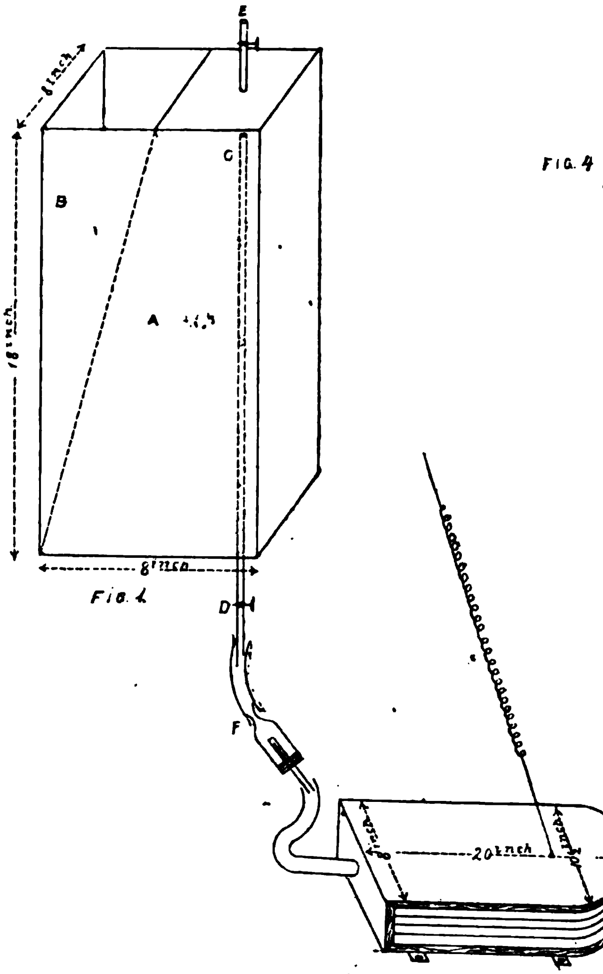


FIG. 1.

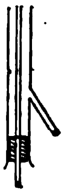
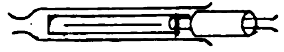


FIG. 4

FIG. 2.



as it is then inaccessible if it should get out of order, it is best to place it between the regulator and the bellows at F. The ordinary Bunsen valve is convenient, and is shown in detail in Fig. 2. A piece of glass tube, 3in. or 4in. long and about 1in. diam., is drawn out at one end to take an indiarubber tube, and rounded at the other, which is fitted with a good cork. Through this cork passes a smaller piece of tubing, projecting through it about ¼in. To this projecting end a short piece of good, rather thick-walled, indiarubber tube is attached, and tightly wired down with iron wire. The other end of the rubber tube is then closed with a bit of glass rod and wired down; but, before doing this, a piece of wood, such as a bit of lead-pencil, is pushed into the tube, which is then cut through longitudinally by one blow of a sharp chisel. Cutting with a knife won't do. This slit should be at least an inch long. This valve will be found to work well if carefully made, and will very rarely require attention.

In order to introduce the proper quantity of water close the taps E and D, and then fill up the chamber B within 1in. of the top. Then, upon opening E, the water will sink until it stands at the same level in both chambers, and a powerful blast be thereby forced through E. If more water than this is put in, it will overflow at the top when working.

For a moderately small blowpipe, an ordinary small household bellows will answer well, and give a very steady flame.

The regulator should be placed on a stand under the working bench, so that E passes through a hole in it. The bellows is fastened down to the floor (but raised a slight distance from it), conveniently for the feet of the operator. It is as well to fasten a piece of wire gauze over the hole for the clapper to prevent small bodies getting under it and injuring its efficiency. A spring is attached to the bellows and to the bench in order to raise the top of the bellows after each compression.

If a large blowpipe is used, the bellows must be made proportionately larger. If required, one can be made very cheaply. The shape and suitable dimensions are shown in diagram, but it might be a little larger with advantage. The bottom board and end piece are fastened firmly together. The top is hinged on to the end piece, and a piece of wood is placed inside to prevent the top being forced down far enough to wrench the hinges. A 2½in. hole is cut in the bottom board, and a 4in. piece of truly-planed wood is covered with wash-leather, and fitted as a clapper, being kept in its place by strips of leather. The exit tube is screwed into the end piece, and a paper pattern prepared by which the leather covering is cut out. It is as well to fix two or three pieces of cane inside and attach them to the end piece by strips of leather. The leather covering is then fastened down with large-headed nails and good glue, especial care being taken with the piece that covers the hinges and the corners of the end piece.

I have had such an arrangement in use for nearly four years without getting out of order, and of course, it may be arranged to work two or more blowpipes; but it is frequently useful to have feet as well as hands free when at work, and further, it is constantly necessary to be able to use a small hand blowpipe at a distance from the bellows, in which case an assistant is required to work the bellows.

The following modification of the Sprengel blowpipe meets these cases, and in many ways is a most useful piece of apparatus. Fig. 3 shows the general arrangement. A A is the working bench. The tap F and the troughs K and C are not parts of the apparatus proper, but were previously existing, and have been taken advantage of. As in most laboratories, the waste water from the tap and trough, F and K, falls into an open trough C placed under the bench, and thereby solid bodies are prevented from entering the escape-pipe and choking it. C always contains an inch or two of water, filling it to the level of its escape-pipe.

Upon the same stand as C is placed a large bottle, B, of about two gallons capacity, but the exact size is immaterial. This bottle is fitted with an indiarubber stopper (cork does not answer well) with three holes bored through it. Through one hole passes a short length of glass tube, which serves as the air exit, and is connected to the blowpipe by indiarubber tubing passing under the bench. Through another hole is passed a siphon tube G, one end of which is beneath the level of the water in C. This tube is filled with water, and always keeps the level of the water in the bottle constant. Through the third hole passes a long glass tube D, which is carried up the wall, and has an open side tube welded upon it. The height varies—it may be conveniently one yard from the tap F to the top of the bend. The other end of this tube has a length of indiarubber tube wired on it, which can be slipped on to the tap as required. When the tap is turned on, the water rises until it falls over the bend, and carries with it bubbles of air as it passes the side tube. The only exit for this air is through the tube H, and a very regular and steady blast is obtained, which is regulated by the amount of water allowed to pass. The only objection to the arrangement is the fact that the water used runs to waste; but if it works a small blowpipe only, the amount of water required is very little. I mostly use it for sealing terminals into vacuum tubes, or for working a hand blowpipe at a distance, and for these purposes it is very useful. Of course, if the water is turned on sufficiently a very powerful blast may be obtained.

The usual arrangement of the Sprengel blowpipe has a tap in the lower bottle for the escape of the water. The siphon is a much better arrangement, being automatic and always ready for use, carrying off the water slowly or quickly, just as it is supplied. I have had mine in use for twelve months, and so far it has never got out of order.

The amateur glass-blower requires at least two blowpipes, a small one and a larger one, and he cannot do better than adopt the sizes given in Mr. Shenstone's very useful little book. Fig. 4 shows how they are made. A brass tube has a side tube brazed to it, and is fitted at one end with a good cork, through which passes a glass tube for the air supply. The larger should be about 5in. long and ⅝in. internal diameter, and the orifice of the glass tube should be at least $\frac{3}{16}$in. diameter. This can be worked with the apparatus first described. smaller should be 5in. long, $\frac{7}{16}$in. internal dia and the glass tube very fine to give a long- flame.

I notice very little has appeared for some time in the "E.M." respecting glass-blowing, and I hope to forward shortly some hints on the construction and use of the Sprengel pump in connection with vacuum tubes.

Leicester. **E. E. B.**

JOE IN THE BOTTLE.

[29944.]—HAVING just seen "Joe in the Bottle," I am sorry to see the explanations dropped. "Ferrum Primus" (29456) is good as far as he goes, and one could understand it if anyone touched the bottle; but the difficulty still holds, as no one does touch the bottle; the bottle is also isolated from electricity by glass columns.

Can platinum wire burn itself into glass so as not to show in any particular light? If not, what force or power makes "Joe" to move? No one is near him, and he does what anyone—that is, showman or looker-on, says. I hope someone will be able to give a hint—several hints might make a whole.

"Physco" has electricity inside him, and I can understand how that is controlled; but "Joe" has not. The thing to find out is what force is put upon the water without any visible connection. However done, it is very good, and well worth seeing.

The Vale, Eastbourne. **W. B. Chambertin.**

PSEUDOSCORPIONIDEA—CHELIFER.

[29945.]—THE insect drawn by "Appendiculata" is commonly known as the "Lobster insect." It is rather scarce, and is generally discovered by rendering itself conspicuous in attacking the common house-fly, though I do not think it is parasitic. For so small a creature it has a great power of grip in its serrated claws, holding on to the leg of a fly with one, and grasping a filament of cloth with the other, and so defying all attempts of the fly to escape. It is difficult to ascertain the purpose of this attack, as apparently it has no means of feeding on the fly, but will remain hanging on to the end of the leg for days together. On one occasion I detached the leg from the fly, but still the little chelifer retained its grasp, and wandered disconsolately about for two days, holding the dried limb like a truncheon. I then introduced into the glass box in which it was confined some very minute flies, for which it dropped the truncheon, and seizing a live fly, crushed it up with its powerful claws, and carried the carcase to its mouth.

This particular species does not attack its fellows, as I once discovered a small colony of them nestling close together.

Another variety is very plentiful, and may always be found in summer time, in moderately damp places, on the underside of pieces of tile or flower-pots, oftentimes with the pear-like body of some podura in its grip. This species is a terrible cannibal. If a number are confined together, the strongest will infallibly destroy and devour the young and weak ones. As these vary very much in size, they evidently acquire growth by casting their skins as spiders do. **F. H. Wenham.**

[29946.]—IN *Science Gossip* for 1869 there is much interesting matter concerning these creatures, accompanied by many illustrations. The volume for 1867 has a reference to a paper on this subject, read at a meeting of the Quekett Microscopical Club. This may indicate another source of information for H. Marle. **E. D.**

PERSPECTIVE DRAWING.

[29947.]—I HAVE known and practised, since perhaps thirty years, the method of obtaining lines in correct perspective, when drawing from nature, to which your correspondent, "Glatton" and Mr. H. Cunnynghame allude. I found it, as well as I can recollect, in a work on drawing, published about the beginning of the century, by a drawing-master, named, I think, Hayden. I forget the title of the book.

By means of this system I have executed very difficult and complicated drawings, such as the curved corridors of the Coliseo in Rome, which would otherwise have required a long and tedious geometrical construction.

As "Glatton's" description, however, is not very clear, perhaps it may be well to state my method. The pencil should be held at a convenient distance from the eyes and parallel to them. Then it must be inclined till it coincides with the line to be represented, but always remaining in a plane parallel to the eyes; then lowered on to the paper, care being taken to hold it steadily, and always at the same angle. Its direction is then marked on the paper.

D. S.

FRESH EGGS.

[29948.]—THE only good test for eggs in my estimation is to hold the egg in front of a strong light and as near to the light as possible, yet without touching it. It is thus easy to turn the egg round in the fingers and note any peculiarity in what now looks a semi-transparent body (while in front of the light). With a "fresh" egg you will see the inside of the shell to be quite free from any honeycomb (Fig. 1) markings. If there are any of these markings (see Fig. 2), the egg has already begun to lose its freshness. If it is full of these markings, then the egg is very stale. If the egg has any black markings inside, like Fig. 3, you may depend upon it that it is useless for boiling purposes. Usually eggs that have laid in the same position for a long time become black, as in Fig. 3. This will spread throughout the whole of the egg. I find that in the bulk of cases it is the yolk that has got stuck to the side of the shell when black patches as in Fig. 3 occur. When the egg is broken this black patch is of little consequence, as it sticks to the shell; the remainder of the egg is useful, unless it smells faint. Eggs with several smaller black patches inside are useless generally. When the whole of the egg appears black by this test it is rotten.

Pickled (lime) eggs I now refer to. These are deceptive. As domestic articles they are almost a failure. Under the foregoing test they do not turn out as "fresh" eggs do. I have known lime eggs to give all the appearance of a fresh egg, and yet for it to turn out bad when broken. I don't like lime eggs. Lime eggs *always* crack in the pan when boiled.

FIG. 1

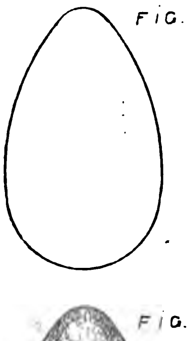


FIG. 2

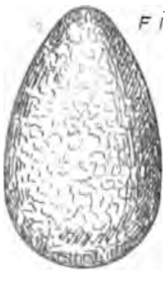
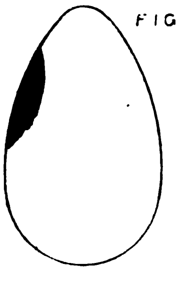


FIG. 3



Eggs will keep good a long time during the winter months. In the spring time they will boil when a month old. I have known some look equal to a new-laid egg when this age. In the hot summer months eggs quickly turn. I have known a week of hot weather play havoc amongst the eggs, bursting their shells, and filling the room with a horrible smell. Eggs that have been turned bad with hot weather will stand any amount of shaking against the ear; Samson himself could not make their inside shake so that he could hear it, the pressure inside being too great.

The common notion that an egg is good because one end is warm when touched with the tip of the tongue is erroneous. A bad egg is warm in the same way until the cavity gets filled up by the expansion of the matter inside the shell.

May 4. **D. B. L.**

Castor Oil as a Lubricant.—The Italian Admiralty have recently caused to be carried out a number of experiments with a view of testing the comparative merits of castor oil and olive oil for lubricating purposes on board ship. From the results obtained they have given orders that henceforth all exposed parts of machinery are to be lubricated exclusively with castor oil, while mineral oils are to be used for cylinder and similar lubrication.

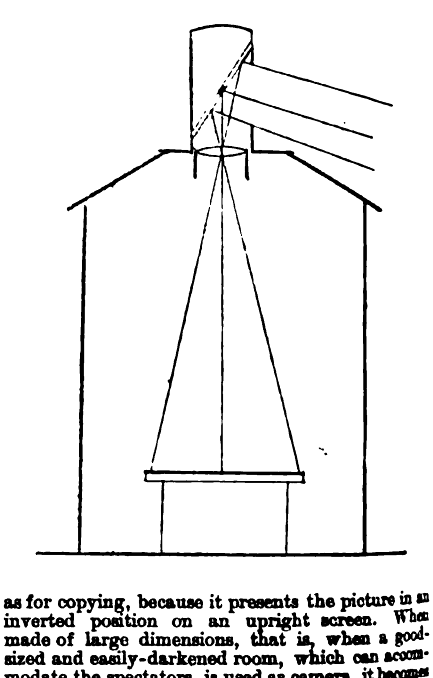
REPLIES TO QUERIES.

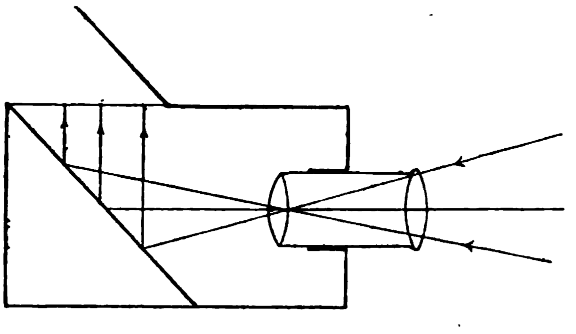
*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67717.]—**Smoke-pipe.—"Technical" Corrected.**—The geometry of this problem in your last issue, and for which Mr. Warn is said to be responsible, is somewhat misleading. Firstly, the ellipse of an oval should be a circle; secondly, an oval cannot be constructed by the method given; thirdly, the periphery of an oval cannot be equally divided by equal chords. The Fig. 4 in your last issue, will probably be found sufficient for my proofs, but I leave that matter in the Editor's hands. Now the half-chord of the smaller circle taken anywhere along the line $m\,r$, will be $= m\,l$. We merely want to find a point in $m\,r$ where the half-chord of the larger circle will also $= m\,l$. For this purpose we will remove the oval and replace it by a quadrant of a circle. Mark off $L\,d = F\,l$, draw $d\,f$ parallel to $L\,A$; f is then the point where the half-chord of the larger circle will equal $m\,l$. At the point r where the two lines intersect the chords of the two circles are common; other points can be similarly obtained, and the curve drawn. Now to prove that an oval cannot be described by the method given. Call the points where $b\,N$, $L\,M$ intersect W; join $L\,a$, $M\,a$. If $M\,N = M\,A$, it will be readily seen that the common centre would be A, and the figure therefore a circle. It will, therefore, be granted that $M\,N$ is greater than $L\,N$. Now $b\,a$ being $= b\,M$, the $\angle\, b\,a\,M = \angle\, b\,M\,a$, i.e. $\angle\, a\,N\,M + \angle\, a\,M\,N = \angle\, b\,M\,W + \angle\, W\,M\,a$, and as by similar triangles $b\,N\,M = A\,M\,L$ $\therefore$ the remainder $a\,M\,N =$ remainder $a\,M\,W$. Similarly it can be proved that the $\angle\, W\,L\,N$ is bisected by $L\,a$. It can also be proved by Euclid's problems that the straight line which bisects one angle of a triangle, will cut the opposite side in the same ratio as that which exists between the adjacent sides. $\therefore W\,a : a\,N :: W\,M : M\,N :: W\,N : L\,N$ (by similar triangles). Again $W\,a : a\,N :: W\,L : L\,N$. $\therefore W\,N : L\,N :: W\,L : L\,N$ and $W\,N = W\,L$. And by similar triangles $M\,N = M\,b$ and $A\,L = A\,M$, i.e. $A\,M = b\,M$, or as Euclid would have completed it, $M\,N = L\,N$, but by the construction $M\,N$ is greater than $L\,N$ $\therefore$ $M\,N$ is equal to and greater than $L\,N$, which is absurd.—Q.E.D. My third proposition requires no demonstration.—R. N.

[67862.]—**Distribution of Load.**—When the forces are in one plane, only two equations can be formed; and therefore, with more than two unknowns, they are indeterminate. When they are not in the same plane, three equations can be formed, and their values determined where there are not more than three unknowns.—R. N.

[68019.]—**Camera Obscura.**—Camera obscuras are made in various forms. The earliest was, probably, that which has since become the prototype of the photographic camera, and which still retains its original name in French and German. In small sizes this type is inconvenient for viewing as well as for copying, because it presents the picture in an inverted position on an upright screen. When made of large dimensions, that is, when a good-sized and easily-darkened room, which can accommodate the spectators, is used as camera, it becomes effective and simple. The lens has only to be placed in the window-shutter, with a little provision for focussing, and it will depict the distant objects which it faces on the back wall of the room, on which sheets of paper or calico can be stretched





Still the picture will be inverted unless, indeed, the lens has an erecting combination behind it like a terrestrial eyepiece of telescopes. "Widnesian," with his octagonal house, cannot, I think, desire this form of camera, which is too rigid for most of look-outs. Improvements were soon made in such cameras. By receiving the horizontal rays that come through a lens on a silvered mirror placed at an angle of 45°, they are turned upwards against a screen of ground-glass which forms part of the top side of the camera and there form the erected image. The viewer has simply to darken the space around it, when it will appear fairly distinct and convenient for tracing in pencil or copying in its natural colours; and this, before the advent of photography, was a great advantage. Hence it is that we meet with so many well-made cameras dating from the early part of the century, both rigid and folding, for portability. Portrait and landscape painters often availed themselves of them. The most convenient form of camera is the upright one. This has the optical part at the top of a box, tent, or other pyramidal-shaped and darkened inclosure, and throws the image of the landscape, monument, machine, or group directly down on to the paper or canvas intended for its transient or permanent reception. You can here view it in direct light, not in light enfeebled by the passage through a more or less transparent screen. The details and colours all appear fresh and bright, the grouping natural and perfect. The optical part of this camera can be in one piece—namely, a rectangular prism, one side of which is ground convex like a lens, or in two parts—namely, a lens and a plain glass mirror placed above it. This prism lens is more compact, and gives better light than the other arrangement, but becomes expensive if made large. The lens and looking-glass can easily be made of any size. It is the form most suitable for a little garden house or kiosque, such as "Widnesian" seems to have. The prism lens is generally mounted in a brass drum, with a side window to admit the light. For the purpose of focussing, it slides up and down in a collar or flange, which is screwed on to a block of wood; this block is then supported on four upright sticks, entering the four corners of a table or drawing board, resting on some sort of stand. The board and all above it forms the camera, and can be inclosed and darkened by black canvas or any other material suitable for portability. The reflecting glass is usually hung in a wooden box on centres, so that it may be swung to face the object, the light of which it receives and reflects down on to the lens 2in. below, which converges them to a focus on to the table. The distance of the table regulates the focal length. All things equal, the greater the distance the greater the picture. A large picture requires a good light, and therefore a large lens. Assuming "Widnesian's" house to be 9ft. to the centre of the roof, where the lens would have to be placed, and the table on which the picture is to be cast, and round which his friends would stand to view it, to be 3ft. high, then the focus of the lenses would have to be at least 6ft., and its diameter not less than 6in.—if more the better. When the camera-head is placed in the skylight of a house, as often happens, the dimensions of the lens must be suited to the place. A little consideration will suggest various means of improving the effect of the picture—i.e., by artificial sun and sunlights, by auroras, rainbows, storms, &c. Where fine views are to be had on more than one side, the camera-head should not be fixed but screwed on to a rotating disc, which enables you to present all the views successively in panoramic form. The rough sketch explains itself.

A. CAPLATZI.

[68230.] — **G.W.R. Automatic Vacuum Brake.**—This brake is similar to that used by the L. and N.W., L. and Y., and other railways, and is being more largely adopted than any other brake on account of its being more reliable and perfectly automatic. If you have the chance, ask a driver of either of the companies mentioned what his opinion is with regard to the automatic vacuum brake, and he will perhaps explain to you the working of the vacuum gauge on his engine. As to which is the quickest train stopper, I don't think Westinghouse can beat the automatic vacuum in this respect, for this reason: with both brakes the driver is able to apply his brakes hard enough to stop the wheels running round, and any more power than what is required to do this is not needed.

B. R. W.

[68269.]—**Pattern.**—Cannot "Carpenter" refer to the numerous articles on Pattern-making given not very long ago? I presume he does not want a "5ft. gap," which is, however, what his query says.

T.

[68270.]—**Fret - Sawing Machine.**—Several fret-sawing machines have been illustrated in back numbers, one on p. 167; but as to making a machine, what does the querist mean? If he has to get iron standards, it will cost him a lot more than it is worth; and a real mechanic would do more work with a penny saw than he could with his machine.

NUN. DOR.

[68274.]—**Railway Accidents.**—The accidents at Loughborough Junction and at Snow Hill were due to faults or carelessness of those in charge of the trains—not to any defect in the signalling. If every line were as well signalled as the L.C. & D., there would be little to complain about; but signal never so well, you cannot *prevent* a driver going past the spot where he ought to stop. I hear that the L.C. & D. are fitting the Westinghouse to their local traffic trains, and I am wondering when the L. & N.W., the G.N., and the Midland will do the same. When the patents have expired, think you?

NUN. DOR.

[68279.] — **Luminous Lifebuoys.** — These buoys are coated with Balmain's luminous paint, the composition of which has been described years ago in these columns. The querist will also find a description of Holmes's flaming signals to burn in water given in a back volume. If the matter were of any interest to readers, I would take the trouble to look up references for the querist; but he can probably do that himself now that he is told the information has been given.

NUN. DOR.

[68280.]—**Induction Coil.**—I do not see how anyone is to help "Nil Desperandum" without examining the coil he has made; but if, after studying the directions frequently given in the columns of the "E. M.," anyone fails to make a working coil, he has mistaken his vocation. What is meant in this case by "the contact-breaker is on a different stand"? If so, why? and how is the thing worked?

J. E. M.

[68281.]—**Collotype Printing.**—This is a rather peculiar query. "What gelatine would you recommend?" Gelatine cannot vary much except in purity and quantity of water, and the quality cannot have much to do with the tendency of the films to peel off. Where is our friend Mr. Pumphrey? He knows all about collotype, and could, no doubt, help you; but I have not noticed his signature in these columns lately.

S. M.

[68287.]—**Polishing.**—"Machinist" asks how a fine polish is put on parts which an emery wheel cannot reach. I suppose it is possible to get any desired amount of polish short of burnishing by means of fine emery and oil, and that indispensable ingredient, "elbow grease."

T. J.

[68289.]—**Mincing Machine.**—If the white enamel wears off "Meat's" mincing machine, he must send it to be re-enamelled, as he cannot well do it himself. The black covering is no doubt what is known as "Japan," and, again, it will cost him more to do it himself than he can get it done for.

J. M.

[68291.]—**Burnisher.**—Any dealer in photographers' apparatus will supply a "burnisher," which is usually a roller that can be heated. The print, which has been previously dressed with a solution of Castile soap (say, five grains to the ounce of methylated spirit), is either passed between warm rollers, or has a warm roller passed or rubbed over it. The simplest plan is to coat the print with the soap solution, and then rub a piece of warm and very smooth steel over it. The process has been described hundreds of times, and is given in all the manuals.

J. T.

[68292.]—**Surfacing Machine.**—I don't know as to a "perfect degree of flatness." If it is flat there is no "degree" about it, but certainly there are plenty of flatting machines in the market. "Scraper" wants a planing machine, or else, what his own signature is, a scraper. A "perfect degree of flatness" is best attained by the help of a machine in which the metal surfaces are compelled to pass under a knife, which levels them.

NUN. DOR.

[68295.]—**Silver Solution.**—As few readers can be interested in preparing silvering solutions on the scale desired by the querist, I would venture to suggest the advisability of consulting one of the manuals or receipt books. If, as is not unlikely, the querist finds the directions in the textbooks rather vague, let him put another query, as it is rather funny to read of making a silver-plating solution by "dynamo power." "E. P." should look up his back numbers if he cannot refer to the manuals. Presumably the querist means the cyanide of silver and potassium.

E. G.

[68310.] — **American Organ Query.** — If "Mechanic" cannot find the information he requires in your back volumes, he will not find it anywhere. If he wants it, perhaps it will pay him to look for it. If I understand him, he wants an arrangement of two manuals, in which the reeds are "taken out from the front absolutely." There is not much difficulty about that; but what are the advantages? There is a two-manual illustrated in No. 1,186, and a great deal of information combined with illustrations in back volumes; but if the querist wishes someone to design an organ action for his benefit, he must at least be a little more explicit.

ORGANON.

[68317.]—**Lubricating Oils.**—There is no better lubricating oil than "sperm"; but lard oil is useful for certain work, and sometimes a mixture of washed fat and blacklead — especially, for instance, in the case of the heavy shaft mentioned by "Antares," and in all cases where the bearings are of considerable size. In all cases where the journals are small, sperm is perhaps preferable; but the object is to produce and keep a film of lubricator between the rubbing surfaces, or, rather, the surfaces that would rub but for the lubricant.

NUN. DOR.

[68370.]—**Calculating the R.A. of the Moon.**—I am very sorry I misquoted "F.R.A.S.," but as I had not the back numbers of the "E. M." to refer to, I had to trust to my memory. By the kindness of a friend, I have seen the query in question. What "F.R.A.S." really did say, was:—"The number of minutes the moon comes later daily to the meridian do not represent the number of degrees of a great circle moved over by the moon in her orbit in the interim, because such motion is oblique to the Equator on which time is measured." Now, what I want to know is, how I am, with approximate accuracy, and by graphic means, to plot off on a map daily the departure of the moon from her period of new moon to the Equator relatively to the earth. Having found the position of new moon at any given time, I want to find her position at the same time the following day. In order to do this I have adopted a plan which appears to me to succeed. Over a flat map, polar projection, I have placed a piece of tracing-paper with meridians and degrees round the Equator to correspond with the hours. The hours are represented on the map from one to twelve east and west. On the tracing-paper the hours are represented from 24h. (which corresponds with the meridian of Greenwich) to east, so that one and two o'clock are to the east, and twenty-three and twenty-two to the west of the meridian. If I measure off the departure of the moon from the sun on the terrestrial equator instead of the celestial equator, is there a great amount of error?

RUBIC.

[68391.]—**Hot-Water Circulation.**—The expansion-pipe must certainly be taken up to top cistern. Have supply-pipe ¾in. or 1in.

PRACTICAL.

[68391.] — **Hot-Water Circulation.** — To "SKIBO."—Many thanks for reply. You are right as to weight. The ⅜in. lead compo gaspipe used to stand 65 pounds pressure, weighs 7oz. to the foot. Is this safe to continue to use? It appears to stand it all right, and has done so for over two months. I will fit on an expansion pipe.

NEMO.

[68404.]—**Wheel-Cutting.**—The best way to cut true epicycloids is to draw the curve and make the cutter to its shape. With lantern pinions, the tracing circle is always the same size as the lantern pinion at the pitch circle. The pins are planted on the pitch circle. Their size is determined by the size and number of the wheel; they are just large enough to allow freedom when one of them is in a space. You may consult with advantage the article on "Lantern Pinions" in Saunier's "Modern Horology," and especially Plate 15.

CHARLES A. JONES.

[68404.]—**Wheel-Cutting.**—I have little hesitation in saying that there is no way of making small epicycloidal wheel cutters which "L. J. R." would consider practical. Clockmakers in this country now generally use single-toothed fly-cutters, and an experienced man has no difficulty in making them with sufficient accuracy for all ordinary purposes by the eye. File the cutter as near to shape as possible, and after hardening it try it in the engine and make the necessary corrections with a steel polisher and oil-stone dust. The radius of the cutter may be from about ½in. to ¾in., according to the character of the engine, and I find a speed of about 12,000 revolutions per minute suitable. The cutter should be balanced and left quite hard. The wires of lantern pinions should be on the pitch circle, and the curve of the wheel teeth outside the pitch circle. The thickness of the wires depends on several things. The thinner they are the better depths you will get if the numbers are low; but thin wires increase the tendency which lantern pinions always have to cut up the wheel teeth, if there is much pressure between them. For pinions of 8, the wires should be about one-third of the pitch, increasing to nearly half with pinions of 12. The wheel should be cut to suit the pinion, making the teeth as thick as possible, as with low numbers you will require all the curve you can get to keep the action after the line of centres. Very nice depths can be got with lantern pinions, and as they are easily and cheaply made, and can be repaired without difficulty, I think their use should be encouraged; but the wheels should be made of hard rolled brass, hammered as much as it will bear, and as great wheels cannot well be made of that material, I think centre pinions, particularly for gravity escapement clocks, where the weight is very heavy, should be of the ordinary kind. I may say, however, that I have had a hard kind of gunmetal which answered very well; but I do not know the composition of it. Common gunmetal is too soft, and, besides, it is extremely difficult to cut it with a fly cutter.

G. T. C.

[68410.]—**Erratic Striking Clock.**—Take the movement out and remove the dial. Then put the minute-hand on, and turn the minute-wheel until the pin in it lifts the lifting piece. Then notice very carefully what is likely to cause it to fail, and rectify it. CHAS. A. JONES.

[68420.]—**Musical Instrument.**—The best way would be to take the old comb out and make the other one to it. If the teeth are broken off close together, you had better keep trying the comb to the barrel during the process of making it. I have never made such a thing, so that this may be taken for what it is worth; but I should procure a piece of steel of exactly the same thickness as the old comb; mark it off into 49 divisions, and then cut down the slots with a very thin file or fine saw. It would have to be hardened and tempered; but you should try the temper of the other comb with a file, and if it is moderately soft, temper the new comb *before* cutting down, otherwise the teeth will warp in hardening, so that the pins will miss them. There used to be places in Warner-street where these sort of jobs could be done cheap.

CHARLES A. JONES.

[68422.]—**Voice Lozenges.**—According to the well-advertised ammoniaphone, the chemical ammonia, when inhaled, was to give the power of song, sweetness, and *timbre* of tone, &c., to all those of the genus Homo desiring to possess such, provided always that the said ammonia was inhaled by a certain fabulously high-priced plaything. Like all other such cure-alls, John Bull having eased his curiosity at the expense of his pocket, the ammoniaphone has become forgotten, the adage, "first abused, then disused," being once again hereby illustrated. That the drug ammonia is of much curative value when judiciously and suitably applied, the humble, useful, but much-neglected smelling-salt-bottle amply illustrates. "Sugar Boiler" would do well to study the article, "Ammonia," in Farrington's "New Materia Medica," while a perusal of the articles on the rather numerous drugs affecting that most complex organ, the voice, may give him ample choice of drugs, and a very wide field for his operations; but in so far as affects the ultimate health of the purchasing British public, at least, he may yet come to learn that a little knowledge can be a very dangerous thing. THE LYDNEY DISPENSER.

[68427.]—**Sweaty Soles.**—Probably owing to a peculiar and disordered condition of health. One great reason of leather ('tis here true there's nothing like leather) holding its own in the present day of invention and of substitution as soles for boots, is the porosity of leather, while the opposite in gutta-percha, &c., has probably been prohibitory. If "Solvadero" is a young man the condition may, in medical language, point to a scrofulous diathesis—in other words, to inherent constitutional defective nutrition, and which will probably disappear; if accessible to "Solvadero," application at the London Homœopathic Hospital, Great Ormond-street, London, E.C. (medicine and advice one month, or, rather, four weeks, for 1s.), would no doubt eventually be a matter on which he will hereafter congratulate himself through life.

THE LYDNEY DISPENSER.

[68432.)—**Horn.**—Much of my earlier life having been spent on the banks of the ever-beautiful Severn, I remember that when I had chilblains one or other of the hands employed at the horn-works, Bewdley—Hopkins was the name of the owner; there were few, if any other, horn-works inEngland—was asked to bring a bottleful of the horn-water, a black, stinking stuff, with which my feet were sponged over. In that water horn had been boiled until it (the horn) was soft. Now, nearly 50 years afterwards, that information may prove useful to E. Parfitt. Although often in the quaint old town, Bewdley—formerly an important inland port, the uppermost on the then great highway of commerce, the Severn, and from which a phalanx of packhorses radiated—I regret that I never went over these horn-works, which, in the days when horn lanterns and horn drinking-cups were in vogue, must have been on a far larger scale. As to the medicinal value of the "liquor," which was highly extolled for other ailments than chilblains, the sulphur present therein was the curative agent. At least, homœopathic experience suggests this to

THE LYDNEY DISPENSER.

[68438.]—**Camphor.**—When Asiatic cholera first appeared in Europe as an epidemic (in 1831), medical interference did but insure and hasten a fatal issue. His knowledge of drug-action, especially in its poisonous aspect, enabled the illustrious Hahnemann, when the peculiar features and symptoms of cholera were described to him, to select four medicines, which to-day are still the only ones successfully combating the awful sufferings of this virulent disorder. These drugs were camphor, copper, veratrum, and arsenic. Camphor, if given at the very commencement of the disease, being alone an almost certain cure; while during the progress of the disease copper is suitable for its cramps, veratrum for its rice-water purging, arsenic for its stage of collapse, &c. From No. 4 of the Homœopathic League Pamphlets, 1d. each (Bale and Son, 87, Great Titchfield-street, London, W.), I learn that Hahnemann's almost latest contribution to medicine was a paper on "Cholera, and its Treatment." No. 5 speaks of the efficacy of camphor in the epidemics of 1854 and 1884, while No. 16, which everyone should read (price 2d.), describes the conversion to homœopathy of Dr. Holcombe, of New Orleans, through his experience in cholera. A well-known author speaks of camphor as "causing (bearing on the inquiry only) external coldness, with internal burning; inflammation of internal parts, such as stomach, brain, bladder, &c.; the coldness and sinking of the vital forces being usually regarded as characteristic of the drug, the symptoms of excitement being reactionary." Camphor has, thanks to Hahnemann, become a popular remedy for chills and colds in the early stage. A favourite illustration, showing the affinity of alcohol for water, is that of adding water to an alcoholic tincture of camphor, when the spirit leaves the camphor, which instantly resumes its solid form. As a medicine, camphor is best inhaled, or failing that method, it is preferred in the form of trituration (a powder), by THE LYDNEY DISPENSER.

[68444.]—**Ventilation.**—Tobin created, some twenty years ago, much interest in this problem—one of the consequences of our so-called civilised habits of domiciled life. Tobin based his method of ventilation on that principle in physics that a fluid, once set in motion, continues to progress in a straight line until deflected or obstructed by some opposing surface, &c. A specification of the patent can be had from the Patent Office, London. I conclude the door and windows of the room are generally closed. Air freely admitted from without the room somewhere at the bottom, and conducted up a tube to within a foot or two of the ceiling, would then probably cause the ventilator in the chimney to work effectively; but those holes in the ceiling must be stopped up. A good illustration of down-draught is (or used to be) met with in the library of the Guildhall, London, immediately after the "sunlight" gas-burners in the roof were ignited, and from which practical lessons were learnt by

THE LYDNEY DISPENSER.

[68446.]—**Flat-Bottomed Canoe.**—"Rhenus," 'tis hard to recommend a rig for canoe, as so much depends upon the water at your disposal for navigating on, the sort of landing-place you use, and so on. There is very little doubt that the "Chinese balanced-lug" (either "Pearl" or "Nautilus" type), is the sail for a canoe, being so thoroughly under the control of sailer. I think it was fully described in "Ours" quite recently. You may have excellent sport without adding either keel or centre-board, as far as mere "running" and "reaching" is concerned; but if you want to "beat to windward" you must add something to prevent "lee-way"—a centre-board, of course, for choice—a good heavy sheet of metal, either "yellow metal" (non-corrosive) or iron galvanised.

CÆSAR.

[68470.]—**Engine Turning.**—"F. A. M.," you have simply got hold of some specimens of Bacon's, of London, the eminent engravers of bank-cheques, &c., &c., and well known to every printer.

CÆSAR.

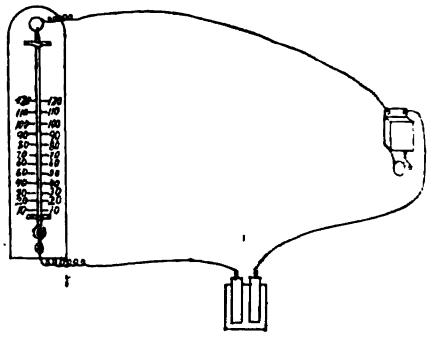
[68456.] — **Combination of Colours.**—What you require is "Fausel's Multiplication Table of Colour," reprinted from an American paper on 11th April, 1889, No. 379 of the *British and Colonial Printer, Stationer, and Booksellers' Circular*. It is the cleverest scheme I ever saw for the purpose, more especially with a view to colour-printing.

CÆSAR.

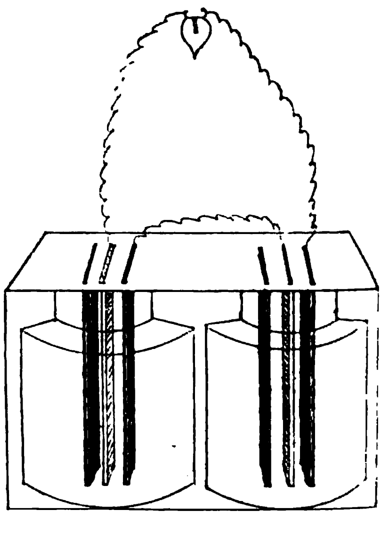
[68472.]—**Transfers.**—To CHAS. R. CHAPLIN.—There is a process exactly what you seem to require patented by a Mr. Gunningham, of Liverpool.

CÆSAR.

[68478.]—**Long-Distance Thermometers.**—By this is meant a simple electrical arrangement whereby, when the temperature in any given place exceeds, or falls below, a certain preconcerted limit, an electric bell, placed at any convenient spot, not necessarily near the place, is thrown into action by the very fact of the limit, either of heat or cold, being overstepped. There are several modes of effecting this. The first is to insert, during the construction of the ordinary mercurial thermometer, a platinum wire touching the mercury in the bulb, and another passing down the upper part of the tube, reaching as far as the point to which the mercury will rise when the limiting degree of heat has been reached. Such a thermometer is shown with the bell and battery in circuit in the annexed cut. Other forms are given in my book, "Electric Bells." S. BOTTONE.



[68490.]—**Electric Scarf-Pin.**—Presuming that you do not want to make an accumulator, which has been described over and over again in these pages, and for which you will find full directions in my book "Elect. Inst. for Amateurs," I may say that if your friend's lamp is an ordinary 4-volt lamp, you can make an efficient little battery by arranging two small pomade bottles, about 3in. high by 2¼in. diameter, in a box with an india-rubber padded lid; through this lid must project into each bottle two plates of graphite, about 2¼in. by 1in. by ⅛in., with a zinc plate of similar dimensions between them, not touching the graphites. Each pair of graphites must be connected together by means of a strip of copper. The zinc of one bottle must be connected to the graphite of the other, the two free elements left being afterwards connected to lamp. To set this battery in action a teaspoonful of sulphate of mercury must be placed in each bottle, which must be half-filled with water, to which about $\frac{1}{50}$th of its bulk of sulphuric acid has been added. If the lamps be of higher voltage, three, or perhaps five, cells may be needed to make it glow nicely. The annexed sketch gives an idea of arrangement. Side of box removed.

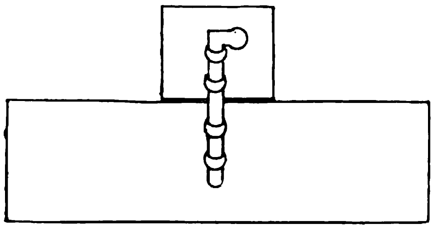


S. BOTTONE.

[68500.]—**Removing Pole.**—Why not drive staple in end of pole C? Through this put iron peg, with eye; attach a rope, and pull.

PRACTICAL.

[68500.]—**Removing Pole.**—If "Double B." unscrews the nut a little and ties a piece of string around the bolt, he may take off the nut and lower the bolt into the box; then pass a sharp instrument under the pole and draw the string that holds the bolt through. He can then draw out the pole, and, by enlarging the hole a little, take out the bolt. If he uses a bolt at the end of the pole, as shown in the drawing, I think he will find it answer his purpose better.



P. CLIFFORD.

[68503.]—**Photography.**—1. In shade. Sunlight gives too strong contrasts in instantaneous portraiture. 2. I have been trying flash-light with a simple lamp of my own manufacture—simply a glass tube with an indiarubber ball affixed by tube, to blow magnesium powder through flame of sponge saturated with spirit. You will want two of them, to be exploded at opposite sides of the face. Result in my case was fairly exposed. Take care to have the light higher than your sitter, or light of the photo. looks extraordinary. Sitter is almost certain to blink, it is better to leave the lamp alight all the time, and get sitter to look steadily at it. The flash is not then so startling. Don't have the lamp in the picture, of course; put it on one side, behind the camera.

R. A. R. BENNETT, B.A.

[68516.]—**Scarecrow.**—Cut a piece of tin to the shape of a cat making a spring; paint it to aid the delusion. Then suspend by a cord, so that it will swing to and fro in the wind. A windmill on a pole often succeeds, especially if a rattle or clicking arrangement be attached; but the noise might be objectionable.

EDMOND M.

[68517.]—**Speaking Tube.**—A speaking tube composed of lead, compo, or galvanised iron tube would act in an efficient manner. If first cost is a consideration, zinc tubes are cheaper; but for permanence choose either of the two first named. In fixing, avoid sharp bends, and see that the holes in mouthpieces are not too small, and make sure that all joints are made watertight, and have the pipes not less than 1in. inside diameter.

Whitehaven. D. B.

[68535.] — **Bicycle.**—If backbone be hollow, join with a tight iron plug; next get a brass-founder to mould a brass casing outside extending 3in. above and below joint. If tapered with a file upward from the fork below, it will not be remarkable. The frame of my safety met with a somewhat similar accident, and was repaired on the same principle, and seems as firm as ever after travelling a couple of hundred miles. Price should not exceed a few shillings.

EDMOND M.

[68537.]—**Solubility of Hypo.**—According to "Storer's Dictionary of Solubilities," the anhydrous salt $Na_2S_2O_3$ dissolves in 2·01 parts of water at 0° Cent., 1·44 at 20° Cent., 0·96 at 40°, 0·52 at 60°, while the hydrated salt $Na_2S_2O_3 5H_2O$ dissolves in 0·585 parts of water at 19·5° Cent., or 100 parts of water at 19·5° dissolve 171 parts of it, or an aqueous solution saturated at 19·5° contains 63·5 per cent. (equal to 45·8 per cent. of the anhydrous salt), and is of specific gravity 1·3875. According to Watt, the hydrated salt melts in its water of crystallisation at 56°.—H. B. F.

[68547.]—**Clock Gong.**—How would Mr. W. Hall fit his gong to a drum marble timepiece? The gong is now fixed by its brass "lump" to a $\frac{3}{16}$in. brass wire, screwed at foot to a soft wood pedestal. The sound is not clear. Would he advise a thicker wire, or what?

NEMO.

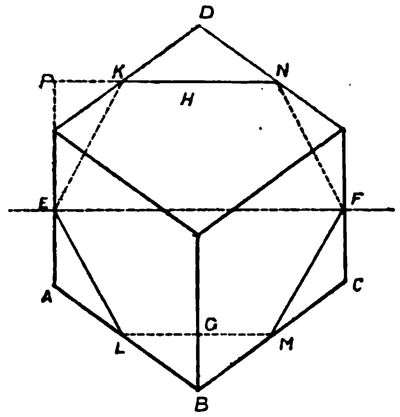
[68547.]—**Clock Gong.**—I don't quite see what you mean by your description. The gong should be fixed (as one piece) to a foot, which is screwed to a block of iron or brass, but not wood. This block should be fixed to a standard of thick wire fixed to the bottom of the case by a nut and washer. But it may not be the gong at all. Try the hammer-head, and see if it is too close to the gong; if so, bend the hammer-stem until it is right. By bending the hammer-stem, it will very probably come right.

CHARLES A. JONES.

[68552.]—**Maxima and Minima.**—Thanks to "A. M." for his neat solution. The printing has also been well arranged, so that it makes a very elegant study. Yes, I meant that this is the only case I have come across where, if my result was correct, the area is a maximum and the perimeter a minimum for the same value of the independent variable. It is like a "double event" in racing parlance, as if the same horse were to win both the Derby and the Oaks! I notice that the angle which has $\frac{1}{\sqrt{3}}$ for its sine may be drawn geometrically by dividing a diagonal of the upper face by 4, and joining one of the points so found with the centre of the cube; the angle contained by this line and the vertical is the angle sought.

Bath. M.I.C.E.

[68552.]—**Maxima and Minima.**—In the figure let K E L G M F N H be a plane revolving on the given axis E F, and cutting the six sides of the cube.



First, as to the perimeter. This equals 4 E K + 2 K N. Let one edge of the cube = 1, and the angle between the plane and the vertical = θ. Produce N K to P, and draw P E perpendicular to E F. Then G H = sec. θ, and, by trigonometry, the perimeter equals

$$2(\sqrt{2 \tan.^2 \theta + 1} + \sqrt{2} - \tan. \theta).$$

Omitting constants, differentiating, and equating to zero, we get—

$$\frac{2 \tan. \theta - \sqrt{2 \tan.^2 \theta + 1}}{\cos.^2 \theta \sqrt{2 \tan.^2 \theta + 1}} = 0$$

$\therefore \tan. \theta = \frac{1}{2} \sqrt{2}, \ \sin. \theta = \frac{1}{3} \sqrt{3}, \ \theta = 35° \ 16'$ nearly. This is identical with the result obtained by "M.I.C.E.," and when the plane is at this angle its perimeter is a minimum, as might have been expected from its being a regular hexagon. Then, as to the area. This equals

$$G H \times P N = \sqrt{\tan.^2 \theta + 1} \ (\sqrt{2} - \tfrac{1}{2} \tan. \theta).$$

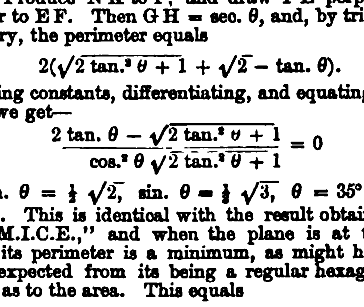
Differentiating, &c., as before, we get—

$$\frac{\tan. \theta \ (\sqrt{2} - \frac{1}{2} \tan. \theta)}{\cos.^2 \theta \sqrt{\tan.^2 \theta + 1}} - \frac{\sqrt{\tan.^2 \theta + 1}}{2 \cos.^2 \theta} = 0,$$

whence $\tan. \theta = \frac{1}{2} \sqrt{2}$ as before. This does not, I think, indicate a maximum or minimum; but that the plane in moving from D B to the vertical is always increasing in area, but at a varying rate; the rate of increase diminishing from D B to H G, where it vanishes, and increasing afterwards. This corresponds to a point of contrary flexure in a curve. The vertical position would seem to give the only maximum.

W. J. A.

[68552.]—**Maxima and Minima.**—Vertical planes through the diagonals of the top of the cube, and a horizontal plane through the line on which the revolving plane turns, will divide the cube into eight similar and equal prisms, one of which is represented in the figure.



A B is an upper edge; A C, B C, semi-diagonals; O the centre point of the cube; and O D the axis of rotation of the plane whose intersections with the top and sides of the prism are shown by the lines E F, E O, F D. Draw F H parallel to O E, and join O A. Let A B measure two units, and put D F + F E = p, this being a quarter of the perimeter of the section of the whole cube by the plane. Denote sin. C O E by x. Then, O C = D B = unity; A C = B C = $\sqrt{2}$; CE = $\frac{x}{\sqrt{1 - x^2}}$, and from these data the numerical values of the other lines in the figure can easily be derived, and we obtain the formula:

$$p = \frac{\sqrt{1 + x^2} - x}{\sqrt{1 - x^2}} + \sqrt{2} \ldots\ldots\ldots \ (1).$$

Differentiate with respect to x, and the result, equated to zero, will be found to give $x = \frac{1}{\sqrt{3}}$ Substitute this value of x in (1), and we have p = 2·1215. Now, when the point E is C, p = 2·4143, and when E is at A, p = 2·2361. We therefore infer that $x = \frac{1}{\sqrt{3}}$ makes p (and, therefore, also $4p$) a minimum. (Of course we might employ the usual process for determining whether p is a maximum or aminimum by successive differentiation; but since $x = \frac{1}{\sqrt{3}}$ makes the second differential coefficient of p vanish as well as the first, the operation would be somewhat laborious). Since sin. O A C = $\frac{1}{\sqrt{3}}$, it follows that when p is a minimum angle C O E = angle O A C, and the triangles C O E, C A O being similar, we have A C . E C = O C². It may be observed also, that "M.I.C.E.'s" problem furnishes an answer to the question: What is the shortest length of string that will encompass a cube-shaped parcel, when so arranged as to be incapable of shifting? Evidently, the string must be 4·243 times the length of the side, and be stretched taut along the section of least perimeter. The angle C O E is 35° 16′, nearly. If S denote the area O E F D, we find—

$$S = \frac{\sqrt{2}}{\sqrt{1 - x^2}} - \tfrac{1}{2} \cdot \frac{x}{1 - x^2} \ldots\ldots\ldots\ldots \ (2).$$

Now, one of the several roots of $\frac{dS}{dx} = 0$ is $x = \frac{1}{\sqrt{3}}$, which value of x substituted in $\frac{d^2S}{dx^2}$ gives a positive result. Hence, supposing my working out of this second part of the question be correct, $x = \frac{1}{\sqrt{3}}$ renders S a minimum. The maxima and minima obtained from the other roots of $\frac{dS}{dx}$ are, probably, hardly worth the trouble of investigation.

Charing. J. R. C.

[68553.]—**Problem.**—By the formula $2S = bc$ sin. A, the sinister is equal to—

$$2S \left\{ \frac{(s-a)^2}{bc} + \frac{(s-b)^2}{ac} + \frac{(s-c)^2}{ab} \right\}$$

or

$$\frac{2S}{abc} [a\,(s-a)^2 + b\,(s-b)^2 + c\,(s-c)^2]$$

$$= \frac{2S}{abc} [(a + b + c)\, s^2 - 2s\,(a^2 + b^2, + c^2) + a^3 + b^3 + c^3] \ldots\ldots \ (1)$$

Also, by the formula $bc \sin.^2 \frac{1}{2} A = (s-b)\,(s-c)$, the dexter is equal to—

$$2S \left\{ \frac{(s-b)\,(s-c)}{bc} + \frac{(s-a)\,(s-c)}{ac} + \frac{(s-a)(s-b)}{ab} \right\}$$

$$= \frac{2S}{abc} \ [a\,(s-b)\,(s-c) + b\,(s-a)\,(s-c) + c\,(s-a)\,(s-b)]$$

$$= \frac{2S}{abc} \ [(a + b + c)\, S^2 - 2S\,(ab + ac + bc) + 3abc] \ldots\ldots \ (2)$$

Comparing (1) and (2), we see that it is enough to show that $2s\,(a^2 + b^2 + c^2) - (a^3 + b^3 + c^3)$ is identical with $2s\,(ab + ac + bc) - 3abc$, which will at once appear by putting $a + b + c$ for $2s$, and multiplying out.

LATRIS.

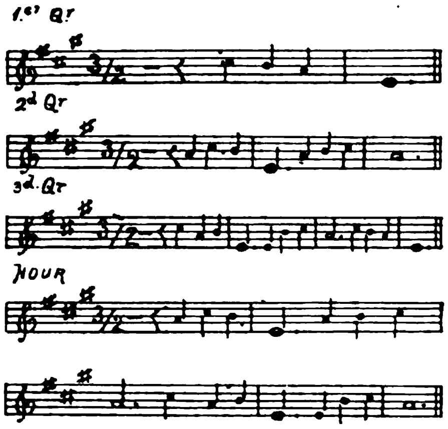
[68561.]—**Engraving.**—Have you seen the machine the Britannia Company advertise? It looks simple and efficient.

T. F. S. T.

[68562.] — **Incandescent Lamps.**—To MR. BOTTONE. — According to Messrs. Edison and Swan's lists, "All lamps supplied are marked with the Company's trade mark, 'the Edison Swan,' underneath which will be found the E.M.F., reference letter, and nominal candle-power, thus: '110, J.K. 16,'" which means that the lamp requires an electro-motive force of 110 volts to send sufficient current through it to cause it to give 16 candle-power light. The reference letter indicates the circuits in which the lamps may be run. Thus any lamp marked J.K. may be run in series with any other J.K., irrespective of the c.p. or voltage. When running lamps in parallel, it is the E.M.F. number that must agree, not the reference letter.

S. BOTTONE.

[68558.]—**Chiming Clock.**—Your question really opens up a whole branch of the horological art. You will want a new train (in a new framework) placed beside the old; but before proceeding you had better see whether the case will take it. You do not say whether your present movement is a locking-plate or rack striking—a most important omission. In either case the new train could be discharged by the minute-wheel raising a separate cam; but the correct way is to have the hours let off at the fourth quarter by the quarter work. If you persist, write again, saying which it is, and I will give you more information on that point. The following is the Cambridge chimes. Thus you see the



barrel makes two revolutions per hour, has five sets of pins, with four in each. You can buy the hammer-work, pin-barrel, and bells. You will have to mark off and pin the barrel, and plant the hammer work. Consult Reid's "Watch and Clock Work," and for a description of modern repeating-work see Britten's "Handbook." The new train would consist of four wheels (second wheel driving pin-barrel, which has a wheel of 40 screwed to it), and you would want a weight of about 28lb. to drive it.
CHAS. A. JONES.

[68564.]—**To Mr. Bottone or Others.**—"D. N. Y." will probably find he requires no extra resistance in series with his arc lamp, and as he does not give the voltage at which it is regulated to burn, it is not possible to advise with any degree of accuracy. However, the lamp cannot well burn with less than 35 volts, in which case he would require about 90 yards of No. 18. I presume his wire is copper. Resistance per yard, about ·0136 ohm.
H. C. BEAUMONT.

[68564.]—**To Mr. Bottone or Others.**—First measure the resistance of your lamp. Since your dynamo gives 25 ampères, and has an E.M.F. of 45 volts, its resistance must be 1·8 ohm. Since $\frac{E}{R} = C$, and you require 8 ampères; E = 45, R must be equal 5·6 ohms. Now add together the R of the dynamo 1·8, and that of the lamp itself, and if this does not make up the desired resistance of 5·6, you must add a few yards of No. 18 iron wire as resistance, remembering that every 10 yards of No. 18 iron wire is equal to 1 ohm, approximately.
S. BOTTONE.

[68569.]—**Electric Lighting.**—To light a room or hall brilliantly there should be a 16c.p. lamp to every 33 cubic yards of space. You do not say the height of your hall; but supposing you do not care to illuminate above the 10ft. line, we may say, roughly, that 38 lamps of 16c.p. would give sufficient light to illuminate the hall well. Armature 10in. diameter, 6in. deep, wound with 14lb. No. 12; fields wound with 80lb. No. 18; connected in shunt.
S. BOTTONE.

[68571.]—**Calculus.**—The equation $a^2 y^2 = x^2 (2a - x)$ may be put in the form $y = \pm \frac{x}{a} \sqrt{2ax - x^2}$. When $x = o$, $y = o$, so the curve passes through the origin. When $x = 2a$, $y = o$, so the limits between which the curve extends are $x = o$ and $x = 2a$. If x is negative, the equation is impossible, so the curve does not extend to the left of the origin. The double sign shows that the curve is a closed one, and is the same above and below the axis of x. The formula for the area is $\int y\,dx$ + constant, taken between the limits 0 and $2a$, or—

$$\frac{1}{a}\int_o^{2a} x\sqrt{2ax - x^2}\,.\,dx + C.$$

The integration of this is given in the textbooks, at least in Todhunter's "Int. Cal.," see p. 20, ex. 11, and p. 50, ex. 3 (third edition). The indefinite integral is rather long, and not easy to print; however, all the terms in our case vanish except the last, at both limits, that is when $x = 0$ and $x = 2a$. It will therefore suffice to say that (ignoring the vanishing terms) the area $= \frac{a^2}{2} \sin.^{-1} \frac{x - 1}{a} + C$; taken between limits of $x = 0$ and $x = 2a$. Now to find the value of C: as the curve passes through the origin, when $x = 0$ the area must $= 0$; put $x = 0$ in the last equation, and also area $= o$, then we get $\frac{a^2}{2} \sin.^{-1} (-1) + C = 0$. Now $\sin.^{-1}(-1) = -\frac{\pi}{2}$ so that $C = \frac{a^2\pi}{4}$. The area will, therefore, be

$$\frac{a^2}{2} \sin.^{-1} \frac{x - a}{a} + \frac{a^2\pi}{4}, \text{ whence } x = 2a,$$

or

$$\frac{a^2}{2}\left\{\sin.^{-1} 1 + \frac{\pi}{2}\right\} \text{ or } \frac{a^2}{2}\pi.$$

This is for the upper half of the curve, so for the whole it will be $a^2\pi$, the same as the area of a circle of radius a.

Bath. M.I.C.E.

[68571.]—**Calculus.**—Solving the equation for y:—$y = \mp \frac{x}{a}\sqrt{x(2a - x)}$; x cannot, therefore, be greater than $2a$ nor less than zero, also the curve extends equally on each side of the axis of x. The

$$\text{area} = \int y dx = \frac{1}{a}\int \frac{x}{a}\sqrt{x(2a - x)}\,dx$$

$$= \frac{1}{a}\int x\sqrt{a^2 - (a - x)^2}\,dx$$

$$= \frac{1}{a}\int -(a - x)\sqrt{a^2 - (a - x)^2}\,dx$$

$$+ \int \sqrt{a^2 - (a - x)^2}\,dx = \frac{1}{3a}\left\{a^2 - (a - x)^2\right\}^{\frac{3}{2}}$$

$$+ \frac{a - x}{2}\sqrt{a^2 - (a - x)^2} + \frac{a^2}{2}\sin.^{-1}\left(\frac{a - x}{a}\right)$$

taken between the limits $x = 2a$ and $x = 0$, this becomes—

$$\frac{a^2}{2}\sin.^{-1}(-1) - \frac{a^2}{2}\sin.^{-1} 1 = \frac{a^2}{2}\pi,$$

and twice this gives the area on each side of x = the whole area $= a^2\pi$.
A. H. G.

[68571.]—**Calculus.**—It will probably suffice to give an outline only of the process for finding the area. The details of the integration will be readily understood by anyone conversant with the integral calculus; they are, however, too long for insertion in the "E. M." From the given equation we see that the curve is symmetrical with respect to the axis of x, and that it extends from $x = 0$ to $x = 2a$. Let the area of the upper half be denoted by A, and let $x - 2a = z^2$. Then $\frac{dx}{dz} = -2z$, and, since

$$\frac{dA}{dz} = \frac{dA}{dx}\cdot\frac{dx}{dz} = -2yz,$$

we have—

$$\frac{dA}{dz} = -\frac{2z^2}{a}(2a - z^2)^{\frac{3}{2}}$$

$$= -\frac{2}{a}\left(\frac{z^6}{\sqrt{2a - z^2}} - \frac{4az^4}{\sqrt{2a - z^2}} + \frac{4a^2z^2}{\sqrt{2a - z^2}}\right)$$

Integrate each term within the brackets by the formula of reduction—

$$\int \frac{z^n}{\sqrt{2a - z^2}}\,.\,dz = -\frac{z^{n-1}}{n}\sqrt{2a - z^2} + \frac{n - 1}{n}\int \frac{2az^{n-2}}{\sqrt{2a - z^2}}\,.\,dz,$$

substituting for n the values 6, 4, 2 in succession. Then add together the terms taken between the limits $z = \sqrt{2a}$ and $z = 0$, which correspond to the limits $x = 0$ and $x = 2a$. The terms containing the two factors, z and $\sqrt{2a - z^2}$, vanish at both limits, leaving only the final terms of each integral, which are multiples of $\sin.^{-1} 1$—that is, multiples of $\frac{\pi}{2}$; and the definite integral reduces to $\frac{\pi a^2}{2}$. Hence the whole area of the curve is πa^2, and equals that of a circle whose radius is a.

Charing. J. R. C.

[68576.]—**Engine for Lathe.**—Yes, they will drive it if suitably geared down. Ports, steam, ¼in. by ⅛in.; exhaust, ¼in. by 3/16in.; and boiler 18in. by 12in. vertical, with firebox.

Bristol. T. C.

[68577.]—**Vulcanite.**—Fine brickdust, water, a high speed, and light pressure.
H. C. BEAUMONT.

[68578.]—**Relay.**—Make a brown paper or turned-wood bobbin, 1⅝in. long, with space for a core ⅜in. diameter; wind this with about 3oz. of No. 32 silk-covered copper wire. Now procure a piece of good, soft iron, about 1in. wide, ¼in. thick, and 5½in. long. Bend it into the shape of a letter L, having the lower leg the longer. Let the relative length of the legs be 2in. and 3¼in. About half-way on the longer limb bore and tap a hole to take a circular rod of soft iron, ⅜in. diameter, 2in. long, which is to serve for the core of the wound bobbin. To the shorter limb, which must be a trifle higher than the core just screwed in, is attached, by means of a screw, a short elastic spring, carrying an armature which stands just over the bobbin and its cover; the length of this armature and spring should be about 2¼in., and a prolongation of the latter, furnished with a platinum speck, must be made to play between the openings of a small metal rectangle (like a letter E with the central stroke removed). This rectangle is furnished with adjusting screws above and below. The one above must work in an ebonite bush to secure insulation; the one below works in the metal, and serves to make contact when the armature is pulled down by the electro-magnet. This rectangle must be supported at the right height by means of a short insulating pillar fixed to extremity of the longer limb. The wires from the bobbin must be connected to the home battery wires, the distant battery wires being connected, one to a screw in the shorter limb of the L-frame, and the other to a screw in the rectangle. You will find description and illustration of this relay at p. 134 of my "Electric Bells."
S. BOTTONE.

[68581.]—**Electro-Magnets.**—Certainly, put plenty of iron in the cores, and make the cores, pole-pieces, and armature nearly a closed magnetic circuit, to do which you must make both poles attract the armature. The weight of iron in the core bears a proportion to the ampère turns round the magnet.
H. C. BEAUMONT.

[68581.]—**Electro-Magnets.**—The best results are obtained when the diameter of the iron core is ⅓ that of the wound bobbin. This is true whatever be the gauge of the wire used. For large currents of low E.M.F., wire of coarse gauge must be used; for small currents of higher E.M.F., finer wire must be employed. Roughly speaking, the attractive power of a single pole, or about a ¼ that of the two poles acting in conjunction.
S. BOTTONE.

[68582.]—**Medical Electricity.**—"Self-Treatment" requires much previous study of electro-therapeutic science and pathology. Here is a brief list of some standard books:—"Guide to Medical Batteries, &c.," by Dr. Alfred C. Garratt, publishers at Philadelphia; "Lindsay v. Blakiston on Paralysis, Neuralgia, &c., Treated by Galvanisation and Faradisation," by Julius Althaus, M.D., publishers Trübner and Co., London; "Harry Lobb on Galvanism," publishers Baillière, London.
EOS.

[68583.]—**Engine Brasses Cutting.**—First your brasses should fit nicely upon a perfectly round crank-pin or journal, then see you have your oil-holes properly channelled or grooved inside the brasses to supply oil all over the crank-pin, then be very sure your oil is without a drop of paraffin in it. If not, there is not anything that will prevent your crank-brasses cutting.
W. P. W.

[68583.]—**Engine Brasses Cutting.**—Take the brasses out and clean them well. Scrape the wearing surface all over with a sharp scraper, taking off as little as possible so long as you make sure of removing any grit that may have got imbedded in the surface of the brass; and scrape out any deep lines that may have been worn by dirt or grit revolving with the crank-pins, so as to prevent a recurrence of the evil. See that the crank pins are clean and smooth. When replacing the brasses see that you can cotter the caps hard down without nipping the shaft—that is, there should be at least as much play as will allow both crank-pins and brasses to expand (if they get heated) without becoming tight-nipped. If there is no play when the cotters are drawn hard down, you will need to put a liner between the edges of your brasses. Put plenty of fine flowers of sulphur into the oil-hole, running it in with the oil, and put in some fine plumbago, too. The sulphur puts a fine smooth skin on the rubbing surfaces. Siphon lubricators I do not think nearly as safe or effective as those glass-bottle ones which are fixed upside down in the oil holes, and have a wire running up through the neck, the end of the wire resting on the shaft. The slight vibration it receives brings the oil down constantly. If it does not come down quickly enough, file a small flat down one side of the wire. Of course, you must fix the lubricators well into the oil-holes, which may have to be enlarged to receive them. It is possible that the taking up of the brasses you have "had done recently" has caused the evil, by their being made so tight as to make them commence cutting. I take it for granted that your shaft is truly at right angles with the centre lines of your engines; otherwise the crank-pins will not be bearing fairly on their brasses. Do you know how to test this?
T. F. S. T.

[68585.]—**Piston Rings.**—Phosphor bronze or delta metal.
T. F. S. T.

[68585.]—**Piston Rings.**—Use phosphor bronze or hard cast iron; the latter is usual.

Bristol. T. C.

[68586.]—**Model Locomotive.**—The boss in Fig. 21 is not for the crank-pin, but for the coupling rod. The crank-pin is directly opposite to that, and is, therefore, opposite to its counterweight. In the engines of the L.B. and S.C.Ry. the inside crank is, as noted in the article of May 10th, on the same side of the axle as the coupling-rod pin, and thus the wheels have the appearance you mention but such practice is exceptional. I do not know of any other case.
J. H.

[68587.]—**Gramme Dynamo.**—You can use your dynamo for accumulator charging, but it will not charge quickly. Supposing you wanted to run six lamps of 45 volts for, say, six hours per night, you would want about 23 cells. You had better buy these; but you might succeed in making them if you followed carefully the instructions given in back numbers, or in my "Electrical Instrument Making for Amateurs." S. BOTTONE.

[68587.]—**Gramme Dynamo.**—"Patience" could, by special arrangements, make his unsteady-running gas-engine charge accumulators during the daytime. If the variations of speed are frequent and considerable, he would have to have automatic apparatus for cutting off the current when the speed rose above a maximum, or fell below a minimum. Ten accumulator cells would give the best result. "Patience" must not think of making them himself. H. C. BEAUMONT.

[68588.]—**Motor.**—To MR. BOTTONE OR OTHERS.—You will find a very full description, with illustrations of the mode of building up a one-man power motor, in the "E. M." for April 6, 1888. The power of the motor described in the last par. of the article for April 26, 1889, is also about one man. Your ring, especially as it is without cogs, will be found rather small; that is to say, you will have to employ a good bit of battery power to produce the same effect. You may use the No. 18 wire. Wait till you have read the next article. S. BOTTONE.

[68589.]—**Taper Key-ways.**—Make a steel counterpart of the nave, file keyway approximately, and drive in a steel drift, with cutting-edges one side to complete.
Bristol. T. C.

[68589.] — **Making Tapered Round Key-ways.**—Fit temporary naves to your steel wheels, say, of cast iron; drill holes where key seats are wanted, and rimer them with a rimer of the correct taper. One temporary nave might do for several wheels, if the holes are not too close together, by shifting it round each time to get solid metal to drill into. I presume "melted" is a misprint for riveted. T. F. S. T.

[68590.]—**Portable Steam Bath.**—"Amateur Bath Maker" may accomplish his desire without difficulty, and at small cost. During the last few years I have put many a fellow-reader of large and limited means into a good, cheap, hot-air and vapour bath, and will instruct "A. M. B." how to make and use it as I do. The uninitiated and those of limited means I am ever ready to help. Most of my clients being amateurs precludes the possibility of giving particulars here, as I invariably find it requires two, three, or more communications to make them understand; therefore, if "A. B. M." chooses to write me, he may see my address in the "Exchange Column." HINCKLEY.

[68590.]—**Portable Steam Bath.**—Years ago I constructed several kinds for my own use. Two of these now described are cheap and simple. For portability and putting away when not in use, I recommend the folding chamber, like the shower-baths used on board ship. Get four strong ash hoops, cover them with very thick, stout, or double canvas, sew on a top end of the same material, having a trap-door hole in the centre large enough to admit your head, with an airtight flap to close while heating the construction, 5ft. about in height. For extra comfort, where stowage is no object, make a light cylinder of wicker-work, 7ft. high, to be covered in with the same material, making the trap-door hole on the side of chamber about 4ft. or more from the bottom; also an entrance-door, 4ft. high, 3ft. wide, with a thick felt curtain to overlap the sides externally. This cylinder will stand upright anywhere, whereas the folding pattern, when in use, requires a hook in a beam, with a running rope on a pulley for adjustment. Having a spare room, I always preferred the wicker cylinder. The heating apparatus is easily made of a large oil-drum well cleaned by boiling a solution of washing soda therein; have a screw fitted into the neck of this vessel on which to attach a globular head. In the side of this have a piece of $\frac{1}{2}$in. iron pipe, strongly brazed, 3ft. long; at the other end of this short pipe have a screwed end or other connecting arrangement to join a longer pipe. This will depend on the distance of your fireplace from the steam chamber, into which a ferrule is fastened with a stout leather to receive and carry the further end, and must be an exact fit. The hole for entry of steam should be placed to suit the elevation of fireplace. A gas arrangement would be the most desirable mode of heating, as you can so easily adapt the arrangement of boiler to a room. It is advisable to hang a small wire screen over the orifice of steam-jet, as I once scalded my legs in this dark inclosure. The steam can be pleasantly scented by the addition of any desired fragrance, as lavender heads and such like vegetable aromatics, to the water in the boiler. As a diagram would entail delay in communication I have omitted it, and hope this description will suffice. When travelling, I have extemporised a vapour-bath by putting a large vessel of boiling water under a high stool of open cane-work. Sitting on this, I drew a blanket all around me from the ground, and was soon in a perspiring condition. This I always did after snipe shooting in the swamps. EOS.

[68590.]—**Steam Bath.**—Allen, St. Martin's-lane, London, sells an effective apparatus in a cheap form; but the most valuable instructions would be found in the hydropathic work issued (2s. 6d.) by Smedley's Hydropathic Establishment Company, Matlock Bridge, Derbyshire. As in most medical matters, a little knowledge is in this case often the means of leading to the doing of much and permanent mischief, while one noted author, physicist, &c., Dr. Carpenter, lost his life in consequence of an accident with the apparently simple apparatus—i.e., combustion of spirits of wine or naphtha having been in his case the source of the heat. Stimulants to the blood circulation, so as to compel the blood to throw out part of its aqueous saline, &c., components being the object of the steam or hot-air bath; then, unless the said sudorific diaphoretic (in Anglo-Saxon, *sweating*) action be stopped by one or other of the methods described in Smedley's book, the skin, as well as the whole system, continues in a state of relaxation for hours. A fire-brick heated in the kitchen fire, an iron pail, a wooden, empty soap-box for a seat, and a blanket form the bath apparatus. A cotton sheet the cold-water bath. Still, as serious results to the constitution from prolonged too frequent use of this apparatus may happen, caution is suggested by
THE LYDNEY DISPENSER.

[68592.]—**Shunt-Winding a Dynamo.**—To MR. BOTTONE.—The next time you start winding a dynamo begin by the armature, and if you can drive at an angular velocity of 1,250ft. per minute, allow one yard of wire on the A. for every volt required, and let the resistance of that length of wire be $\frac{1}{20}$ that of the outer circuit. Then let your fields be of such a size that they can hold 400 times the resistance of the armature. You must now put on about 5oz. No. 20 on your armature, and then you may light one or two 5c.p. lamps of six volts each. S. BOTTONE.

[68594.]—**Mending Glass Wheel.** — If you make up a thick solution of good shellac in methylated spirits, and join your glass plate, previously warmed at the broken edges, with this cement, and then cement with the same a rather wide boss on each side where the spindle passes, I think you will find it will hold together satisfactorily, and it will act electrically, as well as the entire plate. If you have any trouble in the mending, and would like to have a new plate, write to me to the address given in the "Sale Column," and I will advise you in the matter. S. BOTTONE.

[68595.]—**To Mr. Bottone.**—The amount of wire on the F.M. is very much too small in proportion to that on the armature to get economical effects; still the machine should give some current. So I can only imagine—1. That you are driving the wrong way; 2. That there is a leakage somewhere between the iron and the wire; or, 3, that the machine has become wrongly coupled, or even disconnected. To get current from this machine, the armature should run at 3,000 revs. per minute. If you like to send it to me, carriage paid, I will tell you what is wrong gratis. With regard to the proportions of wire for your 10c.p. dynamo, they are quite wrong. The ratio should be—outer circuit 1, armature $\frac{1}{20}$, F.M. 20. Now, $\frac{1}{2}$lb. No. 20 on a drum armature has a running resistance of about 0·5 ohm. To balance this on the fields, no less than 200 ohms are required; and you have only 2lb. No. 22, equal 10 ohms, or 20 times too small. S. BOTTONE.

[68598.]—**Electro-Motors with Horseshoe Magnets.**—To MR. BOTTONE.—If you will kindly refer to my article at p. 472, Vol. XLVIII., of the ENGLISH MECHANIC for Feb. 8, 1889, you will find a detailed description of a motor of the kind that could be made from your electro-magnets. I do not recommend using 2 or 4 sets of magnets, as the current has to split itself up among the magnets, and so the total effect is the same, minus the loss from increased resistance. With six chromic-acid cells and two electro-magnets, 4in. long by $\frac{6}{10}$in. diameter, you should be able to drive a sewing-machine. S. BOTTONE.

[68599.]—**Compound Gearing.**—If the ratio is five to one, the power is increased five times, and so on for other ratios. To compute the ratio, multiply all the teeth of pinions together for a divisor and all the teeth of wheels for dividend, the quotient is the ratio of gear and power.
Bristol. T. C.

[68601.] — **Faulty Accumulator.** — Perhaps some particle of lead oxide has fallen down between the plates, and is short-circuiting them. S. BOTTONE.

[68602.]—**Air in Water.**—By an interval of time almost inappreciable.
Bristol. T. C.

[68605.]—**Electric Light.**—For outdoor work, where fumes are of no consequence, the Bunsen. For indoor the chromate of lime. But this is far surpassed by my new depolariser, for account of which see my advertisements in "Sale" column. As to which lamps require most batteries, it depends on the efficiency of the lamp. However, supposing both sets of lamps take one ampère, and that the 5c.p. are 8-volt lamps, and the 2c.p. 4-volt lamps, then five 2c.p. lamps in series = 20 ohms, would require at least 11 Bunsens, or 10 chromate cells, while the two 5c.p. lamps = 16 ohms could be worked with nine Bunsens, or eight chromate cells. If the lamps were arranged in parallel, fewer cells of a larger size would be used; thus the two 5c.p. lamps = 4 ohms could be worked by two large chromate cells, while the five 2c.p. = $\frac{4}{5}$ ohm could be worked by one cell if large enough. S. BOTTONE.

[68608.]—**Object-Glass.**—"H. A." has put the decimal point in wrong place. The quantity of light passing through similar apertures is as the square of diameters; therefore, since 25in. to $\frac{1}{5}$in. is as 125 to 1, and the square of 125 is 15,625, the 25in. glass will grasp that quantity more light than the eye. E. G. M.

[68608.]—**25in. Object-Glass.**—The areas of circles being to one another as the squares of their diameters, "H. A." goes to unnecessary trouble in this comparison, and also is in error in his calculation of the area of the pupil of the human eye, which should be ·031416 instead of ·31416. S. WILKES.

[68608.]—**25in. Object-Glass.**—There is an error, and a gross one, not in Lockyer's "Lessons," p. 223, but in "H. A.'s" own calculations. The area of a circle $\frac{1}{5}$in. in diameter is not ·31416, but ·031416; hence, as his divisor is ten times too great, his quotient is ten times too small. There is no need to calculate the actual area of either the pupil of the eye or the o.g., the rule that circles are to each other as the squares of their respective diameters being sufficient to settle the relative light-grasping power of the areas in question.
Paisley. J. E.

[68609.]—**Cutting Tube Holes.**—Drill a $\frac{3}{8}$in. hole in centre of each, and then use a cutter in a bar, the point of bar having a pin to enter holes drilled for a guide. The cutter to cut out a kind of washer by a circular groove about $\frac{3}{16}$in. wide.
Bristol. T. C.

[68613.]—**Boiler.**—If properly made with single riveted joints, you might safely work it to 100 or 120lb. The shell and firebox being cylindrical, no staying is required. TARA.

[68613.]—**Boiler.**—Dish the two crown plates, and then no stays are required. Safe at 150lb. at least.
Bristol. T. C.

[68614.]—**Zincs.**—Cast them in a piece of iron gas-tubing, previously rubbed in the inside with plenty of black-lead. S. BOTTONE.

[68615.]—**Lamps.**—Yes; for about three hours. S. BOTTONE.

[68618.]—**Corrugated Sheets.** — Simply lap sideways on the first corrugation and endway 3in. to 4in. according to flatness of roof.
Bristol. T. C.

[68621.]—**To Mr. Bottone.**—An armature $1\frac{1}{4}$in. dia. by 4in. long, fitted in single fields, not double, as in your sketch, each F.M. core being about 4in. long, 4in. wide, and $\frac{1}{2}$in. thick, if wound with about 4oz. No. 22 on the armature, and 3lb. No. 18 on the fields, connected up as a series machine, will give you ample power if driven by your 6-cell battery. S. BOTTONE.

[68623.]—**Storing Negatives.**—Having tried many methods, I am now inclined to adopt Wolff's patent compact negative boxes. Perhaps "A. A." does not know of this plan. He can get a specimen from H. Senier, 88, Norwood-road, S.E. They are very compact and systematic, and they allow of any negative being found at once, with the small additional trouble of making an index. R. A. R. BENNETT.

[68625.]—**Arc Lamps.**—To MR. BOTTONE.—The humming is caused by a rapid vibration set up through imperfect contacts or rapid make and break of contract, either in the working of the shunt regulators, or in the carbon sliding in the holder tubes. S. BOTTONE.

[68627.]—**Gassendi.**—I think it is long since this formation was illustrated in the "E.M.," but some years ago there were good drawings by Birt, Elger, and Gaudibert. In his work on the Moon Neison gives a fine large-scale map of Gassendi, and the same authority gives a very full account of it, with two large drawings, in the *Ast. Register* for 1873. Lardner, in his "Handbook," supplies a copy of Mädler's large plan. Nasmyth also has a drawing of it in his work, and this sketch bears a strong resemblance to the style of the drawing of Copernicus copied by Lockyer. There is a second drawing of Copernicus, however, by Nasmyth, which is taken, doubtless, from a model, and this shows Gaudibert's "elongated lozenge" (letter 22480) and the crater on the southern Copernicus A, mentioned by "M. A." in letter 22999.

E. D.

[68627.]—**Gassendi.**—In reply to "C.," I do not think any very recent sketches of this formation will be found in "Ours," but the subjoined references to drawings in back volumes of the "E.M.," and in other publications, may be useful to him and others. Vol. XII. pp. 129, 225; Vol. XIV. pp. 69, 99, 118, 228, 487, 642; Vol. XV. pp. 177, 277, 485 (central mountains). These representations are of very unequal merit, but are all worth looking up. Vol. XIV. contains in addition many letters by Birt and others on Gassendi. In *Harvard College Observations*, Vol. VIII., there is a fine chromo-lithographic drawing, made on Feb. 8, 1873, which shows a large amount of detail. In the *Astronomical Register*, Vol. XI. p. 113, are two excellent drawings by Neison, representing the most prominent clefts on the floor. Then we have the special map of the formation in Neison's "Moon," p. 337; the late Prof. Phillips's beautiful sketch in *Phil. Trans.* 1868, plate 15; and drawings by myself, *Journal* L.A.S. Vol. V. pp. 60, 90. Schroeter's rude but truthful drawings (*Selenotopographische Fragmente*, T. LIII., T. LIV. Fig. 2) may also be consulted with advantage. They will bear comparison with many recent ones made under more favourable auspices.

T. Gwyn Elger.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

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QUERIES.

[68628.]—**Pressure.**—Can pressure be accurately registered by an ordinary gauge that is connected to a boiler by a proper siphon, and half a mile of pipe, for testing purposes?—Tara.

[68629.]—**Bulk of Sphere.**—How can I obtain the total bulk of a sphere when the diameter is given?—James G. Bowie.

[68630.]—**Punching Brass, &c.**—I want to make a quantity of pieces of brass, 1⅛in. square, with two 3-16 holes through them, and 1-24in. thick. On each side there is an inscription in relief. I should like a few hints. What kind of press for punching? If a screw-press, dimensions and pitch of screw. Could each piece be punched out, and the inscriptions stamped on it at one operation? Would a small fly-press, such as the sawmakers use for punching the teeth of hand-saws, be powerful enough? The relief on the punchings would be only slight; about equal to the letters on a penny.—South Australian.

[68631.]—**To Mr. Bottone.**—I have a small rowing boat, 20ft. long, 3ft. 6in. beam. What would be dimensions of motor, and how many two-quart chromic-acid cells would it require to propel the boat at, say, 6 miles an hour on still water for eight hours at a time?—Nautilus.

[68632.]—**To Mr. Stretton.**—1. Is there an Act of Parliament to prohibit young men from cleaning engines on the railways under 20 years old? 2. What is the limit of age that cleaners of engines on the Midland Railway commence? 3. Is there any distinction of age at the different cleaning sheds on the M.R.; and what wage do they commence work at?—Anvil.

[68633.]—**Watch Repairing.**—I have small English turns, and have made a few brass runners with grooves to lay pivot in. I can with grooves and finishing off with file, manage a pivot of ordinary size very fairly; but when it comes to a very fine one I usually break it in the finishing. The steel I use is very soft. I thought possibly this might be too soft to stand the strain, or are the turns not class enough for this kind of work? It is pallet-staff for Geneva lever, with very fine pivots I have been trying on. If any readers will kindly help me with a few hints I shall feel obliged.—W. R.

[68634.]—**Bushing Pivot Holes.**—I have often to bush holes in framework of clock trains; and the principal tools at my disposal are dividers and angle square. The method I have followed has been to raise a vertical line through centre of old pivot hole, cutting latter by horizontal line, bush hole, and then make lines meet; and at the point where the lines cross I take that as the centre. I should be glad to know of a more reliable way of re-bushing and making pivot holes.—Bushing.

[68635.]—**Jewels.**—How shall I proceed to fit jewels in bridge pieces of galvanometer and other similar things?—Jewels.

[68636.]—**Cycles Up-Hill.**—I should be glad if one of your ingenious correspondents could inform me why it is so much harder work to ride a cycle up a steep hill than it is to walk and push the machine? In a hilly district like this we are painfully conscious that the latter does not demand one tenth the exertion required by the former; but the reason of this is not so apparent when we consider that the weight to be raised (that of the cyclist, plus his machine), is exactly the same in both cases. Is there a defect in the mechanical principle of the cycle, by which a large amount of the force exerted by the rider is lost when ascending a steep incline?—Cyclist.

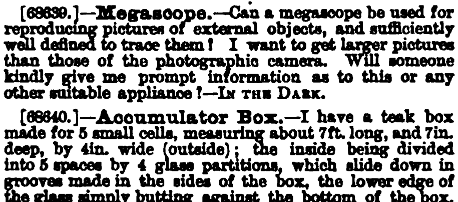
[68637.]—**Dipping Rods.**—Can any fellow reader give me any information about dipping-rods used for testing the quantity of ale in barrels? Are they reliable, and does the ale deteriorate by having the hole bored for inserting the rod immediately the barrel is delivered?—vent-peg inserted in hole afterwards. I had a barrel in some time ago, and I am certain there was not two-thirds of what I was charged for; and I want to find out some means of testing the quantity on delivery.—Barrel.

[68638.]—**Clock Train.**—Will some one give me particulars of a train for the going part of a clock, beginning with the great wheel of 96 teeth, and so that I may have a seconds hand, as is usual in "grandfathers' clocks"; but instead of a recoil or dead-beat escapement, I want to have a four-legged gravity one, like that shown on page 122 of Sir E. Beckett's book on clocks.—Gravity.

[68639.]—**Megascope.**—Can a megascope be used for reproducing pictures of external objects, and sufficiently well defined to trace them? I want to get larger pictures than those of the photographic camera. Will someone kindly give me prompt information as to this or any other suitable appliance?—In the Dark.

[68640.]—**Accumulator Box.**—I have a teak box made for 5 small cells, measuring about 7ft. long, and 7in. deep, by 4in. wide (outside); the inside being divided into 5 spaces by 4 glass partitions, which slide down in grooves made in the sides of the box, the lower edge of the glass simply butting against the bottom of the box. I then gave glass and wood coat after coat of shellac varnish (thin). That near the top dried hard, but at the bottom it was always soft. Convinced that this was useless, I took off the bottom of the box and scraped clean, put on again, and melted some good paraffin wax into all the joints with hot irons. When plates were put in and four cells filled there appeared to be no leakage—electric or otherwise—but after standing a couple of days there was in the fifth cell half an inch of acid, its neighbour having lost a corresponding amount. The joints, when examined, appeared to be quite sound. Could I paint with india-rubber solution?—If so, what must I "thin out" with?—Jerry Wireman.

[68641.]—**Brick Arches.**—In a series of brick arches in Portland cement, carried on girders, where the two extreme abutments are sufficient to resist the thrust, how far may tie-rods be dispensed with in considering the case of the heavy loading of some of the arches, the others being unloaded. Take the case of the right-hand arch being so loaded that there is a thrust, T, of three tons per foot run due to the additional load. The left-hand arch, unloaded, will, to a considerable extent, act as a strut to transmit the thrust to the abutment. The question is, how much will the left-hand arch transmit, and for how much must tie-rods be provided, and how is the unloaded arch acting as a strut to be calculated?—Student.



[68642.]—**Moulds.**—Can any reader give me a few practical hints on the construction of iron moulds (or chills) for making castings in quantities, such as shares, sash weights, fire-bars, &c., together with a description of their use? Also the proportionate components of brass, and how the brass is obtained to any required colour. Also how tin may be recovered from clipping old cases and such-like.—Founder.

[68643.]—**Faulty Steam-Gauge.**—Would you kindly tell me what is the matter with my small steam-gauge (Schaffer Budenberg)? It registers up to 5lb., but no further, no matter what pressure of steam I have on boiler (model). What effect would loosening the two screws at the bottom have? It has behaved very well for two years, and only cost 10s. when new.—Precursor.

[68644.]—**Dynamo.**—What dimensions should a small dynamo be to light five 16c.p. lamps in series, driven by a small steam-engine? What size cores, quantity and size of wire required, &c.?—J. D. Watkins.

[68645.]—**Joints in Indiarubber.**—Would any reader inform me how the joints in bicycle tires are made? Also how to vulcanise indiarubber.—W. Preston.

[68646.]—**Air-Pump.**—Will some reader kindly explain why, in marine engines, the air-pump is made from 40 to 50 times the capacity of the feed pump. All the water and air that enters the boiler must go through the feed pump. Then why cannot a pump of corresponding size deal with the water and air as it comes from the condenser?—Tara.

[68647.]—**Coupling Dynamos.**—Will any kind reader answer the following? I have two dynamos, one a ten-lighter and the other a twenty-lighter, each 45 volts. I want to know how to couple them together, so as I can get thirty lights of 45 volts in one circuit. Also how are the carbon filaments fixed on to the platinum in incandescent lamps.—Vacuum.

[68648.]—**Setting Up Watch and Clock Springs.**—Would anyone inform me the correct way of using the adjusting rod in setting up the springs of English watches and clocks?—Country Clock Jobber.

[68649.]—**Fitting Reeds to Piano.**—Could any reader inform me how I could attach a couple of sets of reeds, on the American-organ principle, to a piano, and what amount of space would be required for wind-chest, pallets, and reed-frames? The bellows I should endeavour to place in a cabinet alongside to be worked with an electro-motor (if possible), and as there would not be much wind required, I should think this could be done easily. Perhaps Mr. Fryer would kindly help me.—Combination.

[68650.]—**Pivots and Pivot Turning.**—I have by me one of Wheatstone's alphabetical indicators. The spindle carrying the small escape-wheel has become broken. I have failed to make a new one to my satisfaction, being a poor affair when compared to the original, which possesses a great amount of elasticity; beside the pivots, which are long and fine, are nicely finished, total length of spindle 3in., front pivot ⅛in., and back pivot [illegible] length, diameter of spindle No. 20 B.W.G. Could any practical reader give me some sound information how to proceed? I have only a turns at my disposal, and sketches of useful tools which would assist me in making the above would be welcomed. Many like me would be glad to see some good articles, written by practical men on pivot making, appear from time to time in "Ours."—Pivot.

[68651.]—**Sand Blast.**—Could any of our readers give me a suggestion for roughening the surface of glass? I require to make the face of the glass, or parts of the face, as can be done with the sand blast. Grinding with rough emery or sand is too smooth, and I have not access to a sand-blast machine. Could there be any simple form of sand blast rigged up to do this sort of thing? Etching with acid is no use for the purpose either. I require the deeply cut grain that is obtained from the sand blast.—Glass Decorator.

[68652.]—**Wood Labels.**—Would some correspondent kindly tell me how I can prepare deal labels, so that the address can be written on them in ink, without the ink running and without painting the label?—Burr.

[68653.]—**Electro-Motor.**—To S. R. Bottone.—What distance apart are the pole-pieces, as described by you, p. 44, on electro-motors? Should the sides of the tunnel be cut away, so as to correspond with one of the segments of the armature? Is five layers of 22 gauge sufficient to wind field-magnets?—A Learner.

[68654.]—**Harmonium.**—Will Mr. G. Fryer or some other gentleman please tell me the best length and depth of channel in the sound-board, or pan, of an harmonium to secure the fullest and richest tone colouring—from [illegible] *f* to upper *f*, five octaves, broad reeds? Are these reed channels the same size and shape in all harmonium pans, or do they differ in scale according to taste? If I had the length, depth, and shape of one channel for the [illegible] and for the highest *f* five octaves, I may scale the [illegible] channels from these. Upon the shape and capacity [illegible] these channels, it is said, much depends the colour of [illegible] produced by the reed it reinforces. I have walked [illegible] miles every week for the "E. M." for the last six months.—James Day.

[68655.]—**Spirit Lamp.**—Could some one tell me the best form of spirit lamp with arrangement for regulating the heat to any desired degree? I have tried several high-priced ones, but found them worthless for the purpose.—Calor.

[68656.]—**Boiler.**—I have a launch engine, [illegible] cylinder 4in. diam. and 3in. stroke, working with [illegible] steam at 120 revs. per minute, and I wish to procure or make, a copper boiler for it, to stand a pressure of [illegible] 120 or 130lb. Will some correspondent kindly give [illegible] particulars and dimensions of such a boiler, suitable [illegible] on a launch or on shore, and the probable cost of material at present prices? A rough sketch of boiler will [illegible] Also will he kindly give the power of the engine?—Launch.

[68657.]—**Sympathetic Snail Compass.**—In *Chambers' Edinburgh Journal* of February 15, 1851, [illegible] article apparently written in good faith, and indexed under the heading of "Popular Science: upon a Sympathetic Snail Compass." It seems that an American and a Frenchman (Messrs. Biat and Benoit) made the discovery that [illegible] snails, after having once entered into an affinity with each other, were endowed with the faculty of remaining permanently under a mutual sympathetic influence, [illegible] was not destroyed, nor even weakened, by the most prolonged intervention of time or space. By placing [illegible] snails, which were in sympathy with each other, in [illegible] prepared in a way the particulars of which are, I fear, too lengthy to trouble you with, but which contained a complete alphabet, it was found that at any distance one snail would accurately follow the movements of the other. Details are given of messages telegraphed between Paris and New York. It is admitted that some inaccuracies occurred in the spelling, but not, however, sufficient to render the words unintelligible. Can any of your readers say whether there was any foundation of truth in this account, or was it only an elaborate hoax?—H. B. R.

[68658.]—**Beet Sugar.**—In 1884, the late Sir F. [illegible] commenced the manufacture by the "Strontia" process somewhere in Suffolk. Is it now carried on?—F. [illegible]

[68659.]—**Midland Engine No. 3.**—Can any reader oblige by giving sketch of Midland engine No. [illegible]—Gerald Bennett.

[68660.]—**Electrical Repairs.**—I am doing [illegible] repairs in electric bells on steamboats. One boat, [illegible] at a foreign port three months since, had [illegible] cells put in, which do not act. I have substituted [illegible] clanché cells with success. Are the Gassner cells [illegible] for that purpose? They were put in new. Do they [illegible] recharging, and how?—Hazelnutt.

[68661.]—**Tables of Measurement.**—Can [illegible] tell me what the measurements of land (lineal, [illegible] square—are in the Transvaal and Cape Colony, [illegible] to English measurement; terms used, &c.—[illegible]

[68662.]—**Telephone.**—Would Mr. Allan or Mr. Bottone kindly give sketch of connections of carbon [illegible] mitter, with induction coil and automatic switch arrangement to cut out transmitter and battery and leave bell in circuit when telephone is on hook?—F. C.

[68663.]—**Albumen.**—Can any reader inform me how albumen is obtained from blood, and about what proportion per gallon?—NERO.

[68664.]—**Keeping Meat in Vapour.**—It is stated that a new system of transporting meat has been discovered: instead of freezing, some kind of vapour is used. Should be glad of any particulars on the subject.—J. W. W.

[68665.]—**Weighing Water.**—At the conversazione of the Royal Society last Wednesday week, Mr. H. J. Chancey exhibited "a hollow cylinder and sphere used in the redetermination of the weight of a cubic inch of distilled water, 1889." The result being "252·286 grains at *t.* 62°, B. 30in." This would make the Imperial gallon 277·463c.in. instead of 277·274 as at present, not a very serious deficiency of 47·680gr. of water, or, say, a little over an ounce in ten gallons. Can any person kindly say where there is any published account of the *modus operandi*?—RHO.

[68666.]—**Chloride of Lime.**—Desiring to experiment with the above chemical as to its drug action on the human body and system, I ground up chloride of lime (commercially sold for bleaching esparto grass in paper-manufacture) 10gr., cane sugar 500gr., in Wedgewood mortar, when after some 10 minutes' trituration the whole mass suddenly surged up with evolution of much heat, the colour having now become changed from a pure white to a yellowish-brown. I think, from its behaviour, that considerable explosive power may be developed by these two substances. Have any of our readers had any experience in this direction? If so, a few lines would oblige.—PHYSIS.

[68667.]—**Photographic Scrap-Books.**—What is the best way to stick photographs in these books? I have heard both starch and gelatine mentioned as good adhesive media, but I should be glad of hints as to the procedure, so as to avoid buckling or blistering. Is it a good plan to soak the prints in water before pasting, and should the paste be applied to the paper or the print, or both? I do not want to spoil any photographs experimenting; hence my query.—GLATTON.

[68668.]—**Surface Condenser.**—Will some practical reader advise me as to the best plan for converting a h.p. marine engine, 12in. cylinder, 8in. stroke, cut-off ⅝, to surface condensing? I want to know the best form and size of pumps and condenser, and if it would be advisable to drive the air and circulating pumps by a separate engine, or use a centrifugal pump on propeller shaft for circulating pump, and adopt some means of driving air-pump from engine. Would the saving of fuel and extra power to engine be worth the expense without compounding the engine?—AJAX.

[68669.]—**Stereo-Metal Dross.**—Having got about 5 cwt. of stereo-metal dross, I want to get all the metal out of it, so as to leave the dross worthless, but don't know how to go about it. I have tried washing it, but when I have washed all the dust away and left the metal at the bottom of the bucket, when put in the pot the dross rises again. There is some process by which you can recover all the metal from dross, and if any of our subscribers could oblige I should be very thankful.—R. B.

[68670.]—**A Proportion Sum.**—In a high-class girls' paper for this month the answer to the following proportion sum is given as 42:—"If a hen and a half lays an egg and a half in a day and a half, how many eggs will six hens lay in seven days?" Can any of our mathematical friends say how this result (42) is obtained, as by the ordinary rules the correct answer would appear to be 28.—R. A.

[68671.]—**Micro-Photo.**—Could any reader of "Ours" give me information for producing microscopic photographs? I may add that I am a decent photographer, and also possess a good microscope, and am anxious to try my hand at above. Is there any book published on the subject?—F. T. B.

[68672.]—**Electrical.**—Will "W. G." or Mr. Mason oblige me by telling the way to connect my machine up in series, a motor armature 1½in. diam., 3in. long, F.M. cores 2⅞in. by 2⅜in. by ⅜in. I want to use up some No. 18 d.c.c. wire. I have bought books, but of no use to me in winding; that is, give me no instructions; and pocket is limited, being poor lad, so I cannot reach those that I have seen advertised in these columns at present. Would the directions given in the last Vol., page 403, answer 67323, do with one wire instead of two in parallel? Is the series wire the same size as that on the fields?—LITTLE HARRY.

[68673.]—**Hardening Lathe Tools.**—Will some of our readers kindly inform me the best known sure and safe way of hardening lathe tools for cast and wrought iron and steel; also will the same plan answer for fitters chisels, &c.? I find running them down cannot be depended on.—MECHANIC.

[68674.]—**Link Motion in Centre.**—When the link motion is in dead centre, is it possible for steam to enter the cylinder at either end? I have always understood when the handle of the reversing lever was in the centre notch it was not possible for the locomotive to move either way, even if steam was turned on at the regulator. I remember once reading "if the regulator was broken or out of repair the engine could be stopped by putting the reversing lever in the centre notch out of gear." Am I right here? I shall feel much obliged for any assistance, having studied the subject a good deal, and yet I am not at all clear on this point.—F.R. MET. SOC.

[68675.—**Telephone Transmitter.**—Is there any advantage in increasing the battery power used with the induction coil of a Blake transmitter?—For instance, would the articulation from the receiving telephone be more distinct and louder by using a bichromate cell in place of the Leclanche? Perhaps, after all, this depends upon the fineness of the resistance of the secondary wire upon the induction coil of the instrument. Any help or references to books treating the matter will oblige.—F.R. MET. SOC.

[68676.]—**Chameleon Weather Glass.**—Can any correspondent give me the formula of the composition with which a transparency on glass is coated, causing the sky and water to appear blue in day and ruddy in damp weather. The specimen I have has "Chameleon Wetterbild, Ruckerts D. R. Patent No. 28,520," printed on it.—ROSICRUCIAN.

[68677.]—**Leg-Irons.**—Will any one kindly give me the best method for making irons for a little boy's legs, about two years of age. He is so heavy in weight that his legs just above the ankles are gradually bending, and I fear the result.—NEW CHUM.

[68678.]—**Foot Lathe.**—I am about to construct a foot lathe, and intend making it suitable for turning both metal and wood. Will some one kindly let me know what size the driving-wheel and cone should be, as I am at a loss to know. What speed it should run also? Any other hints on the subject would oblige.—NEW CHUM.

[68679.]—**Harp Lute, by Light, Foley-place, London.**—I have one of the above with 12 strings, 7 are on the fingerboard, the frets of which are very much out of tune. Wishing to rectify same, I would be much obliged to anyone who will kindly tell me how to refret same properly, and how to tune it. I have had it tuned as follows:—1 treble string C, then G, E, C, G, B flat and A natural. The distance in between the top fret and bridge is 14¾in.: there are eight frets in all. I would like also to ascertain the age of the instrument, which is a very fine one, and bears the above name.—R. B. ROBERTSON.

[68680.]—**Faulty Telescope.**—To "F.R.A.S."—I have a 3in. astro. telescope, which does not perform satisfactorily. The defect, I think, is in the object-glass, which consists of a double concave and a double convex lens. When viewing a bright star with a power of 180, the rings of light which ought to encompass the star appear only on one side, and grow shorter the farther they are from the star, which makes the object appear like a comet with a short conical tail. Colour of a purple tint is also perceptible. Saturn is pretty well defined, and shows like white marble on a black background; but Venus is the most disappointing. It appeared, when favourably situated in March last, as a distorted crescent with a strong tint of purple colour dancing about it. Now, I desire to be enlightened as to the cause of this defect, and whether it is of too serious a nature to be remedied. I may add that the telescope is in other respects a most expensively got up instrument. For any advice respecting the above I shall be extremely grateful.—ASTRON.

[68681.]—**Preservation of Copper Boilers.**—Will some reader give me the best means to be adopted to preserve copper boilers, used for brewing purposes (but not now in use)? They are set in brickwork, and I want to keep them in a state of preservation, as they may not be required again for many months.—REGULAR SUBSCRIBER.

[68682.]—**Chemical.**—Would some chemist detail briefly a good process for the estimation of sulphides, especially the sulphides of the alkalies?—G. GUNN.

[68683.]—**Boiler Flanges.**—Can any of our readers tell me how to make flanges for model boiler, 11½in. over and 5in. over? I have got some ¾in. angle iron, but find that in bending round, it gathers and gets out of shape. I am not particular which way it is bent round, so as I can rivet my plates with as little trouble as possible.—W. H. G.

[68684.]—**Underground Survey.**—Which is the best instrument to use, or that most reliable, the circumferentor, miners' dial, or theodolite, and how can the affectation of the needle from ferruginous substances be avoided or counteracted in mines? What scale are general working drawings of mines drawn to, and also top survey plotting plan?—MINER.

[68685.]—**Holder for Small Incandescent Lamp.**—Could any electrical coorespondent kindly inform me of a holder for a 4 or 5-volt incandescent lamp? Also what thickness of line wire would be necessary to light a 4 or 5-volt lamp at a distance of 25 or 30ft. from three quart Bunsen cells?—G. M. R.

[68686.]—**Overhead Motion.**—Would anyone kindly give us a sketch of one, suitable for 5in. centre 5ft. lathe, for doing real work both in iron and wood, expense and trouble to be taken into (but not to be the first) consideration? Give size of shafting, and all other parts.—H. E. W.

[68687.]—**Division Plates.**—Would any one kindly give directions to fit one lathe, 5in. centre, back-gear, not room on gear wheel, which is 5in. diam.; could run one 2in. larger? Also way of striking out most suitable number of holes—four or five rows—with size. Have collar on mandrel outside of bearing, ½in. wide, 1½in. diam.—H. E. W.

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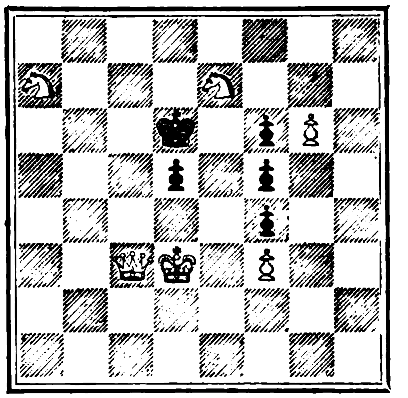
PROBLEM MCXLIX.—BY "BLACK PAWN."

Black.



White. [6 + 5

White to play and mate in three moves.

SOLUTION TO 1,147.

White.	*Black.*
1. Kt takes P on Q 2.	1. K-K 3 (*a*).
2. Q-K B 5 (ch).	2. K takes Q.
3. Kt-Q 4 mate.	
	(*a*) 1. Kt-Q 6 (*b*).
2. Q-B 4 (ch), &c.	
	(*b*) 1. B-Kt 2 (*c*).
2. Q-Q Kt 3 (ch), &c.	
	(*c*) 1. P-K 4 (*d*).
2. Kt takes Kt P (ch), &c.	
	(*d*) 1. P-K 3.
2. Q-B 3, &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,147 by Mendelssohn (except variation 1. $\frac{\quad}{\text{B-Kt 2}}$; correct move is 2. Q-Q Kt 3), F. C. Cook, J. W. Read (but variation 1. $\frac{\quad}{\text{B-Kt 2}}$ omitted), Muzio, J. Bryden (dual if 1. $\frac{\quad}{\text{P-K 3}}$; very good problem with a great deal of variety), J. E. Price (1. $\frac{\quad}{\text{B-Kt 2}}$ should have been given); T. A. Pringle (exceedingly well composed problem, entitled to be put among first class three-movers), Janus, J. G. Hankin (three variations missing), F. Fernando (ditto), W. L. Martin (this problem much liked, but moving a piece *en prise*, first move, a drawback), W. Jay (dual), W. Gleave (not difficult, but accurate and very pleasing); to 1,146, by H. Fellows. A. Fellows, J. E. Price, H. Warren, Janus, H. G. Walsh, A. Bolus, Muzio, Bernard Green, Link, J. Kilbee, J. W. Read, and Othello (remarkably good problem).

H. V. TATTERSALL.—If in 1,146 1. $\frac{\text{Kt takes K P}}{\text{K-K 5}}$, and then?

MUZIO.—We congratulate you on your success, as Mr. Miles's Challenge Problems are usually very tough. We notice with regret that this is to be his last. It is not necessary to give short mates.

A. BOLUS.—It was an oversight, and has been put right

W. GLEAVE.—Yes, as to both queries. Many thanks for problem.

The *Dublin Mail* is getting up a Correspondence Tourney, limited to 18 competitors. Entrance fee, £1 1s. Prizes, £7, £5 5s., £3 3s., £2 2s., and £1 8s. Address, T. B. Rowland, Victoria-terrace, Clontarf, Dublin.

The *Sheffield Independent* announces its eighth Solution Tourney to commence June 1st, and to last four months. It will be divided into a two-move and three-move section. Competitors may enter either or both. Several valuable prizes, from two guineas downwards, are offered. Entrance fee, one shilling, to each of the two sections. For full particulars address Chess Editor, 9, Victoria-terrace, Clontarf, Dublin.

"Chess Openings, Ancient and Modern," by E. Freeborough and Rev. C. E. Ranken (Trübner and Co.)—An English work on this subject has been long a desideratum, notwithstanding the publication of Mr. Gossip's valuable treatise some years ago (and of which we believe a new edition is shortly forthcoming). The specialities of this book are (1), the most recent discoveries in the various openings epitomised; (2), certain original excursus by the editors themselves, which will prove of the greatest interest and value; (3), an admirable statement of the principles which obtain in the conduct of the game; (4), an introduction to each opening, giving the reader an insight into its character and tendencies. The play is arranged in vertical columns, as in Cook's Synopsis; and there are various notes pointing out by-play which could not well be incorporated in the text, but which will often prove attractive to the student. We should have wished for a few more diagrams; but so far as we have been able to judge, the work appears to us a monument of patient industry and profound research, and must prove of the highest value to all who wish to be acquainted with the latest results of analysis.

IT is proposed to erect at Leadhills a memorial t William Symington, the inventor of the pres system of steam navigation.

ANSWERS TO CORRESPONDENTS.

⁂ All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 15, and unacknowledged elsewhere:—

Mac—A. Hunton—Roberto—Mrs. Meade—Condenser—Moulder—Cyrus—C. J. Tahourdin—An Amateur—Bofin—R. A. G.—F. C. Lees—Tria—T. F. S. T.—W. J. Woodward—F. C. Allsop—W. Ridler—Clement E. Stretton—C. Gaudibert—Indoctus.

J. Sherwen. (It is not even known that Saturn will occult the star D M + 17°·2043 at all on the 18th. Its place is by no means well determined, and in order to predict, even with moderate accuracy, the time of nearest approach of the planet to it, a redetermination of its position and a subsequent operose calculation would be needed, which is now impossible.)—W. G. (If you look through back volumes you will find a great deal about water-gas; it is not by any means either a new term or a new idea. Water being composed of oxygen and hydrogen, it is obvious, if it can be split up cheaply, the hydrogen at least would be available as fuel. The favourite plan is to pass steam through incandescent coke, that seizes on the oxygen and frees the hydrogen, which comes over accompanied by more or less carbonic oxide, itself an inflammable gas. We believe that every system of making water-gas or air-gas has been fully explained in our columns.)—An Old Keepsake. (A cement for glass and china that could stand hot water would be very useful. We think for glass the best is gelatine dissolved in acetic acid and applied warm, with a drop of bichromate of potash solution to render the glue insoluble after the light has acted on it, but we suspect you will find nothing but riveting successful for your china bread-plate.)—A Recent Subscriber. (The apparatus you have purchased appears to be one of the forms of microphone which were made when Prof. Hughes described his discovery. With the help of an "English Mechanic" telephone—the original Bell instrument—the ticking of a watch laid on the baseboard of your apparatus would be heard distinctly through many yards of wire.)—Artifiso. (You can obtain the information about engine-room artificers from the Captain of the Steam Reserve at any of the Government dockyards. Artificers cannot become engineers in the navy, as engineers have a special training.)—Mercury. (It is subject to the laws of fluids like any liquid. By the way, the pressure is always "greatest on the bottom" because the bottom presumably has to support the weight of the contents of the vessel besides the pressure. Any dealer in electrical or chemical wares can supply you with quicksilver. See the advertisement columns.)—Fred. (The size of wires suitable was given in the number referred to, or can be found in many other back numbers. The sizes mentioned will scarcely do, and guttapercha-covered wire is utterly out of place in a coil.)—J. Jones. (If you have given away your volumes we will hope that others have benefited by them; but you will readily understand that we cannot repeat queries every time new readers send them, though we endeavour to do so when they are of general interest.)—Freedom. (Caustic potash or caustic soda. If either is not available, make a saturated solution of washing soda and then boil some quicklime in it to a creamy paste. Apply that with an old brush, and mind your fingers! That will soften the paint, old putty, &c.)—John Martin. (We do not think any firm of marine engineers likely to take up the invention, and certainly cannot afford space to illustrate it.)—R. V. S. (If the article is so far perfect that it can be made and put on the market, why not file the complete specification at once and obtain the "seal"? It is unwise to make and sell such things before obtaining the full patent. Any agent would give you advice on the matter.)—Ja. Le. (To gild picture-frames you must adopt either the oil or water process, and the gold leaf must be burnished if you want it bright. There are many processes described in back volumes, and a full account in No. 870, p. 286. Very likely painting with the ordinary gold paint will suit you, especially if you varnish after it; but at any rate, full directions can be found in back numbers.)—A. L. (Tattooing is usually done by pricking with a needle and rubbing in gunpowder. We think the practice absurd, and do not care to help its spread in any way.)—R. A. R. Bennett. (Surely you comprehend that the upper portions of the wheels of a vehicle in motion must at any given moment be travelling faster through space than the bottom portions, which are practically resting on the ground. Hence, with instantaneous photographs—"shots"—the upper portions of the wheels are necessarily less distinct.)—J. E. Lord. (Not comparable in that way. With the telescope we want light-grasping power, which is a function of aperture. See recent numbers.)—Wire. (Any of the recent volumes; but see indices.)—Ruktama. (Will not the directions given in the last volume and continued in this on the "Home Manufacture of Cameras" suit you? See pp. 119, 157, 299, 379, last volume.)—Broad Arrow. (Oxalic acid will generally discharge ordinary ink, but the part will require bleaching afterwards. See p. 206, last volume, and the indices.)—J. F. (Booth's "Complete Art of Brewing," Simpkin, Marshall, and Co., price 1s. Any bookseller will procure it. See back volumes.)—John Clark. (Are they welded? It depends on the kind of steel; but in the case of shafts it would be better to join by means of collars or flanges shrunk on. 2. Wicks's "Organ-Building for Amateurs," Ward, Lock, and Co., Salisbury-square, London.)—Dick. (We do not see how anyone can suggest a remedy without an opportunity of discovering the cause of the hair falling off in parts. Perhaps it is through ringworm. A sea-going engineer's life is a healthy one, if he has not too much Red Sea.)—O. M. (Given in the textbooks, and many times in back volumes.)—F. J. G.—(See p. 486 last volume; it is a matter of practice getting rid of the wire edge. 2. The tin. 3. Treat in the ordinary way. Lute it up in a box, heat to a red, and let it cool slowly.)—E. E. Markwick. (We can insert as a letter, and will do so as soon as space permits.)—S. C. Bailey. (Better take lessons in perspective at some school of art; the teachers will recommend books.)—Novice. (We really cannot undertake to prepare expensive illustrations of dynamos our readers are going to build in order that they may ask the most elementary questions about their construction. If they cannot give dimensions and a description they must go without the information.)—Fred. Carre. (Thanks for your cantankerous letter, which is untrue and impertinent. As you insist that we shall publish it in full or not at all, we have no choice but to omit it.)—R. E. A. H. (Unreasonable to expect what you ask.)

Every Nerve and Muscle of the Body is strengthened by wearing HARNESS' ELECTROPATHIC BELT. It has restored thousands of sufferers to perfect health, and is the best known cure for Nervousness, Debility, Rheumatism, Gout, Sciatica, Liver and Kidney Diseases, Ladies' Ailments, &c. Pamphlet and advice free on application to the MEDICAL BATTERY CO., Limited, 52, OXFORD-STREET, LONDON, W. (corner of Rathbone-place). Those who cannot call should write at once for Belt and Pamphlet.

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Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

Holloway's Pills.—The balsamic nature of Holloway's Pills commends them to the favour of debilitated and nervous constitutions, which they soon resuscitate. They dislodge all obstructions, both in the bowels and elsewhere, and are, on that account, much sought after for promoting regularity of action in young females and delicate persons.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Wanted, **Juvenile Tricycle**, in exchange for new Dynamo to value.—Hellyar, Electrician, 144, Dalling-road, Hammersmith.

Ornamental Lathe, Traversing Mandrel, overhead, with complete outfit, perfect tool. Offers. Photo, 6 stamps.—L., Innisfail House, Vespan-road, Shepherd's-bush, London.

Medical Coil, very powerful, six powers, regulating tube switch, handles, improved bichromate battery, complete, quite new, highly finished. Offers to 50s. value.—Address, below.

Wimshurst (pretty) **Machine**, new, 17in. discs, 4 jars, latest pattern, photo and particulars, 4 stamps. Exchange to £4 value.—Randle, Melton-street, Kettering.

Set Tricycle Wheels, new, balance gear, chain, cranks, pedals, &c. amateur could easily complete. Want drilling machine, lathe accessories.—Hubbell, 58, De Beauvoir-road, N.

Two complete vols. **"Old and New London,"** with plates, clean, cost 22s. Wanted, Anglo Concertina, Tools, &c.—W. Carne, 54, Dieppe-street, West Kensington, S.W.

Small upright copper **Steam Boiler**, with Gas Furnaces, completely fitted. Offers.—Singleton, Lune-street, Preston, Lancs.

Household Book.—Practical Recipes in the Arts, Manufactures, and Trades, including medicine, pharmacy, and domestic economy. What offers?—H. Pritchard, Coventry-road, Hinckley, Leicestershire.

Wanted, in good condition, **"Kempe's Electrical Testing,"** last edition. Will give in exchange nickel-plated Galvanometer, by Dale, nearly new, never been used, cost 12s. 6d.—Geo. Barnard, Marshes, Belvedere, Kent.

Horizontal **Steam Engine**, 1in. bore, 2½ stroke, two flywheels, 5¼ diameter. Exchange to value of 30s.—[illegible], Windsor-road, Bexhill, Sussex.

Revolver and Holster, cost 63s. Inverted Engine Castings and Patterns, bored and turned, 1⅛in. by 3¼in., cost 30s. Offers wanted.—Gale, Seend, Melksham.

"Nature," volumes III. to VI., bound; "Astronomische Nachrichten," 1877 and 1878; "Observatory," lot early numbers. Exchange for "Nature." Wanted, volumes XXV. to XXXVI. unbound, and "Observatory," from Vol. IV., or cash.—Address, Ward, Box 75, Post Office, Belfast.

52in. **Bicycle**, roller bearings, bent handle bar, part plated, good saddle, would suit learner. Offers.—W., [illegible], Church-lane, Wolverhampton.

50in. **Bicycle**, roller bearings, would suit learner; offers.—J. Humphries, 146, Dudley-road, Wolverhampton.

Air Pump, with reservoir, 3ft. high, working order. Exchange for good Lantern Slides, value 20s.—Gilkes, Broad street, Reading.

Landscape Lens, new, ½-plate, two stops, no rack, specimen of work 6 stamps. Offers.—Fenno, 68, Ondine road, S.E.

Over a year's numbers **"New York Electrical Review,"** profusely illustrated, clean, perfect. Exchange Lathe Tools, Circular Saw, Taps, or anything.—B., 51, Bath-avenue, Dublin.

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Wanted, good sound Canoe or 52in. **Bicycle**, in exchange for 1H.P. Vertical Engine, in thorough working order. Full particulars to—E. Slater, 15, Commercial-street, Birmingham.

Stocks and Dies, Whitworth thread, ¼ to 1in.; also parts of Lathe. Offers in useful articles.—Pearce, Kent House, Crystal Palace-road, Dulwich.

Harmonium, with stops, 5-octave, walnut case. Wanted, 4in. Slide-rest or Planed Castings.—Pearce, Kent House, Crystal Palace-road, Dulwich.

Wanted, a genuine **Rover Safety Bicycle**, in exchange for the following or cash:—A Table Engine, cylinder 1⅛in. bore, 6in. stroke, weight about 1½cwt.; 3-hole Indicator and Bell, push, switches, &c.; one pair single-needle Telegraph Instruments, Batteries, and a small Hammond Dynamo.—Presto, 61, Woodgrange-road, Forest Gate, E.

"English Mechanic," volumes XL. to XLV., bound publishers' covers, clean; also odd numbers of volumes XL. and XLI. What offers?—Wilson, 24, Hartington-road, Ealing.

Locomotive, model of N. L. R., built off scale, 1in. to the foot, 17in. long, cost £10; complete set Marine Engine Castings.—Below.

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Marine Engine, complete, slide-valve, new, 1¼in. stroke, ⅞ bore. Copper and brass riveted Marine Boiler, holds one gallon of water.—Below.

Sailing Boat, 42 inches long, 12 deep, 11 wide, built and ribbed, good fast boat; took prize at exhibition.—Below.

Horizontal Engine, complete, slide-valve, 1¼in. stroke, 1in. bore; Sewing Machine, stand complete. Offers.—[illegible]bury, 21, White Post-lane, Victoria Park, E.

Harmonium, Grandfather's Clock, Sewing Machine, Salter's Weighing Chair, with brass dial and stand. Exchange back-geared Lathe.—Moore, Photographer, Oldbury.

Induction Coil, with regulator, commutator, handles, battery, and case, new, worth 40s. Exchange silver Albert and cash to value 28s.—H. Elliott, Alexandra-road, Newport, Mon.

Wanted, good half-plate **Portrait Lens**, or good Background. Will exchange splendid pair of Opera Glasses.—Joseph Mahony, Cappoquin, co. Waterford.

Diamond frame **Spring-front Safety**, 1889 machine, ball bearings, plated parts, nearly new, price £12 10s., take at value Lathe, about 4in. Drilling Machine, Forge Bellows, or offers.—Wm. Poate, Havant, Hants.

Fifty new Edison-Swan 100-volt 16c.p. **Lamps**. Exchange Lathe or Dynamo.—H. Adams, 49, Shaftesbury-street, New North-road, N.

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Six last volumes **"English Mechanic,"** for Bicycle, Tools, Telescope, &c.—J. Tunn, 10, Boston-street, Dorset-square, N.W.

Bunsen Burner, "Angell's Electricity," "Cyclopædia of Education," "Shorthand Dictionary," "Chambers Bookkeeping Set," "Grammaire des Grammaires," "Cassell's Etiquette Book."—Taylor, Woodbine-street, Dewsbury.

Will give a high-class large-size 18-carat gold English Lever Watch, with gold dial, full jewelled, the best watch money can buy, cost £16, warranted, in exchange for Model Beam Engine 2½in. bore cylinder with governors, or a Semi-fixed Model and Boiler complete, same size as above.—Apply, 279, St. Philip's-road, Sheffield. Postcards not answered.

2 Wheatstone's reverse-current **Bells**, 4 ½-gallon and eight quart Stoneware Battery Jars, six large brass Terminals, also Musette.—Below.

3in. **Leg-Vice**, 12 Electric Bell Bases, with bell standard and cores; six Electro-Magnets, 3in. Back Volumes wanted.—Below.

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"English Mechanic," Vols. XXI. to XXXII., inclusive, bound in cloth by amateur. What offers?—L., [illegible], Duke-street North, Halifax.

Printing Press.—Model Press, No. 1, 49in. Bicycle, Nickel Air Pistol, Bat, Stumps, Ball. Wanted, Type, Printing Material, or offers.—Newbery, 110, Avenue-road, Camberwell.

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Splendid **Medical Coil**, with terminals for primary and secondary currents, draw-tube regulator, bichromate battery, and handles, complete, quite new. Offers value 25s.—Below.

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Shop-Window Attraction.—Mechanical Picture, "Sleepy Cobbler and Mischievous Apprentice," strong clockwork mechanism, goes one hour once winding.—Geo. Harris, [illegible], street, Nottingham.

[*Continued on page* viii.]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 24, 1889.

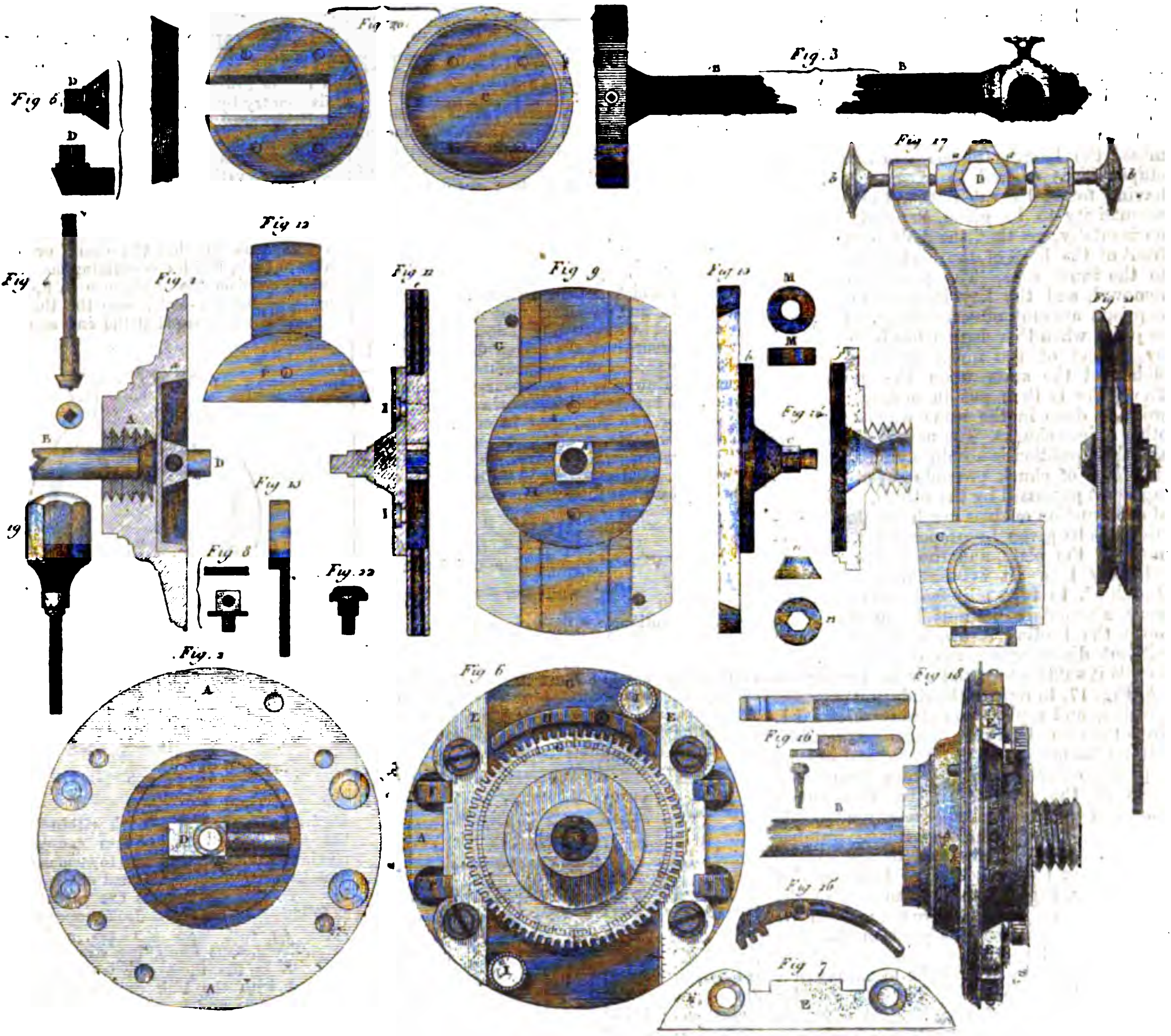
EXTRACTS FROM BERGERON. —XXIV.

French Ellipse Chuck.

On the nose of the lathe mandrel, which must be bored throughout its length, is mounted the base plate A, seen in section Fig. 1, and in front at Fig. 2, Plate 36. At the centre of this plate is made, as in the preceding case, a circular recess *a*, occupies half the diameter, and is hollowed out to a depth of seven or eight lines. This recess is bored through the centre with a conical hole, having a diameter at its larger end the same as that of the bore of the mandrel against which it rests. Through this hole is passed the rod B, Fig. 3, which traverses the entire length of the mandrel. One end of this rod carries the iron box C, the diameter of which is a little less than that of the recess, and of which the outer face is almost flush with the plate A. Inside this box is a plate of iron, Fig. 20, carrying by a dovetail fitting the stud D, which serves to determine the length of the ellipse. This stud, shown separately on Fig. 5, is moved by means of the screw *c*, Figs. 2 and 3, of which details are given in Fig. 4.

Upon the front face of the plate A are mounted two guide-bars E E, Fig. 6, which are attached by flat-headed screws, Fig. 22. A plan of one of these guide-bars is seen in Fig. 7. Four steel pillarets, F F F F, Fig. 6, the details of which are shown in Fig. 8, determine the exact parallelism of the guide-bars, by means of the set screws which pass through them. Between the guides E E the iron slide G, Fig. 9, works, seen in profile, Fig. 10, and in section, Fig. 11. This slide carries on its back surface—i.e., the surface which touches the foundation-plate—a recess of the same diameter as that of the plate, four lines in depth, partly filled by two semicircular guide-bars, made of dovetail section, I I, of which one is removed and seen in front, Fig. 12, and in profile, Fig. 13. These guides are held by two screws, I I, Fig. 11. Their shanks, which have but one line of thickness, are let into a slot of that size formed in the slide. Below this, and still in the thickness of the slide, a hole is drilled and tapped to receive a pressure-screw *e*, Fig. 11, which abuts against the semicircular part of the guide-bar, and serves to force it more or less towards the dies after the apparatus has acquired too much play from continued use. Between the two guides two brass dies slide truly, K, Fig. 9, the union of which presents a round hole of the same diameter as the stud D, Fig. 1, and which tend to close upon the stud on which they turn in proportion to the pressure of the screws of which we have spoken upon the two guide-bars. The front face of the slide shows a raised circular plate, *b*, Fig. 10, necessitated by the recess which is made on the other side. At the centre of this projection is fixed a steel pin, *e*, of six sides, surmounted by a screwed part, and preceded by a coned base. This pin receives a steel cone, *a*, bored with a six-sided hole, which is fitted the same as in the English ellipse chuck, and is secured in position by the nut *n*. The object of this pin is to carry the movable nose G, Fig. 6, seen in section, Fig. 14, which is pierced in the centre with a conical hole, by which it is fitted upon the pin. It is all the more solidly held because its hinder part embraces the circular projection upon the slide. The diameter of the toothed portion at the base of the movable nose is much larger than that of the English ellipse chuck, which allows an increased number of teeth—a great advantage in operations needing accuracy. This toothed disc is held in position as desired by a spring catch H, Fig. 6, shown in detail in Figs. 15 and 16. These are all the parts of the ellipse chuck, which fit upon the central pin, and we will go on to describe those which fit at the back. The pin is terminated by a screw, preceded by a hexagon on which is mounted a piece of brass, D, Fig. 3, which is secured by a hexagonal nut. This piece terminates in a cone, which enters the end of the hole in the mandrel, to which the same form has been given.

The use of this piece is to render immovable the shaft of the ellipse chuck while leaving the lathe mandrel free to move. It is for this reason that it carries two gudgeons *a a*, Fig. 17, against which abut the ends of the pointed screws *b b*, which traverse the branches of the brass fork, Fig. 17. At the opposite end of the shank of this fork there



is a sliding block of conical form, having about the middle of its length a diameter equal to that of the interval of the lathe-bed in which it is fitted. By means of this block the fork is fixed securely, and can have no shake, which is essential to the perfection of work. Fig. 18 represents all parts of the ellipse chuck reunited and fitted on the end of its shaft. There is seen at *b* the hole by which the key, Fig. 19, is introduced, which serves to give motion to the leading screw which moves the stud, the purpose of which is to give the desired amount of eccentricity. Having described the parts which compose this ellipse chuck, and the mode of arranging them, we will proceed to give a few directions as to their use.

First, let us suppose the work to be of circular form. In this state the stud of the eccentric is concentric, and agrees in line with the nose of the chuck. The slide G is fixed by the pins I I, Fig. 6, and the lathe mandrel is put in motion to prepare the work in the usual manner. Next is to be determined the lengths of the two axes of the ellipse it is desired to execute, and after having found by calculation the degree of eccentricity to be given, the slide is placed horizontally, so that the hole *b* may be in front of the head of the leading screw fixed to the inner case. The pins I I are to be removed, and the key inserted to give the requisite amount of eccentricity. It is easy to judge when this degree has been attained by means of the index attached to the slide and the scale upon the guide-bars. The lathe is then put in motion, and the work is done in the same way as with the other ellipse chucks. The nature of the tools and their position is absolutely identical, but this form of chuck presents several advantages not possessed by the others. The plan of construction enables much greater eccentricity to be given in proportion to the diameter of the plate, and the friction is considerably less. It is, moreover, easy with this chuck to turn elliptical and cylindrical work alternately without being obliged to move the leading screw, and consequently without disarranging the eccentricity. To do this it suffices to withdraw the two screws *b b*, Fig. 17, to replace the slide in its vertical position, and replace the steady screws I I. Then the cam, being no longer immovable, follows the motion of the lathe, and in consequence exercises no effect on the internal parts of the chuck. Lastly, this chuck possesses a peculiarity which renders its use specially advantageous in a large number of cases. At the hinder end of the spindle of the chuck the forked piece D is replaced by a pulley, Fig. 21, and the motion of the mandrel is stopped by screwing down its brass bearings in such a position that the slide is placed vertically. In this state, if motion is given to the spindle by means of a cord placed on the pulley, the slide will, by its motion, describe a right line equal to twice the eccentricity given to the work. If the slide-rest is brought up to a cylinder mounted on the mandrel-nose it is easy by this means to cut a right prism or a pyramid of as many faces, as may be desired, since it is possible, by means of the toothed wheel, to divide the circumference into any number of parts. This advantage will be appreciated when a column has to be turned, and it is desired to cut the square parts of the base and capital, which present great difficulties to hand work, especially in the case of a Doric capital. It has been noted in many places of this chapter how essential it is in turning an ellipse to keep the tools at precisely the same height. In order to insure success a kind of rest has been planned, like Fig. 6, Plate 35. An iron frame works on a hinge at the point *a*. When it is desired to turn lengthwise of the work a wedge, *c*, is made use of, which has the power of being raised or lowered by means of the screw *b*. When it is desired to turn the face of the work the frame is lowered, and the tool lying flat cannot incline either way. It has further been designed to fix the tool upon the rest by means of the hooks, represented in Figs. 7 and 11. The T is placed between the bars of the frame, and as the part *b* is rounded, the shank *c* is turned in the direction of the length of the frame, and bringing this to bear upon the tool, it is fixed solidly and immovably. This method is a good one: it suffices to raise the hook slightly in order to give an imperceptible advance to the tool, and when there is need to cut only on the side it is merely necessary to turn the tool slightly to right or left.

O. J. L.

(*To be continued.*)

THE MOLECULAR WEIGHTS OF THE METALS.

DR. WM. RAMSAY, F.R.S., Professor of Chemistry at University College, London, has recently been engaged upon a new series of determinations of the molecular weights of metals, and at a recent meeting of the Chemical Society at Burlington House he gave a preliminary account of his investigations.

The apparatus employed was of a very simple description; it is capable of being used for the determination of the molecular weights of all substances which can be dissolved in any pure menstruum, and by a very neat device they can be obtained without any knowledge of the vapour-pressures of the solvent being required. Raoult's method of vapour-pressure which is to determine the lowering of the vapour-pressure of any solvent due to the solution in it of a known weight of substance, has been used in order to get the molecular weights.

The formula which expresses the relation between molecular weight and the lowering of vapour-pressure is the following—

$$W = \frac{W' \times P \times p}{100 \times d}$$

in which W' = the molecular weight of the solvent, $\frac{P}{100}$ = the weight per cent of the substance in solution, p = the vapour pressure of the solution, d = the depression in the vapour-pressure of the menstruum produced by the addition to it of the substance dissolved. Dr. Ramsay employed pure mercury as the solvent in his experiments, and they were mostly conducted at the boiling point of this metal. The following are some of the results obtained:—

Element.	Atomic weight.	Molecular weight.		Molecular formula.
		Found.	Calculated.	
Lithium ..	7·02	7·00	7·02	Li_1
Sodium....	23·04	12·10	11·52	$Na_{\frac{1}{2}}$
Potassium .	39·14	28·57	(?)	K_1 (?)
Silver	107·93	109·00	107·93	Ag_1
Gold	197·22	204·30	197·22	Au_1
Barium....	137·00	74·45	68·50	$Ba_{\frac{1}{2}}$
Magnesium	24·30	20·33	24·30	Mg_1
Zinc	65·34	60·85	65·43	Zn_1
Cadmium..	112·10	100·00	112·10	Cd_1
Gallium ..	69·90	68·10	69·90	Ga_1
Thallium ..	204·20	183·50	204·20	Th_1 (?)
Tin	119·10	114·90	119·10	Sn_1
Lead......	206·93	204·10	206·90	Pb_1
Antimony .	120·20	134·20	120·30	Sb_1
Bismuth ..	208·10	209·20	208·10	Bi_1

The molecular formula of mercury was assumed to be Hg_1.

The significance of these results can be shown by considering the case of antimony. The metal, of course, forms an amalgam with the mercury, and the molecular weight increases proportionally to the amount present.

Percentage of Sb in Amalgam.	Molecular Weight.	
	Found.	Calculated.
1·117 per cent.	134·2	120·3
1·526 „	155·4	120·3 to 240·6
2·257 „	193·4	120·3 to 240·6
3·289 „	294·6	240·6 to 481·2

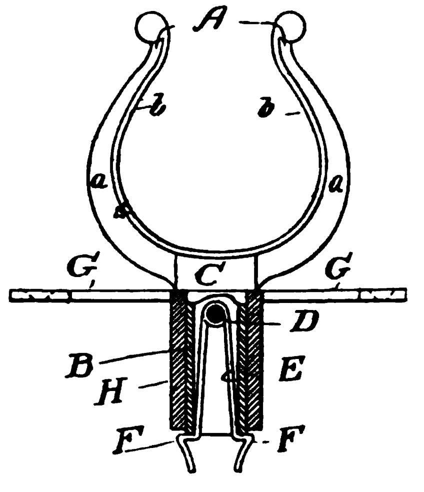
These experimental data seem to point to an *association* of atoms. The numbers in the table seem to do violence to our previously accepted notions of the molecular weights, particularly in the cases of sodium, barium, and potassium, to which Dr. Ramsay's experiments assign numbers that are *half* the *atomic* weights.

The above data are the result of long and careful investigation, and their accuracy is vouched for; but Dr. Ramsay does not at present commit himself to any other positive assertions. The experiments are being continued and confirmed by observations on the depression of the melting point of solvents containing the given substance in solution.

Dr. Ramsay will shortly lay before the Chemical Society a complete account of his work with a detailed exposition of the conclusions he draws from his results. At present these results appear in some cases simply startling, and seem to be almost revolutionary.

AN IMPROVED OAR-LOCK.

WHAT is called an improved "oar-lock," or rowlock, has been recently patented in this country by W. R. Briggs and F. C. Lyon, of Bridgeport, Conn., their invention relating mainly to the method of securing the "lock" within its bearings. The illustration shows a sectional elevation of the improved oar-lock, and the means for securing the same within its bearing. Heretofore, the usual way of securing oar-locks was by chain or cord, but this was disadvantageous in that the chain or cord was liable to kink, besides consuming much time and causing considerable annoyance in applying and removing the oar-lock; also the thole-pin has been split and enlarged at the end so as to afford a spring-pin adapted to lock within the socket; but this latter construction causes so much friction against the socket as to seriously interfere with the free swivel movement of the pin in rowing. These disadvantages the patentees obviate as follows:—A is the oar-lock proper which they prefer to cast with the rib and bead, *a b*, respectively, thus combining strength and lightness. B is the thole-pin, which may be cast integral with the lock proper, or formed of a separate piece and secured thereto by being set within a suitable hole bored in the body C. This pin is hollow, as clearly shown, thus further decreasing the weight of the completed oar-lock. D is a pin passing through the thole, and E is a spring wire coiled about the pin in such a manner that its free ends extend down and without the thole, and terminates in shoulders or catches, F, for the purpose presently explained. G is the usual escutcheon adapted to be secured to the gunwale of a boat, and is provided with the socket H, into which fits the thole-pin. As seen, the catches F in their distended position project beyond the thole and beneath the end of the socket, thus forming an obstruction to the withdrawal of the thole. Instead of forming the thole-pin of tubing, it may consist of an ordinary shank slotted to receive the catch-spring. From the foregoing it will be obvious that to secure the improved oar-lock within its socket it is only necessary to place the ends of the wire E in the socket and exert sufficient pressure to force the catches towards each other, when the thole will readily pass within the socket, and the ends of the spring will distend beyond the thole and immediately beneath the socket, thus securely locking the thole against accidental displacement.



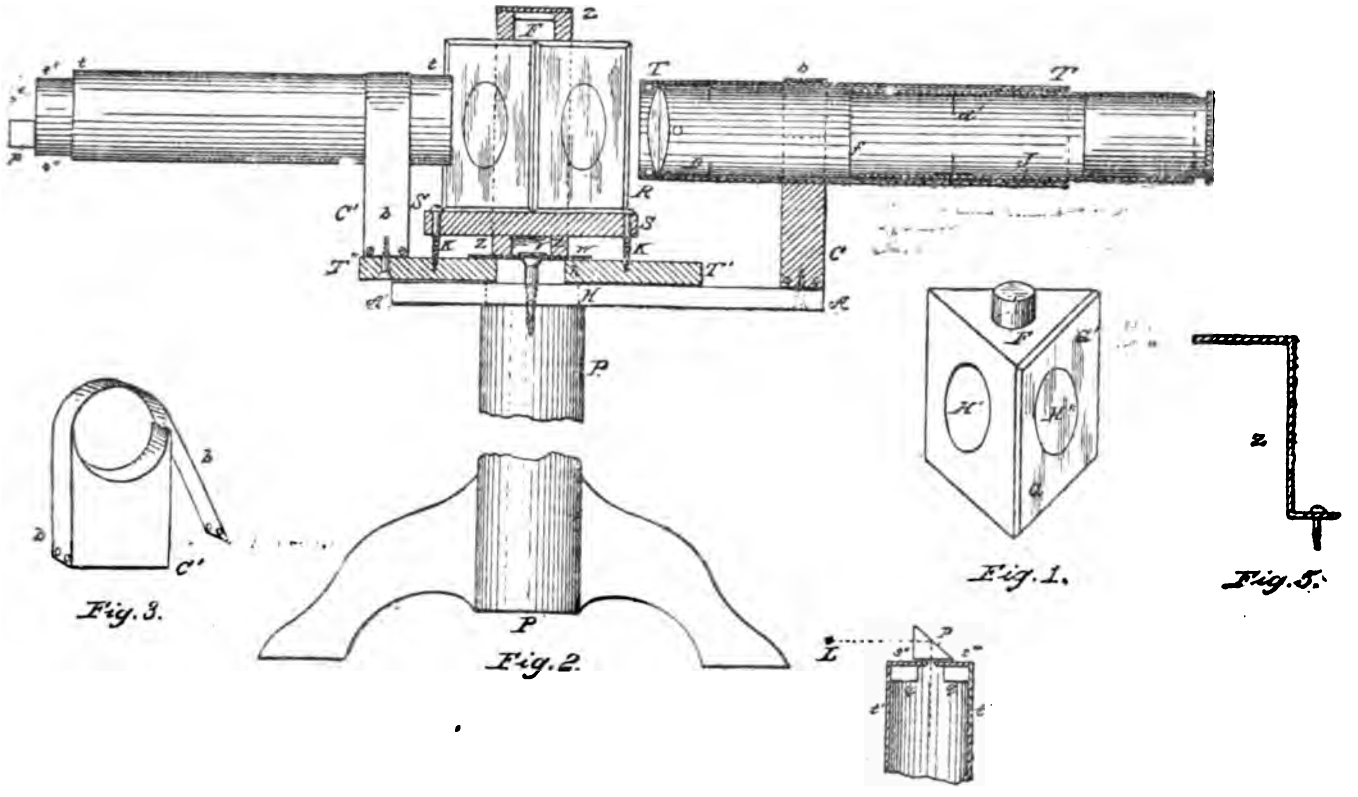


Fig. 3.

Fig. 2.

Fig. 1.

Fig. 5.

Fig. 4.

To remove the oar-lock from its socket the catches are compressed by hand sufficient to clear the end of the socket, and the thole-pin withdrawn. While this improvement is applicable to any class of boat, it is especially adapted for use in connection with folding boats, out-riggers, and the like, where lightness and convenience of manipulation are especially desired.

WATERPROOF ROOFING MATERIALS.

AMONGST waterproof materials for roofing purposes we have preparations in which cellulose is treated with cuprammonium or paraffin wax, and any coarse fibre is coated with tar; but Mr. Meyer, of Ostritz, Germany, has obtained a patent in this country in which the "chemical" treatment is supplemented by what may be called the tar dressing. His improved waterproof covering is made as follows: Woven fabric of jute, flax, or other spun material is impregnated with a solution which renders it sufficiently incombustible. This solution consists of one part of tungstate of soda, ten parts of sulphate of ammonia, and one hundred parts of water. After the material has remained in this solution until it is properly saturated, the moisture is squeezed out and it is hung up to dry, and is then submitted to an asphalting process in the following manner. For this purpose the material is passed through a heated iron vessel containing a mixture of Trinidad asphalt, tar, oil, and sulphur in about the following proportions—that is to say, about 100 kilogrammes of asphalt, 40 kilogrammes of tar, 1 kilogramme of oil, and about 300 grammes of sulphur. After the asphalted fabric is removed from the vessel it is passed through a double or fork-shaped frame, consisting of two iron tubes about 1in. diameter, heated by steam or hot water. This frame is movable round its longer axis, and by its means the surplus asphalt mixture is removed from both sides of the fabric and the surface left smooth. The still warm and soft fabric is then sanded on both sides, and is then, whilst in a half-hardened state, passed between two iron pressure rollers, by which the sand is pressed in and fixed. The material has then become so cold that it can be cut up into pieces of any desired length and breadth in the way usual, or left uncut.

THE South Australian Government have made an arrangement by which an engine-driver who runs his trains for two years without accident will receive a bonus of £10.

A SPECTROSCOPE WITH FLUID PRISM.*

SOME who have constructed and experimented with the small spectroscope described in Vol. XLVIII. p. 327, No. 1,239, may desire to possess an instrument of greater efficiency as regards both dispersive and defining powers, but yet may be unwilling to have recourse to the optician for a dense fluid prism and set of achromatic lenses, and, further, may not have mechanical facilities for constructing the rather elaborate table spectroscope, details of which appeared in No. 1,220. For the benefit of such, a very excellent form of instrument will be described, which can be made from materials of the most inexpensive character, by the aid of the simplest tools and at the cost of but little time; and yet is capable of giving an angular dispersion greater than that under ordinary circumstances attainable by the use of almost any single dense fluid prism, and good definition throughout the entire length of the visible spectrum.

This spectroscope is provided with a *fluid* prism, i.e., a vessel of prismatic form with glass sides, so made as to contain a liquid of very high refractive index—by preference for many reasons carbon disulphide being the fluid selected.

Since, in the ordinary use of the prism for experiments in refraction and dispersion, but two faces are employed, it will suffice that two sides of our spectroscope prism shall possess the quality of transparency. A small vessel of tin plate having the form represented in Fig. 1 is, therefore, to be made or ordered of a tin-worker; its triangular surfaces are of equilateral form, and its rectangular ones square; 2in. on the sides will be a very convenient dimension. Care should chiefly be observed to have the lines bounding the square faces *strictly parallel*, as here a very slight deviation from accuracy will tend to cause distortion of the spectrum. Two of the square faces are perforated with circular apertures of 1in. diameter, as shown at H' H'', the other face remaining unapertured. One of the triangular sides must also have a ¼in. hole, round the outside of which is soldered, as a neck, a ½in. length of tin or brass tubing F, with ¼in. internal aperture destined to be stopped by a cork. The tin vessel thus prepared should be cleaned from every trace of grease, resin, and soldering flux, by washing with a dilute solution of caustic potash and rinsing with clean rain-water. When dried it is to be dead-blacked *on the inside only* by means of a thin solution of glue in ink, applied warm through the side apertures by the aid of a camel's-hair pencil or a little swab of cotton batting tied on a wire.

The transparent sides, one of which is represented *in situ* at G G' may be cut from almost any refuse bit of good mirror plate glass, which, however, should not greatly exceed $\frac{3}{16}$in. in thickness. The dimensions of these little glass squares will, of course, conform to the sides of the tin vessel. The rough cut or cleavage caused by the diamond should be removed by holding the edges upon a well-wetted and slowly-revolving grindstone, or by a file supplied with spirit of turpentine having camphor in solution; if bevels are produced, a better appearance results. After being cleaned from greasiness by rinsing in the caustic-potash solution, followed by rinsing with clear rain-water, the sides are ready for attachment one over each of the apertures H' H'' of the tin form, which is thus converted into a veritable hollow prism. The medium for thus cementing them is acetic glue, and as this must be carefully made to secure the best result, simple directions for its preparation are given:—A small quantity of fine white glue should be placed in a china cup and steeped in water just sufficient to cover it; when the water is absorbed, a moderate heat is applied till the mass becomes fluid, on which enough strong acetic acid is added to reduce the mixture to the consistency of thick cream, a drop or two of glycerine being also stirred in. This glue is applied in a fairly thick coating over one side of the tin vessel, previously made hot to promote adhesion; one of the glass sides, also previously heated, is now dexterously applied thereon, so as to avoid the squeezing out of any glue upon the circle of clear glass covering the central aperture. It is then advisable to place the prism, glass side downward, upon a smooth cloth-covered surface, and press it under a moderate weight for forty-eight hours, by which time the glue will have sufficiently hardened to permit of the second side being secured by a repetition of the same operation. Of course, both sides may, if preferred, be fixed on at once; but as an intermediate heating of the tin is necessary, there is some danger of displacing one glass while attaching the other. After the lapse of a few days the prism may be filled with the best carbon disulphide, and the neck F closed with a sound cork pushed in level with the top of the tube and coated with acetic glue. A small air-space should be left to allow for expansion. Proper care having been exercised in the cementing, scarcely a trace of evaporation will be perceptible, even after long periods of time. The prism should lastly be enveloped in dead black paper, wherein circular apertures have been cut to correspond with H' H'', and just a shade smaller than these.

The stand best adapted for a prism of this kind appears, partly in section, at Fig. 2. Its circular table T' T'', 4in. in diameter, is cut by the aid of a compass saw from a piece of dry ½in. pine, the edge being neatly dressed with a fine rasp, followed by sand-paper. The pillar P P' is a round piece of pine 1¼in. in diameter, 5in. long, and provided at the upper extremity with two shoulders as shown. It enters a hole, *h*, in the centre of the round top T' T'', which rests upon the smallest shoulder, and is secured thereto by the small washer W, of thin sheet brass, through which a wood-screw passes into the axis of the pillar. The larger shoulder forms a bearing for the movable arm or support, A A', of the view telescope. This arm is a strip of ¼in. pine 1¼in. wide and 5in. long. It is provided with a hole, H, the centre of which is 1½in. from the extremity A', and made of a diameter to fit upon the pillar above the larger shoulder with some degree of friction, so as just to move stiffly about it. The view telescope body T T is constructed from a 5in. length of thin brass tube having an internal diameter of 1in.; it should be dead-blacked inside. The objective O, which need not essentially be achromatic, is a convex lens of about 5in. focus, ground to fit accurately into the body tube and secured therein between a band of thick card, D D, glued in the position shown, and a ring of thin spring brass wire, R R, slipped in upon it from the front. The draw or focussing tube *f* is a 3½in. length of tube like that used for the body, but small enough to slip into the latter with freedom, the joint or slide J being a strip of black broadcloth secured in place with acetic glue. Diaphragms of black card should be fixed to the back of the band D, and in the centre of the focussing tube, as shown at *d d'*, the central apertures of these being just large enough to admit the cone of rays from the objective. A very low-power ocular of the positive form is to be employed with this telescope.

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* By A. F. Miller, in the *Scientific American Supplement.*

The collimator tube *t t* must be about ½in. shorter than the focus of the lens adapted to it; in all other respects its arrangement with regard to draw tube, diaphragms, and lens fittings is identical with that prescribed in the case of the view telescope. It may here be stated that, if cheapness be an important consideration, spectacle glasses of equivalent focus may be substituted in both tubes for the more expensive lenses an optician would propose to supply; this concession does not, however, convey an unqualified advantage, since definition will not be quite so good with the cheap lenses as with the better ones. Indeed, it must be admitted that an achromatic objective for the view telescope is most desirable. A cemented combination from an opera-glass or small pocket telescope may often be had at a very moderate price from the repairers of such instruments, and, if substituted for the simple lens, will be found to greatly improve the seeing.

The telescope and collimator are carried in small supports, *c c'*, one of which is also shown in perspective at Fig. 3. These are constructed from short pieces of ¾in. pine the width of the body tubes, and have a semicircular niche fitting to the same cut out at one end. In these niches the bodies are held by bands of thin sheet brass, lapped round them, and secured by two small screws at each end fixed in the wooden part. In Fig. 3 a band of this sort, *b b*, is represented attached at one end by its screws, and free at the other extremity, ready to admit the tube round which it is to be clamped. The carrier C', for the collimator tube, should be 1¼in. high to the bottom of the concave. To allow for the thickness of T' T", that for the view telescope must be ¼in. higher. This latter is secured to the extremity of the arm A by a small wood-screw, as figured, while the collimator support is similarly fixed close to the edge of the table T".

A small circular stage, *s s'*, of ¼in. pine, 2½in. in diameter, cut out with the compass saw and dressed smooth on the edge with sand-paper, supports the prism. It is held in place and its level adjusted by three slender wood-screws with half-round heads, two of which are seen at K K' entering the table T' T". Between the stage *s s'* and the table T' T" (which are, of course, placed concentric) we insert a section of a small soft cork, V, which by its elasticity keeps the stage quite firm, while readily admitting of necessary adjustments by means of the three stage screws.

A holder, Z, of ⅛in. sheet brass, ½in. wide, formed as shown in Fig. 5, will be necessary to keep the prism steady upon the stage. It will require to stand 3in. high, and the extremities bent at right angles in opposite directions will measure 1½in. and ½in. respectively. This holder is fixed to the table by a round-headed wood-screw passing through a hole in the lower bent extremity, the other being turned so as to press upon the cork stopper in the neck of the prism.

Plain directions for making simple slits appeared in No. 1,239, and will therefore not be repeated here. The non-adjustable form there described will fully answer every purpose for the present instrument; but two or three slits of different widths had better be prepared to suit various classes of experiments. It is quite possible to arrange over half the length of one of these slits what is termed a *prism of comparison*—a most useful adjunct, as it permits of two spectra being simultaneously shown in the field of view, one appearing above the other, whereby the coincidence of lines or bands is readily observed. In this case, such a comparison prism is made from a short piece cut from the smallest size of gasalier crystal drops; choice should be made of one having an angle of 90° or nearly that. A piece ½in. long, having been broken off by the aid of a file-scratch or diamond-cut on each face, the surfaces of cleavage are ground as truly flat as possible. The small prism thus formed is then secured upon the outside of the slit by acetic glue in the position shown at Fig. 4, where *p* is the swell prism, *s' s"* the brass slit jaws, affixed to their cork backing *q q*, and *t' t"* the collimator draw tube. It will now be apparent that any luminous source placed in the direction L will send its rays into the slit by total reflection at the inclined internal surface of the glass, as indicated by the dotted line. This prism should occupy the lower half of the slit as at *p*, Fig. 2, the upper half being left clear to receive the rays from a source of light placed directly in front. Good definition at the juncture of the two spectra juxtaposed in this way will depend on the care exercised in truly flattening and fine-grinding the upper triangular surface of the comparison prism.

As a support a tripod of the style depicted will be found steady, and it looks well. Of course, a simple round wooden ball will answer the purpose. The finish of the instrument must depend on the taste of the maker. The table top and prism stage should be dull black, the pillar and foot may be stained and varnished to imitate mahogany, the brass tubes and bands should preferably be polished and lacquered, and the heads of the small screws blued in a spirit-lamp flame.

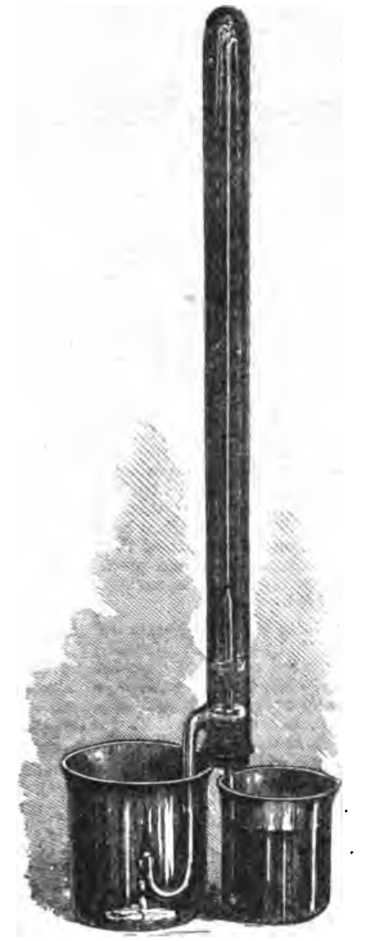
The assembling of the various parts and their adjustment will be apparent to anyone at all familiar with the theory of the spectroscope; or otherwise, reference should be made to the instructions in No. 1,220. The view telescope and collimator tube have, for the sake of clearness, been represented as though directed in the same line. Of course, by moving the former round the pillar they will be placed at the proper angle to one another, and to the faces of the prism. A black cloth should be employed to keep out stray light when the spectroscope is to be employed in sunshine or a brightly-lighted apartment.

WORKING STEEL BY HYDRAULIC PRESSURE.

At a meeting of the Institution of Civil Engineers held recently, Mr. W. H. Greenwood read an interesting paper on the "Treatment of Steel by Hydraulic Pressure," a subject which has attracted much attention of late. The author assumed that molten Bessemer, open-hearth, or crucible steel, possessed the quality of occluding a considerable volume of gases, especially of hydrogen and nitrogen, derived, all or in part, from the products of combustion in the furnace, or from other sources; and that, under ordinary conditions as to pressure, such occluded gases were, more or less, completely evolved at the moment when the particles of metal changed from the liquid to the solid state, and were thus imprisoned within the ingot in the form of bubbles of various forms and dimensions. A second source of unsoundness arose from the contraction of the metal within the ingot after its outer skin had solidified, producing contraction cavities; and, lastly, the metal from ingots as usually cast was weak along the surface, owing to the development of a radial acicular structure in the cast metal. The combined effect of these three causes was that ingots of mild steel, such as were used in the construction of ordnance, large engine-shafts, or other heavy forgings, for cylinder-liners, torpedoes, and war material, contained cavities necessitating the rejection of about 30 per cent. from the head or top end of each ingot; while, to get rid of the surface honeycombs and weak acicular structure, which caused unclean, seamy, and roaky forgings, an additional 10 per cent. to 20 per cent. of metal had to be left for turning and machining to waste. Even after these losses of material, the remaining metal was inferior to the same metal after fluid compression. The method of fluid compression claimed, then, to save the whole of the rejected head or top of the ingot, to reduce to a minimum the amount of metal to be left for turning or machining from the surface of forgings, and to produce for any temper of metal a greater amount of ductility, homogeneity, and reliability than was obtainable under the best conditions of casting in open moulds without pressure. The additions or increased proportions of manganese and of silicon did not commend themselves to the author for the classes of steel under consideration; for, although promoting solidity of the ingot, they hardened, raised the elastic limit and ultimate tensile strength, but lowered the ductility and general reliability of the metal. Of the mechanical devices for increasing the solidity of steel ingots, the author noted the proposals for the cooling of the outside of the moulds, for agitating the metal during soildification, casting the metal in a vacuum, and the direct application of pressure, by the use of high-pressure steam, injection of water, of explosives, of solid carbon dioxide, &c., upon the surface of the fluid steel in closed moulds. These methods of fluid compression had all failed from mechanical, physical, and practical difficulties in their conduct; and the plan suggested by Sir Henry Bessemer in 1856, but quite independently developed and carried to a successful issue at the works of Sir Joseph Whitworth and Co., and now known as the method for the fluid compression of steel, remained the only one before the public which yielded ingots of mild steel of practically uniform molecular structure, strength, and ductility throughout their whole length. The ordinary cast-iron moulds, or wrought-iron casings, lined with brick or moulding cement, could not be used when aggregate pressures of thousands of tons were to be exerted upon the surface of the fluid metal; but such moulds were replaced, in the fluid-compression process, by built-up steel moulds, lined with suitably-grooved cast-iron lags, protected by a coating of refractory siliceous material. A loose plate of the diameter of the ingot fitted in the bottom of the mould, and was protected by an upper covering of burnt fireclay segments, and a similar plate was carried upon the top plunger of the press for closing the top of the mould. The paper traced the development of the hydraulic press for the fluid compression of steel, commencing with the erection, in 1866, in the works of Sir Joseph Whitworth and Co., of a 250-ton press, with a 12in. cylinder, designed more especially for the compression of the metal for steel shells. In this the mould, which was partially filled with metal, was carried in a middle head of the press, whereupon a core, carried upon the top head of the press, was forced into the fluid metal, at the same time closing the mouth of the mould. After this the pressure was applied from below, as in all the subsequent presses. Following this came a much more useful 2,000-ton press, with two columns, and a 30in. hydraulic cylinder. Its columns were secured by nuts to the base or foundation, and upon the upper ends of the columns was carried a fixed head, upon which rested a vertical hydraulic cylinder, whose piston-rod was connected to the intermediate or movable head. The intermediate head could thus be raised to any point, and then locked, so as to resist the application of pressure from below. The locking arrangement consisted of a pair of nuts, each made in halves, and so disposed that, by the movement of a lever and a system of links, the halves of the nuts could be either brought together or separated. When separated, the head was free to move, but, when closed, the nuts embraced the columns and fitted into a series of parallel, slightly undercut, V grooves, which were cut as a thread along the upper halves of the length of the columns. In this manner the head was locked or secured against vertical movement under the action of the bottom or pressing-cylinder. The metal was cast in the steel mould already described, and the further movements and action of this press were similar to those of the larger Abouchoff press below referred to. The next press, also erected at Manchester, had four steel columns, 12in. in diameter, and was fitted with five pressing-cylinders—namely, four of 28in. diameter, and one of 13in. diameter, capable of producing, together, a pressure of 8,000 tons. Except for the locking arrangement, which was complicated, but more nearly automatic than that last described, the principle was the same as in the last. Its columns were, however, screwed with a square screw-thread, and the locking nuts were not split, but could be made to revolve automatically as the head was raised or lowered. The five pressing-cylinders were placed on the base of the press, with the small one in the centre. The cylinder for lifting and lowering the movable head was carried upon the upper fixed head or table of the press, while the locking of the movable head at any desired height, according to the length of ingot under operation, was effected by four locking-nuts, which could be revolved either just clear of the head, or into firm contact with the same. In the latter case the head was locked fast to the columns, and was immovable under the full pressure of the press acting from below; and, in the former condition, the head could be freely lifted to any desired point. This 8,000-ton press was placed second by the author's erection, in Russia, of the press upon the lines of the Whitworth patent of 1874. This press had four screwed columns of 16in. diameter, and one hydraulic pressing-cylinder of 50in. diameter, capable of exerting a gross pressure of 10,000 tons. For working the press, an accumulator, giving a pressure of two tons to the square inch, was employed, to effect the rapid movements of the head of the press, of the lifts, cranes, &c., during the manipulation and transference of the fluid metal from the furnaces to the mould, and of the mould under the press. The mould having been prepared, dried, and warmed, was placed in position on the lift in front of the press, the ladle with the metal was run over it, and the metal tapped into the mould. The ladle was then quickly run back from the face of the press, and the mould with its charge was raised until the platform rested on its top stops. A horizontal hydraulic ram then transferred the mould on its carriage beneath the press, after which the ram was withdrawn and all workmen retired. The moving head then descended until the top plunger came fairly into contact with the fluid metal. The head, weighing 50 tons, would continue to descend for a few seconds, after which it was locked in position and the compression completed by admitting the water direct from the pumps to the large pressing-cylinder. During the first few minutes the ingot shortened rapidly, and a considerable volume of gases escaped and burned from the vents around the top and bottom of the mould. The pressing was continued as long as there was any perceptible shortening. The maximum pressures attained ranged from 4 to 12 tons per square inch on the metal, and were maintained for from forty-five minutes to three or four hours, according to the size of ingot and the condition of the metal. The contraction in length during the application of the pressure usually amounted to about 1⅛in. to the foot of length. The author then referred to the former practice of casting hollow forms under the press, which, owing to various enumerated difficulties, had been abandoned in favour of the solid ingot both in England and in Russia. In the manufacture of trunnions for 6in. B.-L. guns from unpressed ingots, the practice was to take an ingot of 65cwt., reject one-third from the top end, and then to make three trunnions from the remainder of the ingot, after which not unfrequently one of the forgings was rejected for unsoundness. When pressed ingots were taken, however, five trunnions were made from the same ingot, and a rejected forging for faulty metal was unknown. The density of a fluid-compressed ingot as a whole was from 8 per cent. to 12 per cent. higher than an unpressed ingot. The author's experiments upon sound samples of crucible steel containing 0·54 per cent. of carbon gave a specific gravity of 7·8542 for the unpressed metal, as against a mean of 7·8795 for specimens of the same metal after fluid compression. In order to compare the behaviour of the pressed with the unpressed metal, made from similar materials, and in the same manner, the two ingots of eight tons each were cast of open-hearth steel. The unpressed ingot contained carbon, 0·5 per cent., and manganese, 0·35 per cent.; it was 30·75in. in diameter, and 82in. long. The second was a similar ingot, but containing carbon, 0·39 per cent., and manganese, 0·4 per cent.; it measured 70·5in. in length after fluid compression, or 79in. as cast; it was 34·25in. in diameter. A slab of 4·75in. in thickness, and of the full length and width of the ingot, was obtained from the centre of each by parting each ingot longitudinally into three pieces on the planing machine. The surfaces so obtained presented much unsoundness in the unpressed ingot, while the pressed ingot was quite sound on both faces. The central slab from the pressed ingot was cut up into seven series of test-pieces, in such manner that ninety-eight test-pieces were prepared from it, but only five series, or seventy test-pieces, were obtainable from the unpressed ingot. The centre-test of each series was taken directly along the axis of the ingot, and test-pieces in each series were cut directly across the axis of the ingot; these were intentionally taken from the very worst part of the compressed ingot. Notwithstanding this, and that the mean results were taken over the whole length of the pressed ingot, as against the best or lower two-thirds of the unpressed ingot, and also that the test-pieces from the pressed ingot were taken over the full diameter of the ingot, while the samples from the unpressed ingot were taken only over 24in. of the diameter, the outer and unsound 3¼in. at each end of the diameter being rejected—after these and other advantageous conditions were allowed, yet the mean results from the pressed ingot over its whole volume were superior in each detail to those from the five series of tests from the unpressed ingot, and especially in the contraction of area and elongation before fracture. The results, as derived from the test-pieces cut transversely, compared equally favourably. The test-pieces were cylindrical, with collars, and the metal was not subjected to any hammering, annealing, hardening, or other treatment, except machining, after it came from the ingots. The pressed ingot gave its highest breaking-strength in the upper sections, while the unpressed ingot, on the contrary, was at its best towards the bottom, and showed a rapid falling-away at points exceeding one-half of the length of the ingot from the lower end; and, while the elongation amounted to 12·4 per cent. in the lowermost of the tests from the unpressed ingot, it fell rapidly away towards the upper part, so that in the fifth series the mean elongation was only 2·02 per cent. The pressed ingot, on the other hand, gave a mean elongation at the lowest point of 13·7 per cent., decreasing somewhat in the succeeding series; but, still, at the very top of the ingot, the elongation was represented by 11·63 per cent. The figures further indicated that, in the unpressed (where sound) and also in the fluid-compressed ingots, the mean value of the elastic limit, as also of the ultimate breaking-strength of the material, was slightly greater in the metal towards the outer boundary of the ingot, and tended to decrease towards the centre. In the sound portion of the unpressed ingot the mean figure for ductility was much the same, 8 per cent. at all radial distances; but, with the compressed ingot, there was a decided superiority in this respect as the outer boundary was approached, the figures being 8 per cent. at the centre and 17·61 per cent. at the circumference; but the centre approached the high figure of the outer circumference exactly as the pressure applied had been of higher intensity and more effectively applied. The author inferred, from the figures adduced, that under mechanical tests the metal from the top, or any other vertical section, of a pressed ingot was, at least, equal to the unpressed ingot after one-third or upwards of such ingot had been cut off or rejected; that the weakest part of the pressed ingot was along the axis, where the pressure had been least effective; but that this weakness, as compared with the outer layers, arose from insufficient pressure, and could be localised; so that, for hollow shafts, tubes, hoops, cylinders, and the like, where the centre was finally removed, either by boring or punching out, it was unnecessary to proceed to the higher pressures, required to insure absolute solidity and uniformity over all parts of any section. With unpressed ingots, on the other hand, the unsoundness was irregularly distributed, and not capable of such localisation, even in the lower end of the ingot.

MERCURIAL JET SIPHON.*

THE ordinary jet siphon, reproducing to a certain extent the experiment of the fountain *in vacuo*, is one of more than ordinary interest. A descending column of water, acting as one member of a siphon, is caused to rarefy the air contained in a cylindrical vessel. At the same time water admitted through a jet in the base of the vessel forms a fountain. The descending column may be quite long, and there is no difficulty in producing a fountain two or three feet high, provided the vessel is large enough. This factor of height of fountain depends upon the length of the descending column, and is greater or less as the latter is longer or shorter. The water can never rise in the fountain to a height equal to the length of the actuating column, on account of friction.

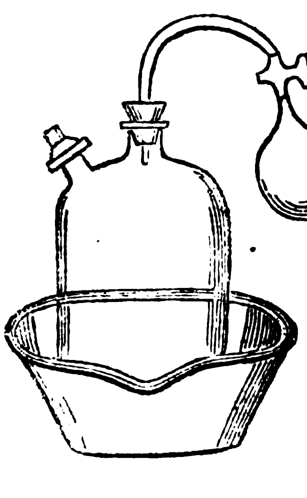


In the cut accompanying this article a very pleasing variation upon this experiment is shown. The descending and actuating column of fluid is composed of mercury. As this fluid is about thirteen times as heavy as water, a 2in. column is more efficient than a 2ft. column of water. The general construction of the apparatus hardly needs description. The main tube may be ½in. or ¾in. in internal diameter and 15in. high. At its upper end it is sealed. Its lower end is provided with a perforated indiarubber cork. Through the aperture in the cork a small tube about 6in. long is passed. At its upper end this tube is drawn out to a fine jet, great care being taken to have it true and symmetrical, so as to deliver a straight jet of water. Sealed into the side of the large tube is an outlet tube, carried downward as shown. The end of this is bent upward, or, what is better, it is left straight, and a U-shaped piece is attached to it by a piece of indiarubber tubing. The last construction is the less fragile of the two.

To use it, the indiarubber cork is removed and the tube is inverted, and mercury is poured in to a depth of two or three inches. The cork, with its jet tube, is then replaced, and the finger is held firmly over its open end. The whole is then quickly inverted so that the end of the U-shaped discharge tube is simultaneously brought into or over a beaker or other vessel. Most of the mercury runs out, the bent tube preventing the access of air. Then the end of the jet tube, which hitherto has been kept closed with the finger, is placed under water contained in a second vessel, and the finger is removed. At once, under the influence of atmospheric pressure, the water enters the partially exhausted tube, and rises to its top, forming a fountain. The rest of the mercury gradually escapes, but the jet, if small enough, may last for several minutes. The interesting feature is involved in the action of a column of liquid but a few inches long producing a jet over a foot in height.

A SELECT METHOD OF PREPARING NITROGEN.*

THE formation of nitrogen gas when required as an agent, either for the lecture-table or when in larger quantities for research, always presents more or less difficulty as regards its preparation; one process, still recorded in the various handbooks of science, being the action of nitric acid on raw meat. This method may, however, without doubt be regarded as nothing more than an alchemical memoir, since it would be evidently difficult to state or enumerate the complicated mixture of other gases which, becoming evolved at the same time, would naturally contaminate the product. The action of potassium nitrate when heated in a suitable apparatus in admixture with ammonium chloride produces, when prepared cautiously, a moderately pure gas; but owing to the inconstancy of the reaction the same is rendered considerably tedious and unprofitable. As a third instance, the reaction that phosphorus affords when burnt in a limited supply of air, as, for instance, when confined by the aid of a bell jar and in direct contact with water, at once presents an elegant, and, at the same time, uncostly method of preparing a very pure gas, and direct from the atmosphere. This, although a favourite method of most demonstrators and others when experimenting with, or illustrating the component parts of the atmosphere, yet at the same time few, if any, seem to have adopted a plan to recover, or more correctly to collect, the so prepared gas, which by a slight alteration in the form of apparatus to that generally employed may be procured in any desired quantity.



The accompanying figure, which is intended to illustrate the apparatus required, consists mainly of a doubly tubulated gas-receiver or bell jar connected either with a bladder provided with a suitable stop-cock, or, if required in larger quantities, to an ordinary gas-holder, the outer vessel containing a sufficiency of water to allow of the gas jar at the termination of the action to be immersed to the required height. In using the apparatus all that is necessary is to apply a hot wire to the pieces of phosphorus contained in a small brass dish, the same being allowed to float upon the surface of the water. This is most readily accomplished by withdrawing the stopper from the side tubule, inserting a hot wire in order to start the combustion of the phosphorus, and replacing the stopper. The apparatus and its contents, after the combustion of the phosphorus has terminated, is allowed to remain a few moments in contact with the water in order to allow the fumes of phosphoric pentoxide occasioned by the combustion of the phosphorus to unite with the water. The stop-cock, in connection with the receiver intended for the reception of the gas, is now opened, the weight of the bell jar exerting a pressure sufficient to allow of its contents to be discharged into the receiver. The tap in connection with the receiver is next closed; the stopper from the side tubule again withdrawn, thus allowing, on raising the apparatus to the surface of the water, to admit of a fresh supply of air, which may be proceeded with as before. By this method, operating with a jar capable of retaining one cubic foot of atmosphere, a gas-holder able to contain six cubic feet of nitrogen may be filled in less than an hour.

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* By T. O'CONOR SLOANE, Ph.D., in the *Scientific American*.

* By H. N. WARREN, in the *Chemical News*.

USEFUL AND SCIENTIFIC NOTES.

The New Darning Weaver. — Messrs. Edwards and Barnes, of Broad-street, Birmingham, are introducing a handy little article called the "Patent Darning Weaver," which will be appreciated in every home by every woman. There will be no excuse in future for the unsightly, untidy darns which are all most women are able to accomplish, and then only at a painful weekly sacrifice of time and temper. With the aid of the "darning weaver" pieces are literally woven on to the stocking or other article, becoming, in fact, part of it, and as durable and as neat-looking as itself. Soldiers and sailors will hail the new invention, and bachelors will henceforth be quite independent of their washerwomen and landladies. The makers, by the way, are arranging a grand series of cash prizes to be competed for by users of the weaver. Specimens of work have to be sent in by July 1, and all further particulars may be had on application to them.

The Pilatus Railway.—One of the most noteworth feats of modern mountain-engineering is the cogwheel railway from Alpnach-Stad to Pilatus-Kulm—6;724ft. above the level of the sea—in Switzerland. The road has been constructed by Messrs. Locher and Co., and Mr. E. Guyer-Freuler, of Zurich, under the personal supervision of Colonel Locher, the engineer and inventor of the system. The roadbed is of solid masonry throughout, faced with granite blocks. Streams, gorges, &c., were traversed by means of stone bridges. There are seven tunnels of 30ft. to 300ft. length. The track is entirely of iron and steel, firmly fastened to the masonry of the roadbed. The rack-rail, midway between and somewhat higher than the tracks, is of wrought steel, and has a double row of vertical cogs, milled out of solid steel bars. The locomotive and car, containing 32 seats, form one vehicle—train—with two ordinary axles and four cogwheels gearing into the cogs, and which, on the downward trips, can be controlled by automatic brakes. The locomotives were constructed by the Swiss Locomotive and Machine Factory, Winterthur. The speed of the locomotive is about 37 miles per hour. The views from the window of the car during the ascent are very grand, wild mountain scenery constantly changing with varied and rare Alpine flora. Close to the station on the top of the mountain is the Pilatus-Kulm Hotel, a new and massive building, in a sheltered position. All rooms here have a southern aspect, and afford superb views of the mountains and glaciers of the Alps. The old hotel Bellevue will be used as an annexe to the new hotel. The Pilatus Railway will be opened on June 15th, the beginning of the season; its starting point, Alpnach-Stad, is connected with Zurich, Lucerne, and Interlaken, by the B. and N. E. Railways, while the steamers on the Vierwaldstätter lake, connect it with all points on the beautiful lake, and the Riga and St. Gothard Railways, thus bringing the Pilatus tour within easy access for tourists travelling through Switzerland.

Manganese ore has been discovered in large quantities, and of splendid quality, near Dunedin, from which a valuable export trade is expected to result. A sample was sent to London, and a cable message has been received, placing a value on it that leaves a large margin for profit. The quantity of this ore exported from New Zealand up to 1885 amounted to 12,000 tons, valued at £43,000; but of late years the shipments have fallen off largely. It came chiefly from the Bay of Islands, and was not, a contemporary says, nearly so pure as the present discovery, which assays 80 to 99 per cent. of pure peroxide.

A process for electric deposition on glass or porcelain is ascribed to M. Hansen, and the medium used is a solution of chloride of gold, or of platinum in sulphuric ether, which has received a sufficient quantity of sulphur dissolved in a heavy oil, to bring the whole, after being gently boiled, to a consistency which permits it to be painted on the glass, &c., with a brush. The plate is then slowly heated in a furnace until the sulphur and chlorine are driven off, leaving the gold or platinum adhering to the surface.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this society was held on Wednesday evening, the 15th inst., at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., president, in the chair.

Mr. T. H. Hall was elected a Fellow of the Society.

The following papers were read:

(1) "Account of Some Experiments Made to Investigate the Connection between the Pressure and Velocity of the Wind," by Mr. W. H. Dines, B.A., F.R.Met.Soc. These experiments were made for the purpose of determining the relation between the velocity of the wind and the pressure it exerts upon obstacles of various kinds exposed to it. The pressure plates were placed at the end of the long arm of a whirling machine, which was rotated by steam power. The author gives the results of experiments with about 25 different kinds of pressure plates. The pressure upon a plane area of fairly compact form is about 1½lb. per square foot at a velocity of 21 miles per hour; or, in other words, a pressure of 1lb. per square foot is caused by a wind of a little more than 17 miles per hour. The pressure upon the same area is increased by increasing the perimeter. The pressure upon a ½ft. plate is proportionally less than that upon a plate either half or double its size. The pressure upon any surface is but slightly altered by a cone or rim projecting at the back, a cone seeming to cause a slight increase, but a rim having apparently no effect.

(2) "On an Improved Method of Preparing Ozone Paper, and other Forms of the Test with Starch and Potassium Iodide," by Dr. C. H. Blackley, F.R.Met.Soc. Some years ago the author made some experiments with the ordinary ozone test papers, but found that the papers did not always give the same result when two or more were exposed under precisely the same conditions. He subsequently tried what reaction would take place between unboiled starch and potassium iodide when exposed to the influence of ozone; but the difficulty of getting this spread evenly upon paper by hand, so as to insure a perfectly even tint after being acted upon by ozone, led him to devise a new method of accomplishing this. Briefly described, it may be said to be a method by which the starch is deposited on the surface of the paper by precipitation, and for delicacy and precision in regulating the quantity on any given surface leaves very little to be desired.

(3) "Notes on the Climate of Akassa, Niger Territory," by Mr. F. Russell, F.R.G.S. This paper gives the results of observations made from February, 1887, to October, 1888, at Akassa, which is the seaport and principal depot of the Royal Niger Co., and is situated at the mouth of the River Nun in the Niger Delta.

(4) "Wind Storm at Sydney, New South Wales, on January 27th, 1889," by Mr. H. C. Russell, F.R.S.

THE LIVERPOOL ASTRONOMICAL SOCIETY.

The last meeting of the eighth session was held at the room in the Royal Institution, Colquitt-street, on Monday evening, May 13, 1889. Mr. James Gill, F.R.A.S., occupied the chair. The preliminary business of reading the minutes of the last meeting and election of the members being over, the secretary was called upon to read the papers communicated. The first was Mr. James Gordon, on "Mr. Lockyer's Meteoric Theory of Nebulæ, Variable Stars, Comets, &c." The paper was mainly a reply to Mr. W. H. S. Monck's criticisms on the theory. A warm discussion followed, in which the Chairman and Messrs. Rowlands, Defieux, and Isaacs took part. A communication from Prof. Brooks, of Geneva, N.Y., U.S.A., was read, which gave a short account of his observation of the occultation of Jupiter, which took place on the morning of March 23, 1889. "The first contact of the (bright) limb of the moon with the planet was noted by me at 18h. 45min. 47sec. local sidereal time. The last contact at emersion from the moon's dark limb at 19h. 37min. 31sec." "The whole phenomenon occurred in full sunshine; but Jupiter was very distinctly seen, and the belts of the planet were visible. . . . Magnifying powers used were 80 diameters on the large equatoreal (10¼in.) by myself, and 30 by my daughter, Anna, with the finder." Other communications were:—"How to Become an Amateur Astronomer: a Few Practical Hints," by Mr. F. Woulfe Brenan; "A Catalogue of the Aphelia of Comets," by Mr. W. H. S. Monck. After the meeting the Rev. J. Mitchell, B.D., exhibited a small pocket transit instrument for finding meridian.

SCIENTIFIC NEWS.

In a paper by Mr. O. T. Sherman, of Newhaven, Conn., in the *Astronomical Journal*, reasons are stated for thinking that a considerable amount of matter is coming to the sun from space. If so, its place of meeting with matter coming from the sun would abound in collisions and display local spectra abounding in bright lines. The study of the perturbations of Mercury, a subject Mr. Sherman has taken in hand, may lead to important discoveries, and solve some problems which have puzzled observers of the zodiacal light and the other phenomena of the heavens. Studies of the nebulæ, especially with the aid of photography, will no doubt be pursued with energy now, and we may expect a good deal of literature on the subject during the next session.

Barnard's comet *b*, 1889, is in the following position at Berlin midnight on May 28—R.A. 5h. 6m. 52s.; N. Dec. 14° 13, and will remain thereabouts for some time; but, as will be seen, it is too near the sun for observation.

The white spot on Saturn's ring cannot be seen by observers who use telescopes of silvered glass up to 18½in., while others, using smaller apertures, see it clearly!

At a recent meeting of the Philosophical Society, Cape of Good Hope, Dr. Gill gave an account of recent results in connection with the Geodetic Survey of South Africa. The work has been carried out in a thorough manner at an expense of something like £25,000, the determination of the longitude of Cape Town and Durban having been made with all possible accuracy, while that of less important places has been determined in a manner sufficient for all practical purposes. The work of reducing the field measurements is now in hand, and the final result would give South Africa a "survey" which will compare with any other.

The death is announced from Rangoon of Dr. Robert Romanes, Professor of Science in the College there, and chemical examiner to the Government of Burmah.

The Swedish Government have decided to send a man-of-war to New York to bring home the body of Captain Ericsson, who expressed a strong desire to be buried at Langbanshyttan, in Vermeland, the place of his birth. No directions are given in his will as to the disposal of his valuable collection of models, but it is stated that the executors will present them to the Smithsonian Institute.

In connection with the Congress of German Anthropological Societies, which is to meet this year at Vienna, a large exhibition of prehistoric objects is being formed. All the smaller public collections and the most important private ones of Austria will be represented.

Dr. Pinel, of Paris, is said to have succeeded in hypnotising several subjects by means of the phonograph. All the commands given through this channel were, he declares, as readily obeyed as those which he uttered directly, and "suggestions" of every possible sort were as effectually communicated through the medium of the machine as if made *vivâ voce*. The conclusion which he deduces from his experiments is that the received theory of a magnetic current passing from the operator to the subject is entirely baseless, and that the real cause of the phonomena of hypnotism is nervous derangement on the part of those subject to them.

The report of Major Marindin to the Board of Trade on electric lighting in London has attracted some little attention; but it is doubtful if the use of the current for motive power will increase very rapidly. It is stated in the letter of the Board of Trade to the County Council of London that "The Board of Trade concur in the opinion expressed by Major Marindin that, looking to the fact that the supply of electricity on the alternating current and transformer system cannot be made use of for motors, the competition of a system which can be made useful for motors is desirable, and that, consequently, where powers are granted within the same area to two companies, both those companies should not be those using alternating currents." If water-power were running to waste in or near London, electricity would no doubt be used extensively as a "motive power," but dear as coal is in London, there is no cheaper source of energy. Meanwhile several works are either erected or going up in and near London, to supply the area of the Metropolis with current for lighting purposes.

What can be done where water power can be had for the cost of putting in turbines has been shown in the North of Ireland, and at several places in America; but a scheme which is just being formulated in Baden may give a stimulus to the work. Three firms of Oerlikon have been studying the question of distributing power, and they propose to erect the necessary plant at Rheinfelden. The preliminary surveys have been made, the plans are already drawn up, and a concession from the government of the Grand Duchy of Baden is being applied for. The village of Rheinfelden is situated on the Rhine, about 15 kilomètres from Basle, and the promoters estimate that about 15,000H.P. will be available if modern hydraulic plant is installed. It is proposed to erect twenty 750H.P. vertical turbines, coupled direct to as many 500,000-watt dynamos, giving 2,000 volts and 250 ampères. Several dynamos will be connected in series, and a series system of distribution will be employed.

In the Commercial Library of Bologna a bookcase containing a number of unclassified volumes has been discovered, and amongst them a treatise on electricity, by Galvani, hitherto unknown. What if it should contain descriptions of the telephone, of quadruplex telegraphy, the incandescent lamp, and the dynamo and current transformer!

One of the effects of the high price to which copper was recently run is seen in the following:—The high price of brass has led the clock manufacturers of Ansonia, Waterbury, Thomastown, Conn., and other places to experiment with steel for certain parts of the cheaper grades of clocks, and the result has been gratifying. Soft sheet steel has been put under the dies, and many working parts are now made entirely of steel, which were formerly composed of brass.

Manufacturers of dynamos in the United States have received a blow in the recent decision of the American Patent Office on a patent of Mr. Weston applied for some six years back, in which the method of making dynamo armatures of thin metal plates, insulated from each other, is broadly covered. At that time Edison filed an interference claim, and the subject has been under consideration ever since. The authorities have now, however, come to a decision, Edison's objection being disallowed; but this will not affect the Edison companies who have taken out a license to manufacture from the Westinghouse Company, who now hold the patents. These two companies therefore promise to have a monopoly of dynamo manufacture in the States.

At a recent meeting of the Royal Scottish Society of Arts, Mr. A. D. Mackenzie read an epitome of a paper prepared by him on the "Risk of Fire from Steam and Hot-Water Pipes." The results of experiments made by him was that under ordinary circumstances, wood, wool, cotton, paper, and such like substances would not fire under or even at the boiling point of mercury (680°); and very probably the temperature at which they would ignite readily was nearer 800° than 700°. The highest temperature he was able to get on a high-pressure hot-water pipe was 500°, and he got that only by very hard firing, and by loading the safety-valve. The usual high-pressure apparatus seldom reached 400°, and, therefore, he concluded, that under ordinary circumstances these pipes could not originate a fire. Mr. Proctor said that mice, attracted by the warmth, often made their nests in close proximity to the pipes, and thus collected quantities of highly combustible material from which fires might originate.

The Upsala University and the Swedish Geographical Society have sent Dr. Carl Forsstrand to study the marine fauna of the West Indian Islands during the present summer.

THERE are more miles of railway in the Australian Colonies in proportion to the population than in any other country in the world, with the single exception of the United States of America. The total cost of construction of the Australasian railways is estimated at £85,503,210, the average cost per mile for several years being about £10,102. The highest average is in Victoria, where it amounts to £13,634, and the lowest is in Western Australia, where it amounts to £4,038.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE CORONA, &c.

[29949.]—I THANK "F.R.A.S." for his courtesy in replying to letter 29909; but he appears to have misunderstood both the general drift of the letter and of the questions asked in it. As to the former, he says that I seem to think the corona is "merely the visible æther!" Nothing, however, could be further from my meaning. I meant that as the corona is *too large* to be due to the sun's atmosphere *only*, for reasons which I there gave, and that, on the other hand, the illumined æther must be visible, and brighter in proportion to its nearness to the sun, and therefore that it must be due to the two causes *jointly*, and perhaps, to some extent, to the substance seen as the Zodiacal Light.

I was not, however, asking what the corona was due to; but what are certain appearances which it presents. I have never seen a total eclipse, unless that of 1821 was such; but as I was so very young at the time, I do not remember particulars.

What I wanted to learn, then, was—(1) Whether in consequence of the *joint* effect of solar atmosphere and illumination of æther, there were any indications, in the last total eclipse or any other, of there having been a narrow band round the sun, more or less defined, and of greater brightness than the rest? and (2), Whether the corona was ever seen to extend farther in one direction than another? On the first point "F.R.A.S." is silent; but on the second I gather from his letter that he speaks in the affirmative. And, if so, I quite fail to see in what he differs from me in the matter of the corona, unless, indeed, he denies the visibility of the æther; the which, however, if it is a new idea, will, of course, for a time, be either opposed or else "severely let alone." The denial of it, however, implies one of two things—either that the æther is a myth, or else that it is the one solitary illumined substance which is impossible to be seen.

I will only add that in consequence of the solar activity being *greater in one part of its surface than in another*, two things will follow—(1) The increase of *heat* may expand the sun's atmosphere more in one direction than another; and (2) the increased *light* will cause the illumined æther to be seen farther in one direction than another. The united effects of the two will doubtless be complicated enough.

W. G. Penny.

R. CORONÆ—34 BOOTIS.

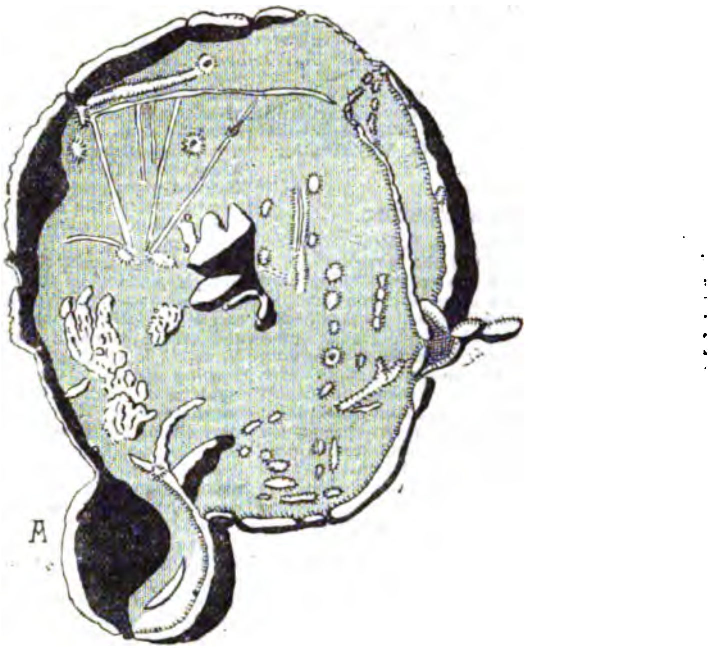
[29950.]—WITH reference to letter 29929, I may inform Mr. Gemmill that all my observations of R. Coronæ are correctly given in the March number of the *Journal* of the L. A. S., excepting those for November 29 and 30, which should read 6·2, the star having been noted as "slightly less than π" on those days. As regards the observation of May 11, too much stress should not be given on my magnitude (7) as the original observation ran "about 7m., much less than π."

I have seven observations of 34 Boötis this year, all making the magnitude practically 5·2.

E. E. Markwick.

SELENOGRAPHICAL—GASSENDI.

[29951.]—IN answer to the query of your correspondent "G." (68627), I may say that the formation Gassendi was the object of a thorough examination by several observers between the years 1870 to 1875, and if he can consult the ENGLISH MECHANIC of that period he will obtain the best possible information. He can also find a good résumé in Neison's "Moon." Since that time attention has been drawn to other objects, and so far as publication goes Gassendi has been quite neglected. As, however, so rich a formation is far from having been exhausted, it is well to keep it in view as lunation after lunation bring it before our sight. My latest observation bears the date of April 11th, 1889, and I send it to you hoping that, in part, at least, it may be of some use to your correspondent and perhaps to others. As this beautiful ring has been described over and over again, I will not occupy uselessly the pages of your periodical to come over the same ground again, especially as the sketch will easily show the nature of the object represented. I will only say that it was examined with a beautiful 10¼in. telescope by With; but as the air was very bad (as, indeed, it has been continuously so for more than six months here), I could only use a power of about 100 on the whole aperture. Many more clefts exist here than those shown. The one situated E. of the central mountains, as well as the one coming out of the shadow of the same mountains, were also well seen with a beautiful 8½in. by With on the 11th of February last. With both telescopes the ground is covered with a vast number of minute hillocks, and the floor is very far from being level, as the sketch would lead one to suppose. The markings are only the principal ones, and the existence of each is certain, and are the only ones I had time to draw. The mass of débris on the N.W. of the floor, covered with minute round balls, as if it had the nature of scoria, always gives me the impression as if it had been ejected from crater A.



May I call the attention of selenographers to the central mountain of Moretus? On the 10th of April last I found a small crater on its summit, a little E. of centre, and last night, through openings in the clouds, I saw it again, but not quite so well, as the moon was very unsteady.

On May 11th I again observed Gassendi. In my observation of April 11 I carefully examined the N.W. wall because I was struck with its extreme thinness. On the 11th May I was very much surprised to see on this wall a small crater as black as ink. It is somewhat nearer the "Spoon" than the break of the wall on the S.W. As this crater is easy with 9¼in., and does not seem to have ever been seen before, notwithstanding the close scrutiny Gassendi has been subjected to, I call the special attention of your readers to it. Another crater was seen among the débris in the same neighbourhood. Among other clefts, Nos. 15, 25, and 31 were well seen.

Vaison, May 18th. **C. M. Gaudibert.**

THE MOON AND THE WEATHER.

[29952.]—DURING the late fever epidemic in this ity, one of the prominent topics of general conversation has naturally been the probability of a change in the weather, the temperature ruling exceedingly high, and the continued drought causing much inconvenience, owing to the insufficient water supply.

It was suggested in one newspaper that the extreme heat was the consequence of the absence of spots on the sun; but there seemed to be a general idea prevalent that to the *changes* in the moon we should have to look for a modification of the existing state of things.

Although, as far as I am aware, observations conducted with a view to discovering whether or not the moon's phases have any influence upon the weather have resulted negatively, I thought it might prove interesting to make the comparison during the present dry season, when the changes would be more marked, and the following are the occasions upon which there was any decided alteration, with a note appended of the moon's phase, when it happened to coincide with the change:—

1889.	31 Jan., 7 p.m.	Heavy thunderstorm and rain	New moon..	Jan. 30, 21h.
	15 Feb., 4 ,,	Rain	Full ,, ..	Feb. 15, 10h.
	17 ,, 7 ,,	,,	(?)	—
	22 ,, 6 to 11 p.m.	,,	Last quarter.	Feb. 22, 11h.
	23 ,, 6 to 7 ,,	,,	(?)	—
	27 ,,	Slight rain at night	(?)	—
	1 March, noon	Rain	New moon..	March 1, 10h.
	13 ,, 8 p.m.	Thunder and rain	(?)	—
	17 ,, 4 ,,	Heavy rain; weather continued showery up to 21st, and temperature fell about 10° to 15° (88° to 73°)	Full moon ..	March 16, 23h.
	6 April., 8 p.m.	Thunderstorm and rain		
	11 ,, 6 a.m.	S. wind and rain		
	15 ,, 5 ,,	S.W. gale; slight rain; therm. fell from 80° to 73°	Full moon ..	April 15, 10h.

Dr. Terby's discovery of a white spot on Saturn's ring was published by the Observatory here in the 6th inst. I await further particulars of the observation with much interest. **G. W. Nicolls.**

Rio de Janeiro, April 20, 1889.

THE MOON'S ALBEDO.

[29953.]—THE question of S. E. Peal, on p. 238, is very readily answered. If the moon had ice or snow on her surface, the sun's rays would quickly raise in vapour either the whole of it or as much as to form a steam atmosphere many times denser than our air at sea level, and extending much higher than ours. Lord Rosse had proved the solar heat on her noon meridian to be something near or above boiling, at which steam is dense enough to support 30 barometric inches of earth-bound quicksilver; therefore 120 of the same only moon-bound; and as the vapour would also have as little weight compared to what it has on earth, it must be piled vastly higher before evaporation would stop. As we can see, there is not even a hundredth as much atmosphere as ours. Still less can there be any unevaporated ice or snow. If any streaks have the albedo of snow, they must be either white lead, Carrara marble, or something whiter.

E. L. G.

ASTRONOMICAL—VENUS.

[29954.]—I MAY tell Mr. Holmes (letter 29932) that if naked-eye observations of Venus's crescent in this country are doubtful, that a very low power indeed is sufficient to show it quite easily, as on 27th of April last I was using a binocular power between two and three diameters which showed it plainly, and two or three of my friends also saw it, much to their surprise, the state of the air not being very good either; and I can quite believe that in very clear air it is possible to see and distinguish the crescent form without instrumental aid. I remember some years ago making a naked-eye observation of one of Jupiter's satellites, and verifying it shortly afterwards with the telescope. I had not had the chance of observing Jupiter for some time previously, and did not know the exact whereabouts of the satellite, which, as most people know, is a material help in looking for an object.

Hadleigh, Suffolk. **C. May.**

[29955.]—J'AI lu avec beaucoup d'intérêt la lettre 29932, p. 238, de M. Holmes. Je me permettrai cependant les quelques mots suivants. Je suis certain que l'auteur regrettera un jour son incrédulité à l'égard des découvertes faites dans Mars. Est il certain de n'avoir jamais à s'étonner de découvertes plus merveilleuses encore? Quant à la tache blanche de l'anneau de Saturne, quelle qu'en soit l'explication, je ne regrette pas trop de l'avoir signalée, puisqu' elle donne lieu à tant d'observations intéressantes. L'explication de M. Holmes est très ingénieuse, mais elle se heurte à quelques petites difficultés dont voici les principales. S'il est vrai que la tache n'est qu'un effet de contraste au un phénomène de l'ordre des *couleurs accidentelles*, comment se fait-il qu'elle paraisse ne jamais avoir été remarquée jusqu'ici? *Comment se fait-il que la blancheur n'apparait que d'un côté de l'ombre du globe, c'est-à-dire sur l'anneau et nullement du côté opposé, c'est-à-dire sur le globe lui-même?* Je serais bien heureux si M. Holmes pouvait me donne cette explication. Je dois dire aussi que, d'après ce que j'observe moi-même depuis le 12 Mars, je dois penser que tous les astronomes qui ont confirmé ma remarque n'ont vu qu'une atténuation du phénomène; les 6 et 12 Mars, en effet, son intensité était *incomparablement plus grande*. Quelle que soit l'explication, il me suffit que mon observation soit confirmée. M. Holmes n'a-t-il point songé à une réflexion de la lumière solaire sur une certaine région du globe Saturnien, lumière solaire que seraite ensuite projetée sur l'anneau à la faveur de certaines conditions rarement réalisées? **Dr. F. Terby.**

Louvain, 17th Mai, 1889.

REMINISCENCES OF SOUTHERN SKIES.—I.

[29956.]—THE following notes were made during a sojourn extending over several years in various parts of Natal, Transvaal, and Cape Colony. The instruments used were a 2¼in. refractor of very excellent definition, supplemented by a small hand telescope about 1¼in. in diameter. But many notes were made from observations with the naked eye, which takes in at one sweep all the glories of the sky, and gives general impressions of certain phenomena such as the Milky Way, Zodiacal light, &c., which of course cannot be obtained by any instrumental means.

I shall not forget the night on the voyage out from England when the clouds of Magellan were first seen, an earnest of what was to come when still lower latitudes were reached. A sea voyage, and especially one in which the course is nearly N. or S., is very instructive to the amateur in impressing upon him the rotundity of the earth, as night after night more southern constellations become visible. The actual sight of these southern stars getting higher and higher every night, brings home to one, better than any amount of book-learning, that the only possible cause for such a phenomenon must lie in the fact that the surface of the earth is curved, and that we are traversing that curved surface.

I beg to prescribe such a voyage to the "flat-earth" people, as the very best cure for such paradoxers. When we get well into the S. hemisphere, and see the Orion turned upside down, how can we come to any other conclusion than that we ourselves, in the course of our voyage, have turned gradually upside down, so that at the same instant of time we see Orion inverted, while a northern observer does not. The navigation of the ship, too, based, of course, on a perfect knowledge of the size and shape of the earth, must convince them that the theory of the rotundity of the earth is correct. It would put any of them to the test to be asked to navigate a ship over the trackless ocean on *their* theory, and to prick off the ship's position day by day with unerring accuracy on the chart, which is done on every sea-going vessel.

Returning home after several years' absence, it was pleasant to see the old familiar Northern stars getting higher and higher. One night we steered due north, and the pole star might be seen dancing about in the rush of heat from the furnaces just over the funnel—this, of course, seen from the steamer's stern. I once travelled towards the N. boundary of the Transvaal, and distinctly remember seeing the chief stars in the Great Bear skimming the N. horizon. Such an observation would have been impossible but for the transparency of the atmosphere in these regions, which often permits one to see bright stars down to the horizon.

In the interior and uplands of South Africa the winter season was nearly always dry and bright. Every day a brilliant sun, and at night a perfectly clear sky, with cold, frosty air. This state of things continued for months at a time without any change. The climate in the coast regions is entirely different, the rain being of a more Tropical character, the temperature higher, and the amount of cloud generally far greater than in the interior.

The three features of the nightly sky which I think strike the visitor to southern climes most, are the Milky Way, Zodiacal Light, and Clouds of Magellan.

Whether it is owing to the clearer air or not, the Milky Way is far more impressive to me in the S. than the N. hemisphere. Some of the rifts and gaps in it are remarkably well defined and sharp. Which things strongly bear out the late Mr. Proctor's idea of the Milky Way—i.e., not an infinitely extended stratum of stars, but rather a comparatively limited ring or circle of stars. In the former case we shall have to believe in long, cylindrical, or even thin flat openings, all of which converge exactly towards us, which involves a deal of improbability. The latter assumption, however, renders it far easier to account for the gaps, rifts, &c., as parts of the ring which have been denuded of stars by the greater attraction of masses of other stars in the neighbourhood. Proctor's view is greatly strengthened by the consideration of the Milky Way in the constellations Lupus, Ara, and Norma, with its delicate cloud-like wisps of light and dark passages twining in and out among the star mist. There is a peculiarly thin, dark rift just preceding the star θ Ophiuchi, which was like a long black wedge lying over the bright background of the Galaxy. Such sudden and well-defined gaps would seem to show that the Galaxy is *comparatively* limited, unless we believe that the gaps are due to masses of some obscuring substance, interposed between us and the galaxy.

As for the Zodiacal Light, it is a wondrously beautiful spectacle, seen night after night at a certain period of the year. It got to be quite a common sight, and I always found that the axis coincided approximately with the Ecliptic. My observations were not sufficiently precise to note any difference between the axis of symmetry and axis of brightness, which some observers have detected. Once when Venus was situated in the Zodiacal Light, I noticed that the light of both was quite sufficient to throw a shadow on one's hand, when holding the other hand between it and the west. The twilight at the time was all gone, and therefore the light must have come from Venus and the Zodiacal Light.

When the Milky Way and the Zodiacal Light sprang upwards from the same points of the western horizon the display of brilliancy was very marked; add to this a configuration of three or four planets with some bright stars, and a spectacle was offered of the greatest beauty. These planetary configurations and the changes of relative position, night after night, afforded one a great subject of interest. It is only after seeing the planets in a clear sky like this that one can realise how intently the old Chaldæans and Babylonians must have watched the skies. Mercury, then, is no phantom, or *nominis umbra*, which it is to most amateurs in England, but a brilliant object, brighter than a first mag. star, taking up various positions with regard to neighbouring stars, and leaving no doubt as to its planetary character. Many is the time when on the march, or "on trek" (i.e., travelling) I have rolled myself up at nightfall in blanket and rugs, for one bivouacks with ease in the winter owing to the dryness of the atmosphere, and taken a last peep at the lovely stars overhead, to wake next morning before dawn and see a wondrous change in the position of the heavenly bodies. Pages could be penned about these ever-glorious skies, a thing of beauty and joy for ever; they seem to be all the more beautiful when seen with memory's eye. I cannot forbear quoting a fine passage on the subject from the writings of Dr. Macmillan, "Bible Teachings in Nature":—"It is impossible for those who have never visited the glowing East to form an adequate idea of the exceeding beauty of an Oriental night. The sky—which bends enamoured over clusters of graceful palm-trees fringing some slow-moving stream, or groves of dark motionless cypresses rising up like Gothic spires from the midst of white flat-roofed villages—is of the deepest, darkest purple, unstained by the faintest film of vapour, undimmed by a single fleecy cloud. It is the very image of purity and peace, idealising the dull earth with its beauty, elevating sense into the sphere of soul, and suggesting thoughts and yearnings too tender and ethereal to be invested with human language. Through its transparent depths the eye wanders dreamily upwards until it loses itself in the threshold of other worlds. Over the dark mountain ranges, the lonely moon walks in brightness, clothing the landscape with the pale glories of a mimic day; while the Zodiacal Light, far more distinct and vivid than it is ever seen in this country, diffuses a mild pyramidal radiance above the horizon, like the afterglow of sunset. Constellations, tremulous with excess of brightness, sparkle in the heavens, associated with classical myths and legends which are a mental inheritance to every educated man from his earliest years. There the ship *Argo* sails over the trackless upper ocean in search of the golden fleece of

Colchis; there Perseus, returning from the conquest of the Gorgon, holds in his hand the terrible head of Medusa; there the virgin Andromeda, chained naked to the rock, awaits in agony the approach of the devouring monster; there the luxuriant yellow hair of Berenice hangs suspended as a votive offering to Venus; while the dim misty track formed by the milk that dropped from Juno's breast, and which, as it fell upon the earth, changed the lilies from purple to a snowy whiteness, extends across the heavens like the ghost of a rainbow. Conspicuous among them all, far up towards the zenith, old Orion, with his blazing belt, meets the admiring eye, suggestive of gentle memories and kind thoughts of home; while immediately beyond it is seen the familiar cluster of the Pleiades, or Seven Stars, glittering and quivering with radiance in the amethystine ether, like a breastplate of jewels—the Urim and Thummim of the Eternal." This description applies equally well to the sky of the Cape.

The two Magellanic Clouds are well known and characteristic features of the S. sky, and they always afforded me a means (when camping out, travelling long distances, &c.) of at once getting the points of the compass approximately. The two clouds form a very roughly-shaped equilateral triangle with the S. pole; and in the latitude of Natal; at one season of the year they just skim the southern horizon. With my small instrumental means, they did not turn out so interesting as one would perhaps have imagined. 18Δ, a cluster near to the Nubecula Minor, is a superb object, with numbers of stars shining like glittering dust over it.

There is another phenomenon which I saw a great deal of, especially in Natal, and one which impresses itself on all those who witness it—viz., lightning. In the rainy season thunderstorms of most astonishing intensity used to occur frequently—often, indeed, day after day. The lightning was very dangerous, and there were many cases of accident from it; but at night it was perfectly lovely to those who cared to watch. In was always of a fine purple tint, and appeared in the form of long strings of vivid light, generally speaking, approximately vertical, but curved and indented throughout their whole length with countless sinuosities. I cannot remember noticing any branches; each thread or string of light was separate. On one occasion a tent at Fort Napier, Pietermaritzburg, was struck, and I saw the soldier's waistbelt and bayonet which had been hanging from the pole scarred and damaged. People get accustomed to these terrific thunderstorms; but to the newcomer they seem appalling.

E. E. Markwick.

ORGAN MATTERS—GENERAL DESIGN IN ITS RELATION TO TONE-COLOURING.

[29957.]—With reference to Mr. Michell's statement that my Concert-room organ scheme is borrowed from the system of building at present followed by Mr. Roosevelt, of New York, I emphatically deny that he has "replied" to my "request" or in any way answered my challenge to point out wherein I have been guilty of "imitation." So far as I can understand him, he says that my Concert-room organ scheme resembles the Roosevelt organs in *size*, and must accordingly be in imitation of them. May I ask him, in this respect, if I am not equally guilty in imitating Mr. Willis's large organs in the Royal Albert Hall, 111 stops; the Alexandra Palace, 87 stops; and St. George's Hall, Liverpool, 100 stops; and Messrs. Hill and Son's large Sydney organ, which contains 126 speaking stops?

In my letter in your issue of April 26th I say:—"Perhaps Mr. Michell will point out wherein I have copied from the schemes by Mr. Roosevelt." Instead of accepting the gauntlet thus thrown down he, in every subsequent remark on the subject, seeks undignified protection under covert sneers and charmingly ambiguous phrases, certainly characteristic of the writer, but hardly what those who are unacquainted with so great an authority on "organ matters" and "general design in its relation to tone-colouring" might reasonably expect. Well, all this goes to prove that Mr. Carlton C. Michell's original and uncalled-for personal attack was based upon his incapacity to realise the different principles underlying the Roosevelt organ schemes and those distinctly laid down in connection with my representative Concert-room Organ in these columns.

Now, I shall look to a more generous and appreciative man—one who always knows what he talks about—for a little justice in the matter at issue. The letters which have been passing will doubtless meet the eyes of Mr. Walter F. Crosby, the able manager of the New York branch of the Roosevelt firm; and as no one can be in a better position to prove Mr. Michell's accusation of "imitation" to be correct or false, I hereby publicly ask him to express in these columns his unbiased opinion on the matter.

In my letter in your issue of May 10th I pointedly ask Mr. Michell to describe *his means*, which he says I much admire; but, in asking the question, I was perfectly aware he could not and would not attempt to answer it. He has, of course, not done so; but, instead, given us another proof of his appreciation of Dundrearyism. Well, let me emphatically deny that I ever admired *his means*, and that I ever knew he had *any means* beyond the recognised talents of his "late partner, Mr. Thynne." Now, if he has recently discovered some *means* of an *original nature* whereby he can do greater things with "50 stops" than ever Willis and Roosevelt have been able to do with twice the number, let him first patent them and then fully explain them in these columns. No one sooner than myself will sit at his footstool and gratefully acknowledge the lesson so learnt.

G. A. Audsley.

Devon Nook, Chiswick, May 20.

[29958.]—I have much pleasure in replying to a letter by "Tacett" anent the old Organ recently acquired by him; but, with reference to the probable age of the original instrument, I feel it very difficult to form anything like a satisfactory opinion with only the few data to guide one which he has supplied. That it is one hundred years old is more than probable; but it is also likely that it is considerably older. An inspection of the organ would enable me to form, in all probability, a fairly accurate idea of the time of its construction; but as this is not likely to take place, may I ask "Tacett" to furnish, in another letter, the exact lengths and widths of both the natural and sharp keys? On having these particulars, I may have something further to say on the subject. The list of the original-stops does not assist one in the least if taken alone.

Now, with reference to the stop (?) labelled *Tacett*, and which I can easily understand "Tacett" not being able to trace. I read his "cannot trace it" as signifying that he has been unable to find a special slider for it. *Tacett* is obviously an old spelling of the word *tacet* still used in musical nomenclature to indicate *silence*. In orchestral scores it appears with relation to certain instruments; for instance, when one finds "Contra-basso tacet" written it signifies that the double-basses are to be silent and to allow the bass part written for the strings to be taken by the violoncelloes only. Such being the case, and as the word is evidently identical with the Latin word, tacet, be silent, it is highly probable that *tacett* was used in the old Organ under consideration either to indicate that the draw-knob controlled some ventil which produced partial or total silence of the speaking stops, or that it indicated that a stop was provided for but not inserted. The owner of the Organ will perhaps kindly give further information after what has just been said.

The only instance of the use of the word *tacet* in connection with Organ nomenclature known to me occurs in the Specification of the Organ in the Cathedral of Abbeville, as given by Dr. Hopkins in "The Organ." In the Grande Orgue we find, in the list of its stops, "Flute Tacet": and in the list of the Positif stops, "Hautbois Tacet." I have not had the opportunity of examining this interesting old Organ, and, accordingly, am not able to state whether the word *tacet* is inscribed on the draw-stop knobs; but I may say that I have always understood from the Specification in question that the word was employed with the intention of indicating that the Flute and Hautbois were prepared for on the windchests, but were not inserted at the time particulars were furnished to Dr. Hopkins. On referring to Fleming and Tibbins' *Grand Dictionnaire*, I find the following:—"Tacet, *s. m.* Terme de Musique qui se dit d'une partie que se tait pendant que les autres chantent." Perhaps Mr. Robinson can throw some light on the question.

G. A. Audsley.

Devon Nook, Chiswick, W.

[29959.]—The instrument referred to by "Tacett" (29936) would probably be a "Snetzler," and his name will perhaps be found inside the windchest *on the wind bar*, written on coarse paper similar to that used in old account books. The name "Tacett," i.e., silent, meant that a rank of pipes was prepared for, but not planted; the same as we leave a knob unengraved at the present day, as funds may be short, or a question of what stop may be decided upon has not been settled. I have met with the name "Tacitt" on a small one-manual organ, where, upon drawing it and letting its rod catch in the stop-jamb to prevent its slipping back, it shut off all the stops from their wind except the open and stopped diapasons, and upon releasing it, it sprang back and restored the tone to whatever was out before. This was done with double slides, one over the other; the "Tacitt" being *over* the true slide and always being on, or at least when *out of action*, its holes corresponded with those in the table and upper board, and was kept so by a spring, and upon the stop being drawn that "Tacitt" slider moved independently, leaving the true slider to remain in its position as the player arranged it.

In re "Gedeckt." I find in Cassell's "German Dictionary," "Dectel," a "lid," a "cover," a "tympan"; "Decten," "to cover," "to deck." Hence the real name would be "Lieblich Gedeckt," or "lovely" covered diapason. For many years I understood it to be "Ged*a*cht," simply by hearing others pronounce it so; but I lodged with a German, who, *not* being an organ-builder, explained the matter very clearly.

W. Robinson.

[29960.]—With regard to Mr. Michell's letter (No. 29841, p. 154), I also think that with 50 stops the utmost variety of tonal colouring is possible, and that the duplication of stops in the Roosevelt organ at the Calvary Church, New York (the specification he gave on 327, Vol. XLVII.) is of questionable value, and also seeing that a large proportion of the manual stops are inclosed, a large portion of the pedal stops ought to be expressive; but I cannot agree with Mr. Michell when he maintains that Mr. Audsley's concert-organ scheme is an imitation of it. In fact, from what I can read, I find that he endeavours to make each department as contrasted as possible. Perhaps Mr. Michell may refer to the multiplication of stops of the same colour to form the harmonic structure of each department, in which case I don't see how he (Mr. Audsley) can do otherwise. If Mr. Michell has much fault to find with Mr. Audsley's design, what has he to say to such useless repetition and want of contrast of departments in such instruments as the Albert Hall, the St. George's Hall, &c.?

I think a few remarks about the power and tone of the various stops included in the specification given on p. 114 might tend to show Mr. Michell that perhaps his remarks might not then apply.

1. To be of large scale (say, CC 5½in. Ten. C 3¼in.), and voiced to yield a very round tone, quite free from reediness, and to be *the* foundation stop of the organ.

2. A double-mouthed stop of very full tone, and great "filling-up" quality.

3. To be much softer, lighter, and clearer than No. 2 (say, about half its power), and slightly reedy in tone, so as to be as distinct and different from it as possible.

4. To be pungent, and at the same time most refined and prompt of speech, and about the same power as No. 2.

5. To be *pp.* very delicate, refined, and reedy.

6. To be of the same quality of tone as No. 1, only lighter and more silvery, about three-quarters its power and scale.

8. To be of salcional scale, of bright tone, and at the same time thin and delicate.

9. Must be of the smallest scale salcional pipes, and *ppp.*, each rank getting softer as it ascends in pitch. The octaves to have a predominance over the fifths, and the fifths over the thirds. The whole stop must be most refined, so as to be useful in soft combinations.

10. Must be rich and grand, of medium scale (say, CC 3½in.).

11. Very pure and refined, about the same power as No. 3, only perfectly different in quality.

12. Should be the true echo of No. 1, and rather softer than No. 5, very smooth, delicate, and refined, and as free from the reediness of the ordinary dulciana as possible, so as to have no sympathy with No. 13.

13 and 14. Should be very reedy, thin, and delicate; about twice as loud as No. 5, and half the power of No. 4, and very prompt of speech.

19. To be of the smallest scale vox angelica pipes; its ranks to be about half the power of those of No. 9. The same remarks apply to it. This stop to be of the softest possible intonation.

20. To be very refined, even, and rather fuller than the ordinary oboe.

21. Very refined (not the ordinary harsh nasal affair), being a kind of echo clarionet.

22. Very brilliant and fluty.

23 and 26. As near perfect imitations as can be made on a 3in. pressure by either wood or metal pipes; 26 to be rather softer than 23.

24. To be of smallest scaled pipes, and the softest possible intonation, voiced to yield whispering tones on 1¾in. wind.

25. To be a near imitation, and rather louder than the orchestral instrument.

27. To be very imitative, and rather softer than 25.

28. To be very imitative, and delicate-voiced—quite differently from No. 20.

29. To be as imitative as possible, perfectly adjusted, even, and regular.

30. To be very grand and gorgeous, and able to assert itself when added to the otherwise full organ; nevertheless, free from brassiness, and perfectly different in quality from No. 10.

I certainly do not know how it is that I can't gain delicacy on 1¾in. pressure, and also that the pressure that a trumpet player uses has anything to do with the pressure used in an organ, seeing that the ordinary orchestral trumpet is quite differently constructed from the reed pipes of the organ trumpet.

I think that Mr. Michell overlooks the fact that the instrument in question is a chamber organ, where a high pressure is out of place.

Perhaps Mr. Michell is quite satisfied with the pedal organs of ordinary church instruments, consisting of about two pedal stops, very often only one, to balance about 20 manual stops (including perhaps two of 16ft. tone). I, however, am not, as I thoroughly agree with Mr. Audsley on the true nature and office of the pedal organ. With regard to my own scheme for the pedal organ, I will abandon it for Mr. Casson's, if it can be easily applied.

With regard to letters 29878 and 29899, I may say that I know an organ by a German builder which has a flute-toned stop called "Lieblich Gedeckt."

With regard to letter 29900, touching personalities, I can't help thinking that Mr. Michell's sarcasm will not do much to mend matters. By the way, perhaps he will be kind enough to explain the character and construction of such stops as "Contrabumblebee" and the "Last Trump," which he mentions, since I am sure it would be exceedingly gratifying to our readers interested in organ matters! **G. Dixon.**

Bradfield College, Berks, May 7th.

PERSPECTIVE DRAWING.

[29961.]—It is evident from "D. S.'s" letter that he does not understand my or (as it appears from Mr. Cunningham's letter, I should say) our method or its object.

The plan I described gives the *point* on a picture from which all lines, which are *actually* parallel, *appear* to radiate. The old method he writes about, which is as old probably as the art of drawing itself, gives the angle but not the position of a line in the picture. I did not mention it, as my object was to give a *new* way of locating the vanishing point.

As he does not seem to understand the position of the pencil, I will point out that in my plan the pencil is held so that it *is* parallel with the lines to be drawn. In the old plan it is held in a plane parallel to the picture plane (usually vertical), and moved in that plane till it *appears* to be parallel with the line (but is not really so). Then he looks across the pencil; I look along it—a great difference.

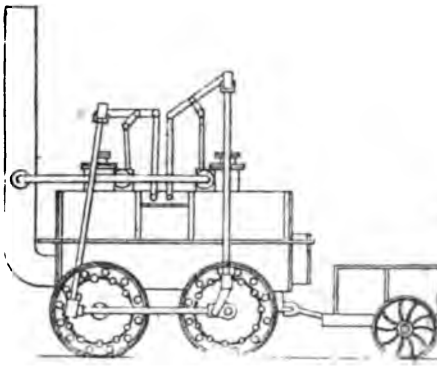
Of course the methods should be combined. Mine gives a point; then the old plan gives the direction of the lines radiating from that point, and the two help to preserve proper proportions; especially when another old rule of measuring apparent lengths with the thumb upon the pencil is also used. **Glatton.**

MOVEMENT OF THE ATMOSPHERE.

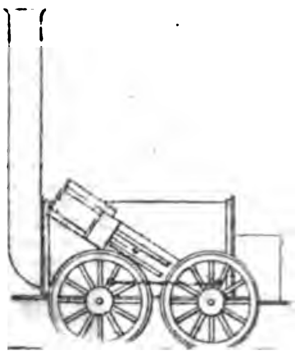
[29962.] Admiral Fitzroy stated so far back as 1864 that there is a "lateral translation of the atmosphere towards the east in Temperate zones." I should be glad if any readers of the "E.M." who have practically studied this subject would kindly give me some more definite idea about this eastward translation. My own observations on the subject go to prove that, while storms travel from west to east at very varying velocity, anticyclones remain almost stationary. From April 24 to May 18 an anticyclone has remained with but little motion over Northern Scandinavia and Lapland. How does this agree with the theory of a general eastward translation? Again, the anticyclones frequently move towards the west. My observations, particularly of Captain Hofmeyer's charts and daily examination of the English and European weather reports, have convinced me that this "eastward translation" is very variable, sometimes remaining almost at zero, and at others advancing at the rate of 12° to 13° a day. Is anything known at all about the maximum and minimum rate at which storms travel across the Atlantic and Europe? I am anxious also to obtain some information with regard to the recurrence of storms. I believe it has been stated that, upon the average, a storm may be expected every two days over the British Isles. The only fact that seems pretty certain about them is, that they follow each other in much the same track for a period of from seven to eight days. None of the works on the subject speak of any periodicity having been noticed. **W. R.**

LOCOMOTIVES WHICH OPENED FOUR EARLY RAILWAYS.

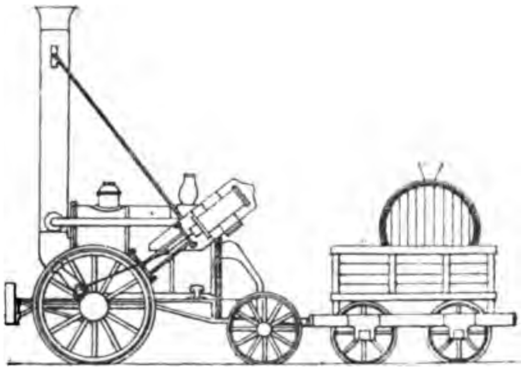
[29963.]—The Stockton and Darlington Railway was opened on the 27th September, 1825, by the "Locomotion" constructed by Messrs. R. Stephenson and Co., the dimensions of which were as follows:—Vertical cylinders, 10in. diameter; stroke, 24in.; length of boiler, 10ft.; diameter of boiler, 4ft.; four coupled wheels, 4ft. diameter; steam pressure, 25lb. per sq.in., a flue tube passed through the boiler; weight of engine, 6½ tons; weight of tender, full, 1½ ton; total, 8 tons. The exhaust steam, it will be observed, was conveyed to the chimney by a blast-pipe for each cylinder. This engine is preserved upon a pedestal at the North-road Station, Darlington.



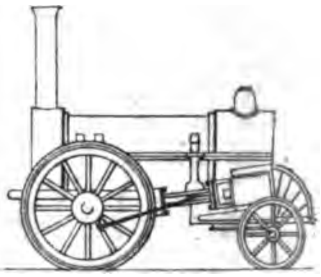
The "Locomotion," 1825.



The "Invicta," 1830.

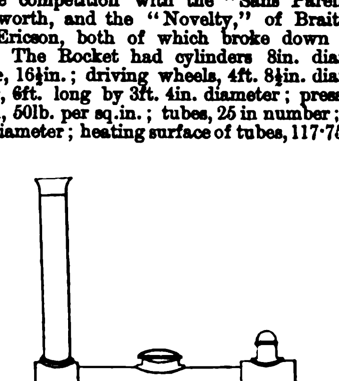


The "Rocket," 1829.



The "Northumbrian," 1830.

The "Rocket," built by Stephenson, it is well known won the prize of £500 at Rainhill, on the Liverpool and Manchester Railway, October, 1829, in the competition with the "Sans Pareil," by Hackworth, and the "Novelty," of Braithwaite and Ericson, both of which broke down at the trial. The Rocket had cylinders 8in. diameter; stroke, 16½in.; driving wheels, 4ft. 8½in. diameter; boiler, 6ft. long by 3ft. 4in. diameter; pressure of steam, 50lb. per sq.in.; tubes, 25 in number; tubes, 3in. diameter; heating surface of tubes, 117·75sq.ft.; heating surface of firebox, 20sq.ft.; total, 137·75sq.ft.; weight of engine in working order, 4 tons 5cwt.; weight of tender in working order, 3 tons 4cwt.; total, 7 tons 9cwt. This engine attained a speed of 29 miles an hour at the Rainhill trials, and settled the locomotive question for ever against fixed engines and ropes and horses. Stephenson then constructed, for the Liverpool and Manchester Railway, seven other engines of a very similar design named Meteor, Comet, Arrow, Dart, Phœnix, North Star, and Northumbrian. The Rocket is preserved in the South Kensington Museum.



The "George Stephenson," 1831.

The Canterbury and Whitstable Railway was opened 3rd May, 1830, by the "Invicta." This engine ran upon four wheels coupled of 4ft. diameter. Cylinders, 10in. diameter; stroke, 18in.; boiler, 10ft. long; 3ft. 4in. diameter, containing a 20in. flue tube; pressure of steam, 40lb. per sq.in. The Invicta is preserved by the South-Eastern Railway Company at its Ashford Works.

The "Northumbrian," driven by George Stephenson, headed the procession of locomotives at the opening of the Liverpool and Manchester Railway, 15th May, 1830:—Cylinders, 11in. dia., 16in. stroke, 5ft. 8in. centres. Front wheels, 5ft. dia.; hind, 2ft. 8in.; wheel-base, 7ft. 6in. Boiler, 6ft. 6in. long; 3ft. dia.; 132 tubes 1⅝in. dia; heating surface of tubes, 379sq.ft.; fire-box, 32·75sq.ft.; total, 411·75sq.ft. Area of firegrate, 6·11sq.ft.; weight in working trim, 7 tons 6cwt. 3qr.; weight on driving-wheels, 4 tons 0cwt. 1qr.

It may be mentioned that on the opening day, when Mr. Huskisson was knocked down and run over by the "Rocket," he was conveyed by the "Northumbrian" 15 miles in 25 minutes, or 36 miles per hour.

The Glasgow and Garnkirk line was opened in 1831 by the "George Stephenson." This engine had "inside" cylinders, 11in. dia.; stroke, 16in.; four coupled wheels, 4ft. 6in. dia.; length of boiler, 6ft. 11in.; diameter, 3ft.; number of tubes, 113; diameter, 1⅝in.; total heating surface, 399sq.ft. It should be mentioned, in conclusion, that the engines are drawn to a scale of ⅛in. to a foot. **Clement E. Stretton, C.E.**

Saxe Coburg-street, Leicester.

"AN OLD AMERICAN LOCOMOTIVE."

[29964.]—The valve-gear of the "Old Ironsides" when constructed in 1832 consisted of a single loose eccentric for each cylinder, placed on the axle between the crank and the hub of the wheel. On the inside of the eccentric was a half-circular slot running halfway round. A stop was fastened to the axle at the arm of the crank, terminating in a pin which projected into the slot. The engine was reversed by changing the position of the eccentric on the axle by a lever operated from the footplate.

This form of valve-gear was, however, shortly afterwards changed, and the Ironsides was provided with a single fixed eccentric for each cylinder: the rocking-shafts, which were under the footplate, had arms above and below, and the eccentric-straps had each a forked rod with a hook, or an upper and lower latch or pin, at their extremities to engage with the upper or lower arm of the rocking-shaft; the eccentric rods were raised or lowered by a double treadle, so as to connect with the upper or lower arm of the rocking-shaft, accordingly as a forward or backward motion was desired.

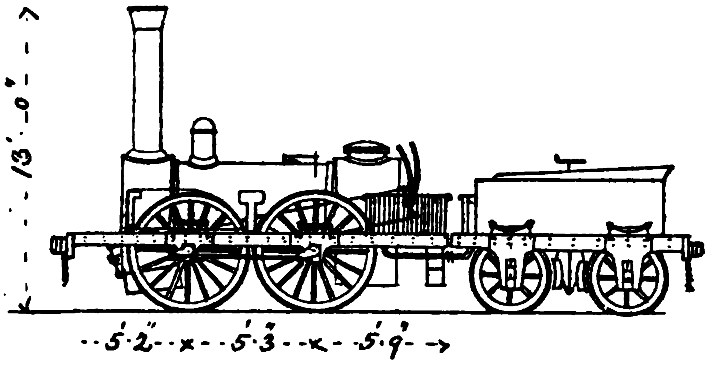
It should be mentioned that the "Ironsides" was built by Mr. Baldwin, 1832, upon the model of the "Planet" class introduced by Stephenson upon the Liverpool and Manchester Railway, 1830; and one of the "Samson" type was sent from Newcastle-on-Tyne to the Mohawk and Hudson Railroad, 1831. I trust these particular will give Mr. A. Marson, p. 239, the further details he requires. **Clement E. Stretton.**

50, Saxe Coburg-street, Leceester, May 18.

LOCOMOTIVES.

[29965.]—The annexed diagram illustrates the "Comet," built by R. Stephenson and Co. for the Leicester and Swannington Railway, 1832. It drew the train upon the opening of that line, 17th July, 1832, driven by George Stephenson himself, assisted by his son Robert and the regular driver, Robert Weatherburn.

The "Comet" had cylinders 12in. diameter; stroke, 16in.; length of boiler, 7ft. 1⅜in.; diameter of boiler, 3ft.; pressure of steam, 50lb. per sq.in.;



number of tubes, 97; diameter of tubes, 1⅝in.; firebox—length 2ft., width 3ft., height 3ft. 1in.; area of grate, 6sq.ft. Heating surface of tubes, 302·9sq.ft.; heating surface of firebox, 37·3sq.ft.; total, 340·2sq.ft. Diameter of four-coupled wheels, 5ft. The cylinders were placed low down, the piston-rod passing *under* the leading axle.

There was a single eccentric only for each valve loose upon the driving axle, motion being communicated by studs or drivers. The handles of the reversing gear upon the footplate were therefore constantly moving backwards and forwards during the time the engine was in motion.

The rod of the tender brake passed in a tube through the water tank, and the handle could only be reached by climbing upon the coke.

Length of engine frame, 16ft. 2in.; length of tender, 10ft. Weight of engine in working, 9 tons 9¼cwt.; weight of tender fully loaded, 3 tons 10cwt.; total, 12 tons 19¼cwt.

The chimney of the "Comet," when constructed, was 13ft. in height from the rail level; but as it was knocked down in the Glenfield Tunnel on the opening day, it was afterwards reduced to 12ft. 6in.

Clement E. Stretton.

WATER-MOTORS—ROSE ENGINES.

[29966.]—With regard to the water-motor, the question is, If the speed be kept regular, how can the quantity of water used be proportioned to the work to be done? If we suppose the motor makes forty revolutions, then, whether the lathe be at work or not, whether the motor be running alone at forty revolutions or driving at full power *at the same speed*, it will use the same quantity of water. A water-motor is so excellent a means of driving a single lathe, and the cost of the water so serious a drawback, it is surely worth while to try, if possible, to economise by making the expenditure of water depend on the power given out. The plan suggested on p. 197 was sent partly to draw some one to tell us of something better. I think there must be a better way. Could not the high-pressure water be used for the first part of the stroke, and then, when the proper amount of power had been given out, a kind of slide-valve should allow exhausted water to enter, instead of the high-pressure water, to complete the stroke? Another way would be to vary the length of the stroke according to the power required. I think "T. C." could tell us, or Mr. Wenham, whether the thing can be done?

I was glad to see Mr. Maclean's letter, though I think he is rather hard on amateurs. One must have a little time to look round and count the cost before plunging into such a wide field as engine-turning. I should like to see an exhibition of work produced by the engine lathe: many of us have no notion what it will do. I have only recently acquired Bergeron's grand old book, and can now quite understand "O. J. L.'s" enthusiasm for it. There are some curious examples of work there, and some very pretty imitations of watered silk, &c. I hope "Cape Town" will pursue his investigations, and should be glad to correspond with him.

F. A. M.

4, Clarence-road, Tunbridge Wells.

CUTTER-BARS.

[29967.]—Taylor's bar and Tangye's are very much alike, especially Taylor's. In the former the tool can be taken out sideways; this does not obtain in Tangye's, and is doubtless an improvement.

Fred. Carre asks if the Tangye cutters do not shift sideways. They don't, because they can't, as the tool section fills the slot-hole.

As for the Haydon, it overhangs too much for my liking, and it is not a handy tool. My experience is confined to solid bars and the two cutter-bars—the Haydon and Tangye, so that I do not feel qualified to speak with authority on the subject generally. I have what serves my purpose very well in the latter, and one cannot always be buying new things, so I suppose I object to having my mind improved.

We have many interesting letters on tools. If some of our correspondents would from time to time tell our readers what they have succeeded in accomplishing with their tools, it would form a special feature in our old friend the English Mechanic.

Tuebor.

CONTINUOUS BRAKES.

[29968.]—The Board of Trade Return for the six months ending 31st December, 1888, recently issued, shows that during that period the railway companies reported 711 cases of faults or failures of continuous brakes. It is to be regretted that the return does not include a summary showing at a glance the total number of cases under each heading; I have, therefore, drawn up the following table to give this information.

Class 1 shows "Failure or partial failure to act when required in case of an accident to a train or a collision between trains being imminent." Class 2 shows "Failure or partial failure to act under ordinary circumstances to stop a train when required." Class 3 shows "Delay in the working of trains in consequence of defects in, or improper action of, the brakes," or neglect or inexperience of servants.

Railway.	Brake.	Class 1.	Class 2.	Class 3.
Brecon and Merthyr	Fay's	..	1	..
Cheshire lines	Automatic Vacuum	..	..	8
Do.	Simple Vacuum	..	..	1
Great Eastern	Westinghouse	..	1	109
Great Northern	Simple Vacuum	..	11	4
Do.	Automatic Vacuum	..	..	61
Great Western	Automatic Vacuum	1	2	62
Hull and Barnsley	Westinghouse	..	..	1
Lanc. and Yorkshire	Automatic Vacuum	..	..	23
Do. L. and N.W.	Vehicles	..	..	5
L. and North-Western	Automatic Vacuum	..	..	41
Do. do.	Simple Vacuum	..	7	29
Do. do.	Chain	..	..	3
L. and South-Western	Automatic Vacuum	..	2	20
London, Brighton	Westinghouse	..	..	9
London, Chatham	Westinghouse	..	1	23
London, Tilbury	Westinghouse	..	..	3
Man., Shef. and Linc.	Automatic Vacuum	..	4	13
Do. do.	Simplo Vacuum	..	..	3
M. S. J. and A.	Simple Vacuum	..	1	..
Mersey	Automatic Vacuum	..	..	1
Metropolitan	Simple Vacuum	..	7	3
Midland	Westinghouse	..	1	8
Do.	Automatic Vacuum	..	2	15
Do.	Simple Vacuum	..	1	6
North-Eastern	Westinghouse	..	2	96
Do.	Automatic Vacuum	..	..	2
Rhymney	Westinghouse	..	..	2
Som. and Dorset	Automatic Vacuum	..	..	1
South-Eastern	Simple Vacuum	..	6	1
Do.	Automatic Vacuum	..	..	10
Caledonian	Westinghouse	..	..	33
Glasgow and S.W.	Westinghouse	..	..	11
Do.	Automatic Vacuum	..	..	8
Great N. of Scotland	Westinghouse	..	..	9
Highland	Automatic Vacuum	..	..	3
North British	Westinghouse	..	..	31
Belfast and N. C.	Automatic Vacuum	..	..	1
Dublin W. and W.	Simple Vacuum	..	1	..
G. S. and Western	Simple Vacuum	..	1	..
	Total	1	51	659

Totals.

	Class 1.	Class 2.	Class 3.
For Vacuum Brakes	1	45	321
For Westinghouse Brakes	..	5	335
For Fay's Brake	..	1	..
For Chain Brakes	..	..	3
Total	1	51	659

Grand Total of Reports 711

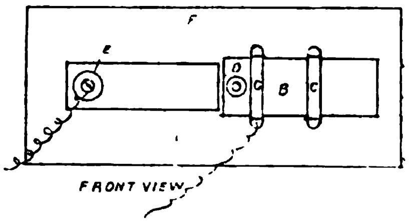
Clement E. Stretton.

40, Saxe Coburg-street, Leicester, May 17.

REGULATOR FOR COILS.

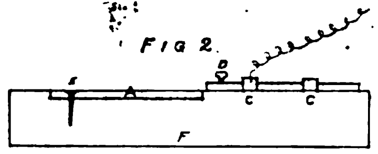
[29969.]—I have devised and am using a new form of regulator for medical coils, a description of which I thought might interest some readers of "Ours." In the accompanying sketch, F is the baseboard, upon which the regulator stands. A is a cake of blacklead, the common sort used for domestic purposes. The largest size I could get was 1½in. long, 1in. wide, and ¼in. thick. This I cut down in two, and joined end to end, making a block 3in. long and ½in. wide. Cut out the baseboard so as to let the block in nearly level; drill a hole through one end of block, through which pass the screw E, with a brass washer under the head; this will serve to keep A in place, and also as a binding screw.

FIG 1.



FRONT VIEW

FIG 2.



SECTION

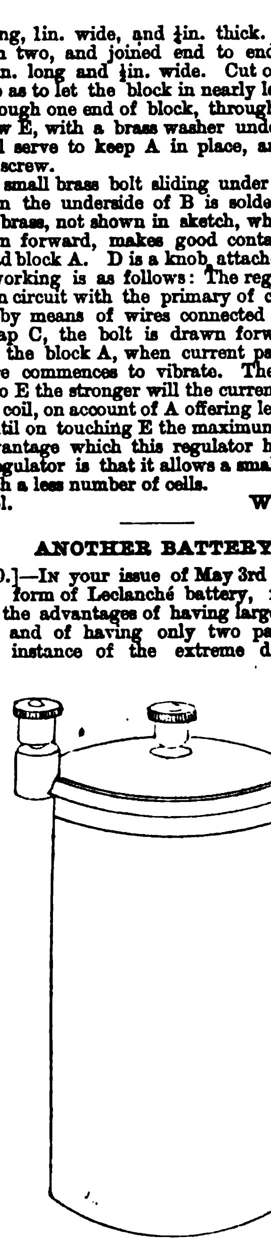
B is a small brass bolt sliding under two straps, C C. On the underside of B is soldered a bit of springy brass, not shown in sketch, which, when B is drawn forward, makes good contact with the blacklead block A. D is a knob attached to B.

The working is as follows: The regulator being placed in circuit with the primary of coil, and the battery by means of wires connected to screw E and strap C, the bolt is drawn forward until it touches the block A, when current passes and the armature commences to vibrate. The nearer B is drawn to E the stronger will the current be passing through coil, on account of A offering less resistance to it, until on touching E the maximum is reached. One advantage which this regulator has over the water regulator is that it allows a small current to pass with a less number of cells.

Bristol. **W. Ridler.**

ANOTHER BATTERY.

[29970.]—In your issue of May 3rd you notice a new (?) form of Leclanché battery, for which is claimed the advantages of having large generating powers, and of having only two parts; and as another instance of the extreme difficulty ex-



perienced in bringing out anything *really* new, beg to call your attention to a battery not unl the above in some respects, which I had the plea of working with as far back as 1886, and for w can be claimed all the advantages set fort belonging to the Holtzer battery, with a few more! From the half-size illustration I send, you will see that this cell is composed of practically one piece (to use your own definition), the glass jar being entirely dispensed with, the carbon forming at once the negative element and the solution containing vessel, it being rendered perfectly watertight by an enamel which is fired into the pores of the carbon during the process of manufacture; into this is suspended a cylinder of zinc, by means of a tightly-fitting cap of insulating material, the cap also serving to render the cell portable and prevent evaporation.

As a proof of the similarity between the Holtzapffel and these batteries, I beg to quote from your description. "There are no fragile parts to be easily broken (*not even a glass jar*); but one strong cylinder of heavy carbon of cylindrical form (corrugated on the inside to increase the surface), having a bending-post secured to it thoroughly protected from salt. Thus has been for several years presented, one of the simplest and most practicable form of Leclanché battery obtainable. The advantages obtained by dispensing with the glass jar are obvious, and the cell has been found most useful for medical batteries, night-lights, portable bells, and, in fact, any purpose in which a powerful, constant, and comparatively light cell is a *sine quá non*, and where space, as is the case in the above-mentioned apparatus, has to be considered. It has also been found that the difference in the cost of carriage between the cell and the glass jar kind is considerable; the sizes and weight of a cell with an output more than equal to a No. 2 Leclanché battery being as follows:—Corrugated cell, with sal-ammoniac complete, 1lb. 2½oz.; dimensions, 3in. diameter by 6in. high overall. Leclanché No. 2, with sal-ammoniac complete, 3lb. 6oz.; dimensions, 3¾in. by 3¾in., 8½in. high overall. These figures, I think, prove the truth of the above statement, and I should have liked, had space permitted, to have given curves showing the fall of potential through a given resistance of these cells in comparison with a Leclanché.

W. J. Woodward.

"Woodbine," Cecil-road, Upton Manor, E.

JOE IN THE BOTTLE.

[29971.]—Having known "Joe" and his inventor for the last six or seven years, I have seen "Joe" act under two or three different arrangements. In one the bottle and table were suspended by an old piece of leather, cutting off all contact except from a hook in the ceiling. I have given up all idea of electricity having anything to do with it, since its inventor asked me one or two very elementary questions about an old electric bell and battery he got hold of some three months or so ago.

Tunbridge Wells. **D. Johnson.**

"NATIONAL" OPEN CIRCUIT BATTERY.

[29972.]—This battery, referred to on page 234, was patented in 1876 by Latimer Clark, Muirhead, and Co., of London. An illustrated description will be found on page 191, English Mechanic, Vol. XXIII.; also in issue for Sept. 7, 1888.

M.M.I.So.S.

ORNAMENTING IRREGULAR SURFACES.

[29973.]—In letter 29939 in the "E. M." of the 17th inst., "F. A. M." tells us that he has learnt many matters of interest from a visit to "C. C. E.'s" workroom, naming two things specially—1. "That a nutshell of irregular shape can be ornamented without first bringing it to truth"; and, 2, "that an irregular-shaped piece of boxwood had been ornamented and hollowed, retaining its original form."

Will it be asking too great a favour of "C. C. E.," or of "F. A. M.," with the former's assent, to describe the apparatus employed?

I know two or three readers of "Ours" who, like myself, possess a lathe with overhead motion, and who wish to be able to do this kind of ornamental work. **Namwen.**

A PIANO FOR EVERYBODY.

[29974.]—And why not? Well, principally, perhaps, because the great makers have not thought it worth their while to cater for the multitude, or it has never occurred to any of them that if they could produce an instrument of good tone, full compass, and fairly portable, the sale of it would be enormous. It would, indeed, supply a "long-felt want." The question arises, Can it be done? Well, it depends what you want. It is a far cry, for example, from the ancient spinet which could be lifted from one table to another with the greatest ease, and the modern ponderous, yet almost perfect, pianoforte. But is it not possible to produce an instrument which combines the good qualities of both? An instrument, for example, a little larger than the spinet, say about the size of the smallest harmonium, and, therefore, fairly portable. It need not be full compass, but might be of the same compass as the harmonium. Of course, it would be impossible to get the long bass strings within so restricted a space, but this difficulty might be overcome by using coiled springs or wire gongs for the lower octaves. The middle and upper octaves might be strung on an iron frame. The action ought to be modern pianoforte action. The object of the designer should be to reduce the size of the instrument as much as possible in order to render it as portable as possible, and to reduce the cost. Such an instrument would find its way into thousands of cottages. It would also be used in church vestries for choir practices, and week-night meetings. It would also have an extensive sale amongst the settlers in the colonies. There are thousands of educated ladies and gentlemen who have emigrated to N.W. America and other newly-peopled lands in all parts of the world, who would be delighted to purchase such an instrument. It would enable them to keep in practice until circumstances permitted them to purchase a larger one. It would also be the means of beguiling many an otherwise weary hour. Such an instrument could not possibly have the full tone of the larger ones; but it would be infinitely better than nothing at all, and would very likely be a superior instrument to that on which the immortal Bach composed his famous fugues.

Wm. Nettleton.

Fitzwilliam-street, Huddersfield, May 16.

CHLORIDE OF HYDROXYLAMINE.

[29975.]—I daresay many of the readers of the "E. M." will remember an article on this substance by Mr. Cassebaum some time since; if I remember rightly, I think the article was taken from an American journal.

It interested me very much, and I asked several queries concerning it; but no one seemed to know anything about, so I determined to experiment myself. My first difficulty was to obtain the hydroxylamine chloride itself; but finally I obtained some of excellent quality from Messrs. Burgoyne, Burbidges, and Co., of London.

A word here about the making of the chloride. In my difficulty about getting some I attempted to make it, and, when it was finished, one of my friends congratulated me on the fact that my product gave distinct indication of the presence of hydroxylamine—in fact, it contained about 10 per cent. —and as he is a reliable authority, I would advise no amateur to try making it himself, as it is almost impossible on a small scale. My finished product had been saturated with H_2S, filtered, and again saturated with H_2S and filtered, and yet there was about 90 per cent. of SnA_2 in it.

To return. Having obtained my chloride at the moderate price of 2s. 6d. per ounce, I commenced experimenting. At first I was not very successful, owing, I think, to the nature of my alkaline solution; but after some trials I discovered a developer which any amateur can easily make, and which gives excellent results. The following is my developer:—

A.—Pyrogallic acid, 1oz.; sulphurous acid, 3oz.; sodium sulphite, 4oz.; water, 4oz.

B.—Ammonia (·880), 1oz.; sodium sulphite, 1oz.; potassium carbonate (pure), 3oz.; water, 8oz.

C.—Hydroxylamine chloride, 1oz.; water, 2oz.

For use, to 1½oz. of water add 20 drops of A, 10 drops of B, and 6 drops of C. The solution C will also be found very useful as a restrainer.

This developer is a considerable modification of Beach's developer. I find that the carbonate of potash alone is too slow for general use. I have some negatives developed with the above developer which look almost like ferrous oxalate development.

I have not tried any lantern slides yet; but from the colour of the negatives I should say that it would do equally well for them.

F. C. Lees, O.L.

PARAFFIN AND PARAFFIN-OIL.

[29976.]—In these few letters I will explain the process by which paraffin and paraffin-oil, &c., are obtained from shale; but before doing so, it will be best to give a short account of how this important branch of science was discovered.

The first to manufacture paraffin and paraffin-oil on the large scale was Mr. James Young. He was the manager of Messrs. Muspratt's chemical manufactory in Liverpool; while there, his attention was drawn by Dr. Lyon Playfair to a coal-working at Alfreton in Derbyshire, where there was petroleum dripping from the roof. The yield of petroleum being 300 gallons a day, he at once commenced to refine it. The supply did not last long, but during this period his study was devoted to the question of how this petroleum was produced by nature. His idea was that the coal had got gradually heated in some way or other, and vapours were given off, which, on passing through the layer of sandstone which lay immediately above the coal, had got condensed into a liquid state, so he tried an experiment to illustrate this natural production. He put some coal into a close vessel connected with a series of pipes and applied a very gentle heat to the vessel—a gas was given off, which was condensed on passing through the pipes into a liquid, which had the very same properties as the natural oil. He patented his process on the 17th of October, 1850, for seven years. He entered into partnership with Mr. Binney and Mr. Meldrum, and erected a work at Bathgate for the distillation of a mineral known as Boghead coal or Torbanehill mineral, found in a field near Bathgate. It did not pay them the first seven years, owing, no doubt, to the slow sale of their products. The sale of the oil began about the time of the Crimean war, when commerce between this country and the Russians was at a stand, and tallow for candle-making became very scarce. Mr. Young patented his process for another seven years, and made enormous profits by his products. The paraffin-oil at that time was very yellow in colour, having a bad smell, and the price was 3s. 6d. per gallon for burning-oil, about seven times the price at present, and 7s. 6d. for lubricating-oil. In the year 1864, after the expiry of Mr. Young's patent, oil-works sprung up in great numbers over all the shale fields in Scotland. Soon afterwards they overflowed the market with oil, which ended in the destruction of most of the smaller companies.

I need not go further with the history of the paraffin-oil trade, but start to explain the process by which paraffin and paraffin-oil are extracted from shale at present.

The first part of the process is the Destructive Distillation of the Shale. This is conducted in large iron vessels called retorts. There are various forms of retorts, but the one I will describe is the Henderson patent retort.

Fig. 1 is a sketch of this retort; A is the retort made of cast iron, of an oval section; B the oven built of brickwork. At the bottom of the oven B there is a fireplace, C, with a brick arch, E, having an orifice, F, and a brick flue, G, leading half-way up into the oven B. The furnace C has a brick wall, D, with an opening up the centre to lead the non-condensible gases into the furnace C, which helps to heat the retort. The products of combustion off the furnace C are led up through the flue G, and spread over on each side of the top of the retorts, travelling to the bottom, and finally out by the chimneys H. The bottom of the retort has an outlet pipe, N, leading to a condenser, to condense the vapours of the shale, and an opening, L, to allow the spent or exhausted shale to fall into the furnace C; this opening has a door, M, luted with some suitable material, such as fireclay. The door M is placed firmly on the opening L by a lever, Q, and a wedge placed on each side of it. The products of combustion off the furnace C are prevented from heating the door M by a valve, P, which is arranged on a hinge so as to shut while the door M is on, and to open when it is off, and guide the spent shale into the furnace C. The grating S at the bottom of the furnace C is arranged on hinges, so as to allow the front part to be lowered, and the burnt shale allowed to fall into bogeys. The shale as it comes from the mines is a brittle solid, resembling a piece of coal, and when placed in the fire it burns, leaving a great

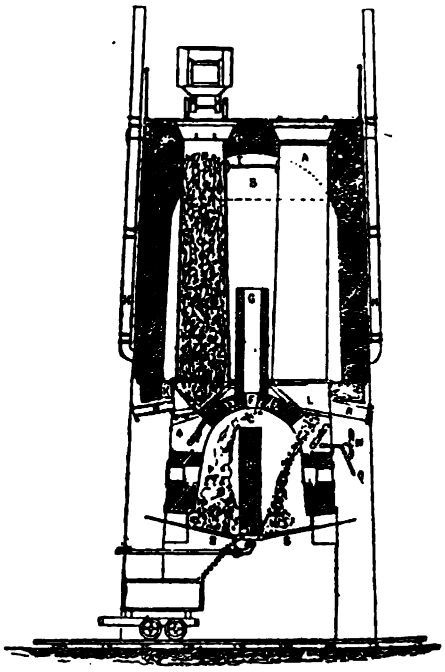


Fig. 1.—Cross Vertical Section of the Henderson Retort

deal of ash behind. When treated with solvents there is nothing dissolves, showing, therefore, that the products obtained from it are produced by destructive distillation. It is passed through two toothed rollers, called the breaking machine, which breaks up the shale into pieces a little larger than an egg. The broken shale is conveyed along the top of the retorts in bogeys and dropped into them. A lid is placed on the top of the retort and luted with sand.

The first charge of shale in this retort is heated with coal; after the shale has been exhausted of all its products, the grating S is lowered, and the burnt coal allowed to fall into bogeys. The grating is now drawn up, and the door M taken off and the valve P opened, so as to allow the spent shale to fall into the furnace C. This spent shale still contains about 9 per cent. carbonaceous matter, which burns with the air passing in by the grating S, and serves to heat up the next charge of shale; so when the retorts are once started they never need coal. The shale in the retort takes about sixteen hours to exhaust itself. They are arranged in benches, so that when one side of the bench is working the other side is being taken off. When the retort has reached a dull-red heat vapours are given off the shale, which are drawn by fans down the pipe N through a main, which condenses most of the crude oil; the ammonia gas and steam, along with the non-condensible, pass through a series of pipes standing vertically in the air.

These pipes condense the steam into water, which holds the ammonia gas in solution, and the non-condensible gases pass through pipes to the retorts, where they are used for illuminating them at night, and help to heat them up. The crude oil and ammonia water is run into a tank, where the ammonia water falls to the bottom, owing to it having a higher specific gravity than the crude oil. The tank is fitted with a stopcock at the bottom, which serves to run off the ammonia water from the crude oil into another tank. There is about 65 gallons ammonia water of 2¼° Twaddle or specific gravity 1·012 equal to 0·227lb. sulphate of ammonia per ton of shale. The ammonia water is made into sulphate of ammonia, which farmers use for cultivation. The crude oil varies in quantity, according to the shale; but the average amount is about 30 gallons per ton of shale, having a sp.gr. of about ·860. The temperature of the Henderson retort does not exceed 1,000° Fahr. scale. The retort must be kept at a low temperature to obtain good crude oil; if it is allowed to get up to a bright red heat more ammonia and non-condensible gases are obtained, but less crude oil, which has a tarry composition, and will not refine.

Broxburn. **Thomas Clarkson.**

USEFUL AND SCIENTIFIC NOTES.

THE inside railway service of the Paris Exhibition has been undertaken by M. Decauville, of Petit Bourg, who has supplied and laid down a double line of 24in. gauge, and steel rails of 19lb. per yard, fitted with his patent steel sleepers and base plates. The line is 3½ miles—six kilos.—in length, the starting point being the Gare de la Concorde, which is the principal entrance to the Exhibition, opposite the Ministère des Affaires Etrangères. The lines traverse the Esplanade des Invalides, Quai d'Orsay, Pont d'Alma, Eiffel Tower, and thence to the Galerie des Machines, opposite the new Bastille. There are, besides the two termini, Gare de la Concorde and Galerie des Machines, three intermediate stations: (1) Pont d'Alma, (2) Palais d'Alimentation, (3) Tour Eiffel. The service will be effected with ten locomotives and 100 carriages of new and various designs, the trains following each other every ten minutes from nine o'clock in the morning until midnight. There will therefore be 188 trains per day during the week, and, if necessary, 300 will run on Sundays. Visitors to Paris interested in portable railways should visit his works at Petit Bourg, where they will be able to gain some idea of the enormous extent of the various departments, and also see at work the powerful tools and machinery. The works are connected with the main line at Corbeil by his electric tramway of 24in. gauge, which every Tuesday and Friday meets the trains leaving Paris at 11.20 and 1.30, enabling visitors to return to Paris by the express leaving Corbeil at 4.39, arriving at Paris at 5.20.

IN his paper on Secondary Batteries, recently read before the Society of Arts, Mr. W. H. Preece recommends the following mixture for the electrolyte of these cells: To a quart of saturated carbonate of soda solution, add slowly, during continuous agitation, 12 fluid ounces of strong sulphuric acid; fill the cell slowly with water 19 parts, strong sulphuric acid 5 parts, soda solution 1 part; total 25 parts. The specific gravity of the electrolyte should be 1·210. The soda solution prevents sulphating.

LEPROSY is increasing in Russia. During the last ten years 49 patients were treated in the St. Petersburg hospitals, half of whom were natives of the city. The Baltic provinces suffer most from the disease.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67995.]—**Ivory.**—In "Nun. Dor.'s" answer to "Pommes de Terre," he says that "the best imitation or substitute for ivory is celluloid, but that substance has not the grain of ivory." "Nun. Dor.," though usually well posted, is quite behind the times so far as the advances in the technique of the manufacture of that most protean of all materials (celluloid) are concerned. I inclose you herewith a slip of celluloid ivory, in which the grain is marvellously well imitated, and I have lying on the table before me a slab 5in. long, 3in. wide, and ½in. thick, in which the appearances of the natural product are so faithfully imitated that I doubt if anyone without the aid of chemicals or the microscope could tell the false from the true. Not only are the longitudinal striæ most accurately followed; but at the ends the concentric arrangement of the natural lamellæ is preserved. I have not tested the specific gravity of the imitation; but it must be very close to that of the natural ivory. Among the more recent imitations of natural products, with celluloid as a basis, I may note Mexican onyx, moss agate, cornelian, tortoiseshell, and similar semi-lucid substances, and all so faithfully copied that only by "hefting" can the imitation be detected.

FRANK L. JAMES.

P.O. Box 568, St. Louis, U.S.A., May 7, 1889.

[68035.]—**Battery Transformers (U.Q.)**—I quote from "Dynamo-Electric Machinery":—"A large number of storage batteries are to be charged in series at a high potential, the series afterwards divided up or rearranged so as to discharge larger currents at lower pressure. This system is applicable to direct-current working only, and not to alternating currents, and has the advantage of storing the consumer's supply." VOOGHT.

[68230.]—**G.W.R. Automatic Vacuum.**—If I might be allowed to be so impertinent as to advise anyone, I would make the pertinent remark that it is just as well to understand just a little of a subject before rushing into print. "B. R. W." (p. 243) doesn't think the Westinghouse "can beat the automatic vacuum" as a train stopper; but there is no necessity for him to "think" at all, because the proofs that the Westinghouse is the quickest train-stopper have been published and are available to all. But what a funny notion to think that stopping the "wheels running round" is what is required in a brake! Why, that is just what is not required; for if you could stop every wheel in a train at once, you would simply skid along on two surfaces of polished (not to say burnished) steel. No; you want to check the speed of rotation of the wheels—not stop them all at once. NUN. DOR.

[68335.]—**Dynamo.**—If "Hopeful" cannot find dimensions of a dynamo suitable to his purposes in back numbers, I do not know where he can find them; for anyone who has glanced over the pages of the ENGLISH MECHANIC during the last two years, say, must have been surfeited with dynamos—at least, I should think so. C. M.

[68339.]—**Paraffining Carbons.**—If our querist "F.R.Met.Soc." had actually tried "Sigma's" method, he would not have sent his query. It is as simple as A B C. You wet the parts of the carbon where you don't want the paraffin, and then you copper the parts where connection is to be made, which is done, of course, with a "wet" solution.

NUN. DOR.

[68340.]—**Camera on Bicycle.**—Is "Brassy" so helpless that he cannot make a couple of rods to support his "bike," while the camera is clamped to it by anything suitable. What is his difficulty?

PERIPATETIC PHOTO.

[68347.]—**Mercury Removing.**—If the aluminium is heated in an oven the mercury will be driven off in vapour; or the querist can apply the blowpipe. At any temperature over 675° Fahr. mercury boils, and consequently it is easily driven out of any amalgam by raising the temperature.

J. T.

[68350.]—**Telephones.**—"Signal" can find all the information he requires in back volumes. The quantities of wire he has on his magnets will do, and he can use ordinary telegraph wire for the "line." A couple of Leclanchés at each station will give him all the "power" he needs. He should look up his back numbers, as this subject has been described almost more fully than the dynamos.

C. M.

[68352.]—**Exhaust Steam.**—The objection to turning the "exhaust" into a chimney is that the steam ruins the mortar of the chimney. The query is, however, rather a funny one. Is it an examination question? X.

[68353.]—**Electro-Plating on Ferns, &c.**—"Beginner" will find a useful article on "Plating Organic Bodies with Metal" in No. 908. It is by Dr. F. L. James, of St. Louis, and gives several methods. If "Beginner" cannot procure that number, I will make an extract from the article, which shall give him all the information he really needs; but "coppering" is a rather inferior process. Why not silver? NUN. DOR.

[68355.]—**Brass Casting.**—Make the core in the ordinary way, as frequently described, then cover with finely-ground plumbago.

T. M. J.

[68356.]—**Amber Varnish for Violin.**—Don't understand about violin. Amber varnish is the same for any purpose, and is made by melting amber in an iron pot and adding pure linseed oil. Take 6lb. of pale clear amber, fuse, and add two gallons of hot clarified linseed oil. Boil until it "strings," and when nearly cool add four gallons of turpentine. See p. 358, Vol. XXVII.

NUN. DOR.

[68358.]—**Small Forge.**—I would recommend "Amateur" to procure No. 1,141, and study the article on p. 491. He can also find diagrams of forges in many back volumes. Of course "Amateur" does not say whether he wants a portable or a fixed forge. T. J.

[68362.]—**The Mass of a Binary Star.**—The formula for any planet is $\frac{a^3}{T^2} = 1 + m$.

$$\left.\begin{array}{l} a = \text{distance from sun} \\ T = \text{revolution} \end{array}\right\} \text{Earth equal to unity.}$$

m = mass of planet; sun equal to unity.

For Jupiter we have—

$$\begin{array}{l} 3 \log. a = 2{\cdot}14871 \ \text{(to save printing)} \\ 2 \log. T = 2{\cdot}14830 \ (2{\cdot}14830) \\ \hline \end{array}$$

$$\log. (1 + m) = 0{\cdot}00041$$

$$(1 + m) = 1 + \frac{1}{1050}.$$

Is this what "Finsbury" wants? TRIA.

[68391.]—**Hot-Water Circulation.**—I have no means of testing the actual bursting point of ⅛ compo., but adhere to my opinion that it is insufficient to stand 65lb., to say nothing of the workmanship. SKIBO.

[68432.]—**Apropos of Horn.**—The inability of the French Government to procure it, at a time of war with Great Britain for use in lighthouses and ships' lanterns, caused them to apply to a *savant*, M. Alexis Rochon, for a substitute. He then invented, in March, 1798, a transparent material of a resinous varnish nature, formed on a woven wire foundation, and applied it to the purposes for which horn had been used, and to roofs of buildings. It is interesting to note that a company has just been formed to work this invention as a *novelty*.

WOODFORD.

[68467.]—**Coach Painting.**—My chief difficulty is in the picking out. It seems almost impossible to get the lines truly straight. I think there must be some sort of gauge used. Would it be asking too much of the gentlemen who replied to tell me if they know of any?

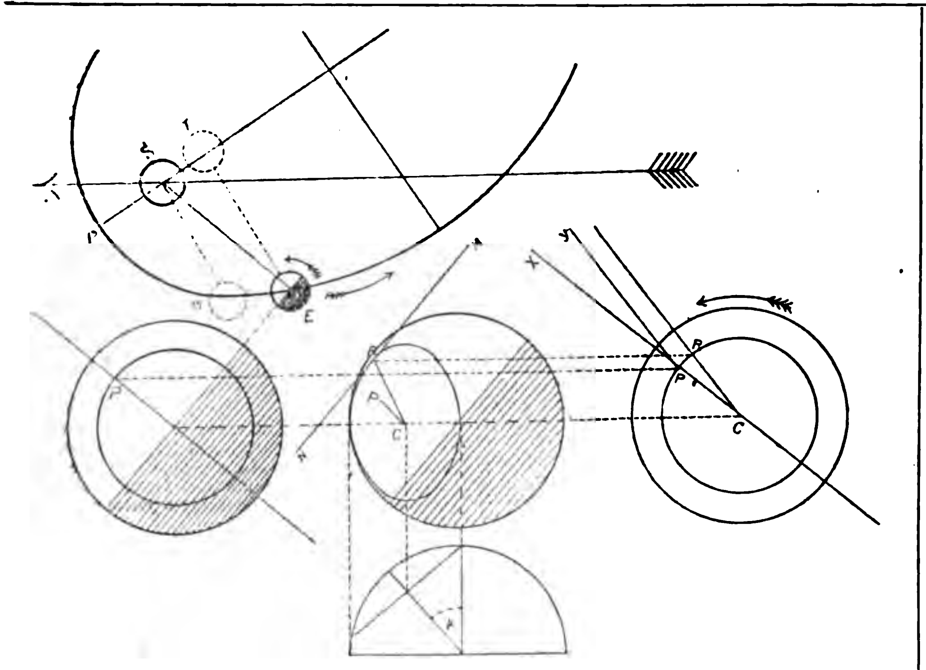
A POOR BLACKSMITH.

[68477.]—**Induction Coil.**—"No Induc." does not state anything about his condenser. I expect the chief cause of his trouble lies there; try a condenser such as I named in my article. Any further particulars "No Induc." may require I shall be pleased to give. F. W. MASON.

[68530.]—**Great Western Broad Gauge Engines.**—Swallow, Prometheus, and Amazon passengers, Europa, goods, Bristol; Avonside, passenger, Exeter; Alma, passenger (? shed); Fenton, Hawk, Gooch, and Hackworth passengers, Taunton; Bulkeley, Buffalo, and Whetham, shunting, Exeter; Bulkeley, Lightning, Courier, Emperor, Sultan, and Tornado, passengers, Bristol; Python, shunting, Plymouth; Pluto, passenger, Plymouth or Newton Abbott; Sol, Prince, and Stag, passengers, Newton Abbott; Elephant and Saunders, shunting, Bristol; Magpie, passenger, Swindon (?); Melling and Pollus, passengers, Plymouth; Rover, passenger, Bristol; Argo, goods, Plymouth; Eupatoria, and Queen, passengers, Bristol; Dewrance, passenger, Exeter (?); Camel, goods (? shed); Sebastopol, Balaclava, Lord of the Isles, and Iron Duke, passengers, Bristol; Sir Watkins, goods, Bristol; Zebra, passenger, Plymouth; Crimea, passenger, Bristol; Murdoch, passenger (? shed). The above is a list of all the names of broad-gauge engines that I know. I have no absolutely certain information as to what sheds they are stationed at. I have mentioned those which they are known to frequent.

W. E. C. B.

[68384.]—**Mean and Apparent Time.**—This query by "W. H. H." has been replied to b "F.R.A.S.," but I confess that I never co understand explanations where the Ecliptic Equator are both brought in; and, without n ing any disrespect to the Equator, I think th means of ordinary "projections" and ana geometry, the subject can be made clear



reference to the Equator at all. The upper part of the figure represents the orbit of the earth, the eccentricity of which is greatly exaggerated; the long horizontal arrow is drawn through the sun and the winter solstice, and points out the direction in which the N. pole is made to lean away from the sun at the solstice, the axis keeping parallel to itself at all times. We know, from Kepler's laws, that the earth travels faster when near the ends of the ellipse than when near the middle, so that if we suppose an imaginary earth, M, which describes equal angles in equal times round the sun, the real earth E will be before the mean moving earth, and the angle M S E will represent in minutes of time (taking 360° = 24 hours) the difference between mean and apparent time, so far as the ellipticity of the orbit is concerned. If we draw T E parallel to S M, the angle T E S = M S E; the dotted sun T may, therefore, be considered the "mean sun," and S the apparent sun, and, as the mean sun evidently crosses the meridian before the apparent sun, we must add the time represented by the angle S E T to the apparent time in order to get the mean time. In other parts of the orbit we shall have to add or subtract, according to the season. The angle M S E = T E S = $2e$ sin. P S M, as found by "Kepler's Problem," which was discussed in former numbers of the English Mechanic. Now, suppose the axis of the earth to be perpendicular to the plane of its orbit, as represented (enlarged) by the circle on the left, and P a place on any parallel of latitude; also suppose that the earth goes round the sun at a uniform angular speed, it would be mean noon at P; but suppose the axis to be inclined to the vertical at an angle A (see bottom of figure), then the circle of latitude becomes an ellipse, as in the middle circle, and in order to find the noon point on the ellipse, we must draw a tangent M N at right angles to the direction of the sun's rays, touching the ellipse at R; then the angle P C R, when spread out flat as in the right-hand circle, represents, in minutes of time, the difference between mean time and apparent time accruing from the inclination of the axis. To find whether we are to add or subtract this difference to the observed time in order to get mean time, we may transfer the angle P C R to the point of observation P. The direction of the observed sun will then be P Y, and that of the mean sun P X; the result of tilting the axis has therefore been to move the sun (as it were) to the west, that is, to put the clock on; the mean time will therefore be slower than the apparent time, and so we must subtract from the apparent time.

Bath. M.I.C.E.

[68518.]—**Compressed Air.** — For a water-jacketed compression pump you may take it that the air is compressed isothermally—i.e., the compression curve follows Boyle's law. Also, in ordinary engineering practice, no one bothers about the decimal as to the exact pressure of the air, but it is taken as 15lb. per square inch; then ratio of compression = 60 ÷ 15 = 4, absolute work done by expansion (or work required to compress) of a gas, according to Boyle's law $= \left(P \times \frac{1+h}{R}\right) \times D$, where P = initial (or maximum) pressure, h = hyperbolic logarithm (see tables in "Molesworth"), R = ratio of expansion (or compression), and D distance moved in feet. Thus, in our example, since 10c.ft. at 60lb. are required, 40c.ft. at 15lb. are necessary; then mean pressure compressing to (or expanding from) 60lb.:

$$= \left(60 \times \frac{1 + 1\cdot386}{4}\right)(-15) = 36\text{lb. effective,}$$

since the atmosphere helps by 15lb. per square inch. To find the work required per minute, assume compressor piston to be 1sq.ft. in area, then piston speed must equal 40ft. per min., or work done = 36 × 144 × 40 ÷ 33,000 = 0·157H.P. about, theoretically, or 5,200ft.-lb. of work per minute. Now, 772ft.-lb. = 1 thermal unit (Joule's equivalent—(i.e., 1lb. water raised 1° Fahr.); therefore, 5,200 ÷ 772 = 6·74 thermal unit. Next, taking weight of air at 0·0872lb. per cubic feet, we have total weight of air as 0·08072 × 40 = 3·2288, and, taking sp. heat of air at 0·24, the thermal units corresponding to 1° rise of temperature = 3·2288 × 0·24 = 0·775 = 8·7° Fahr., as the temperature rise due to this work done. Of course, if allowed to rise in temperature, the work required to compress the air is greater, and the temperature becomes higher still. I only give the above to explain the method. As to the quantity of water required to cool the above quantity of air, you don't say to what temperature it is allowed to rise, which is an essential factor in the problem. If it is allowed to rise to the temperature of the air 60° Fahr.; then since each pound of water takes up (60 − 40) = 20 thermal units ∴ 6·74 ÷ 20 = 0·337lb. = roughly, $\frac{1}{30}$ gallon, which should be injected into the pump, as such a small quantity would be troublesome to pass through a jacket; but it has the defect of reducing the efficiency of the refrigerator by not allowing the temperature of the air to fall so low. As to the second part of your query, I must point out that it is contradictory. You suppose it to escape into a receiver of a volume = 200c.ft., and yet suppose it to retain its initial abs. vol. and pressure = 15lb. and 40c.ft. If it expands twenty times, by Boyle's law the abs. press. should be = $\frac{60}{20}$ = 3lb.; but you will find it is very much lower in practice, the reason being that as it expands it falls in temperature, thereby contracting, and, in fact, behaving exactly as if the the vol. were really much larger than it actually is, and this cooling is the essence of the whole business, and the amount of cooling is that due to the thermal equivalent of the work done by the escaping air, at the range of expansion given = 20, or, what comes to the same thing, the giving out of the expanding air; the work put into it by the act of compression, and afterwards extracted, this necessitates a fall in temperature. Imagine a cylinder, fitted with a piston free to move, the cylinder being 200ft. long and 1sq.ft. area, and the piston at one end, which is fitted with a cover and a passage connecting it with the compressing pump. On the compressor, discharge valve lifting air is admitted to the expansion cylinder, driving it forward 10ft.—i.e., the volume is 10c.ft., as there is no expansion there is no fall in temperature. Work is done, it is true; but it is equal and opposite to that done on the compressor piston, so the two balance. The air supply is now cut off, and the piston moves forward under the expansive force of the air behind it. Now the mean pressure behind the piston may be expressed by the formula first mentioned—viz., $P \times \frac{1 + h}{R}$ where P = the initial absolute pressure. 1 represents the portion of the stroke done before the air is cut off, h = hyperbolic logarithm of R, which = ratio of expansion. Now, with the first part of the stroke we have nothing to do. Heat must be supplied from somewhere, it is true, because work is done; but that heat is supplied to the compressor piston in the form of a mechanical push. The latter part of the stroke is that which causes the fall of temperature. The hyperbolic logarithm of a number is the ordinary logarithm of the number by 2·302585. The common logarithm of 20 = 1·30103 = roughly 2·995, and therefore mean pressure = 60 × 0·14975 = 8·985. This pressure acts through 200 − 10 = 190ft., therefore work in foot-pounds = 8·985 × 190 × 144 = 245,829ft.lb., and the thermal units corresponding to this = 245,829 ÷ 772 = roughly 3,184 T. units. Now, since we have 3·2288lb. of air, which will give out 0·775 T. units per degree Fahr. fall in temperature ∴ 3,184 ÷ 0·775 = 4,100 about = fall of temperature in degrees Fahr., and since we start with a temperature = 60° we get a temperature of − 4,040 Fahr.! Clearly absurd; but this certainly follows from well-known laws; and the expansion must be regulated to suit the desired temperature. If, for example, we expand it 10 times, then we have 23 T. units, corresponding to a fall of temperature of 30° Fahr., and the air is supplied at a temperature = 2° below freezing point. Of course, all the foregoing assumes that the air is perfectly dry. A very small proportion of water in the air will cause an enormous reduction in the range of temperatures given above, even when the air is not reduced to freezing temperature, but only "cooled." If, however, it is reduced below freezing-point, then the effect is even more marked, since each pound of water requires 147 T. units to freeze it—i.e., 147 T. units is the "latent heat" of 1lb. of ice at 32° Fahr. Of course, the air may be expanded in a cylinder connected to the same crank-shaft as the steam cylinder without affecting the foregoing calculations, when the "efficiency" of the apparatus is about 0·6 —i.e., for every 100ft.-lb. of work expended in compressing the air about 60 is returned to the crank-shaft, and only 40 have to be supplied by the steam boiler. In the "Bell-Coleman" machines, as used on board ship, the expansion is so regulated as to give a temperature of about 70° of frost—i.e., about − 38° Fahr.

Govan. Engineer.

[68552.]—**Maxima and Minima.**—The various expressions for the area given in the replies to this query, though differing in form, are, of course, all identical. Taking "J. R. C.'s" as the simplest—namely—

$$S = \frac{\sqrt{2}}{\sqrt{1 - x^2}} - \frac{x}{2\,(1 - x^2)}$$

$$\frac{dS}{dx} = \frac{x\sqrt{2}}{\sqrt{(1 - x^2)^3}} - \frac{1 + x^2}{2\,(1 - x^2)^2} = 0$$

whence $x = \pm \frac{1}{3}\sqrt{3}$

$$\frac{d^2S}{dx^2} = \frac{\sqrt{2}}{\sqrt{(1 - x^2)^3}} + \frac{3x^2\sqrt{2}}{\sqrt{(1 - x^2)^5}} - \frac{x}{(1 - x^2)^2} - \frac{2x\,(1 + x^2)}{(1 - x^2)^3}$$

Putting $x = \frac{1}{3}\sqrt{3}$ we get—

$$\frac{d^2S}{dx^2} = 0.$$

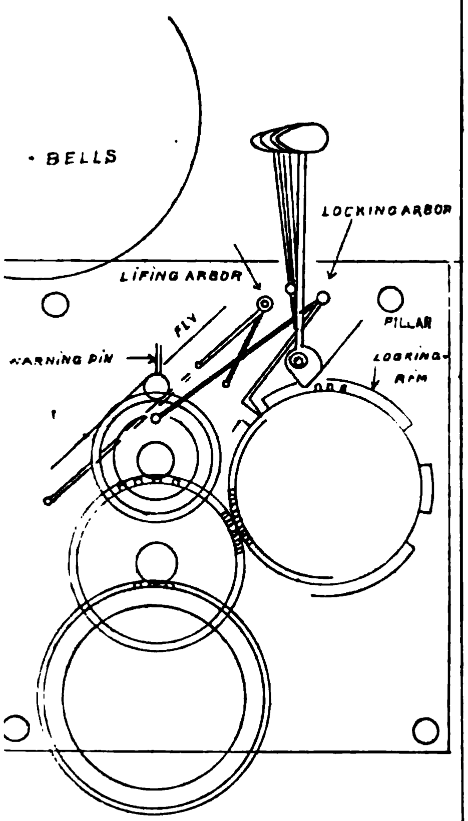
This would be negative if the value for x made the area a maximum, and positive if it made it a minimum. We have only found a point of contrary flexure in the curve, which the first equation above defines. W. J. A.

[68558.]—**Chiming Clock.**—To Mr. C. A. Jones.—Many thanks for reply. The only part I do not understand is why the barrel makes two revolutions per hour. I have marked off mine to make only one revolution per hour, and work it off the great wheel with a locking-plate movement. I am sure a full description of how to add a chiming train to a clock, with diagrams, would be very interesting and acceptable to many readers.

Nemo.

[68558.]—**Chiming Clock.**—To C. A. Jones.—My present movement is on the rack striking. I have made a new train and frame-work—there is room in the case for it. My plan was to make it a four-quarter clock; but I considered that I should like it to chime the Cambridge chimes, and I shall be glad for more information how to proceed, what diameter the barrel should be, and how should I pin it, and how should I fix my bells? What would the bells cost, and how many should I want? You say it will take a weight of 28lb. to drive it—I must say that a 5lb. weight will drive my new train empty. Which of the works is the best for this job, Reid's "Watch and Clockwork," or Britten's Handbook? F. T.

[68558.]—**Chiming Clock.** — A chiming apparatus can be made out of an English eight-day movement, without having to purchase anything except the bells. The going barrel can be converted into the pin-barrel by removing from it the great wheel, motion being imparted to it by removing the centre wheel of going train from its pinion, and fixing it to the pin-barrel arbor, so that it can gear with pin-wheel in striking train. The rim on the pin-barrel should have four notches, dividing it into the four quarters, the space between each locking notch being in proportional distances to hold 4, 8, 12, and 16 pins respectively. A locking plate being fixed to warning wheel on striking train, and a warning pin being fixed on fly-arbor, the chiming train can be locked in the same way as an American clock. The movement would have to be fixed on the top of the clock-case, and the weight to drive it would have to hang down the outside of case. A small wheel of 10 teeth, with a snail attached to it, and geared with the minute-wheel of the clock itself, would go round four times an hour, and release chiming train by means of suitable lifters and a long rod reaching up through clock-case to the chiming lifter. The hammer-tails may be made out of gunmetal and faced with watch mainspring, the watch-spring projecting so far as to reach clock or chiming movement pillar, and so be utilised as hammer springs. The fly-pinion must project through clock-plate, and the fly be attached outside, and must be of good size. I have a clock such as this chiming now.



PEGWOOD.

[68566.]—**Diaphragm of a Dumpy Level.**—I have just done such a job. The webs are in the eyepiece; unscrew this, and you will find the place. They are stuck on with some cement, the places for them being marked with a slight line. Use one strand of the finest silk. For cement I used glue and whiting; diamond cement would no doubt be preferable. BOFIN.

[68567.]—**Meat-Preserving Solution.**—Solution of bisulphate of lime is used for preserving meat. It can be made as follows:—Sulphite of lime (plaster of Paris), 250 parts; sulphuric acid, 100 parts; water, 1,000 parts. Mix the acid and water, and, when cold, put it into a strong bottle, and add the sulphite of lime. Now cork tightly, and agitate well. The liquid can now be strained with expression and filtered. A. HUNTON.

[68571.]—**Calculus.**—In my reply, near bottom of page, "1" has been printed instead of a, the expression should be $\frac{a^2}{2}\,\text{sin.}^{-1}\,\frac{x-a}{a} + c$. Also, near the end, "whence" should be when. The whole indefinite integral referred to has been correctly printed in "A. H. G.'s" reply, but with a contrary sign to that given by Todhunter. My method of using the constant may be thought unnecessary, as the same result is obtained without it; but if the question was asked by a beginner, it is well that he should learn both methods. If in "A. H. G.'s" indefinite integral we substitute $-2\,\text{sin.}^{-1}\sqrt{\frac{x}{2a}}$ for $\text{sin.}^{-1}\left(\frac{a-x}{a}\right)$, then the whole expression vanishes when $x = 0$, and, therefore, no constant is required; we can make this substitution because both of these expressions have the same diff. coeffit. In "J. R. C.'s" solution I think a minus sign is wanting in the first algebraic line.

Bath. M.I.C.E.

[68571.]—**Calculus.**—The equation to "Ion's" curve may be written—

$$y = \frac{x\sqrt{(2ax - x^2)}}{a}.$$

For every value of x less than $2a$ there are two values of y equal in magnitude, but of opposite sign; the curve is therefore symmetrical on either side of the axis of x. Negative values of x make y impossible; hence no branches exist to the left of the axis of y. The area of the whole curve will consequently be

$$\frac{2}{a}\int_0^{2a} x\sqrt{(2ax - x^2)}\,dx.$$

By a formula of reduction the indefinite integral may be put in the form—

$$\int x\sqrt{(2ax - x^2)}\,dx = -\tfrac{1}{3}(2ax - x^2)^{\frac{3}{2}} + a\int\sqrt{(2ax - x^2)}\,dx.$$

$$\therefore \int_0^{2a} x\sqrt{(2ax - x^2)}\,dx = a\int_0^{2a}\sqrt{(2ax - x^2)}\,dx.$$

The latter integral is known—viz.:

$$\int\sqrt{(2ax - x^2)} = \frac{x-a}{2}\sqrt{(2ax - x^2)} + \frac{a^2}{2}\,\text{sin.}^{-1}\,\frac{x-a}{a}.$$

$$\text{Therefore}\quad a\int_0^{2a}(2ax - x^2)^{\frac{1}{2}}\,dx = \frac{a^3}{2}\left[\text{sin.}^{-1}(1) - \text{sin.}^{-1}(-1)\right] = \frac{\pi a^3}{2},$$

which makes the area of the whole curve $\frac{2}{a}\cdot\frac{\pi a^3}{2} = a^2\pi$.

Portsmouth. A. M.

[68575.]—**False Notes on the Violin, &c.**—These are notes of faulty intonation, from which few, if any, instruments are entirely free. Such a note is called a "wolf." The notes which "W. L." hears are probably harmonics thrown off by the sounding string, or due to the sympathetic vibrations of the other strings; or they may be the result of bad bowing, the bow brushing the other strings as it travels along the sounding string. To answer the question positively, one must know—(1) Are the notes which "W. L." hears in the series of harmonics on the note played—as, for instance, does he hear its octave or twelfth?—or are they altogether foreign notes? (2) Does "W. L." by "stopped" notes mean notes actually damped, or merely technically "stopped"? Anyhow, the notes he hears prove nothing as to the quality or tone of the instrument. C. J. TAHOURDIN.

[68576.]—**Engine for Lathe.**—Your engine will be too small for a 5in. lathe; it will be nothing but a toy, though the two cylinders at 80lb. might drive the lathe for a light cut. BOFIN.

[68578.] — **Relay.** — I do not think that "B. R. W." will require a relay at all. A much better dodge is to put a shunt of fine wire across the bell terminals, the resistance of which must be high enough to allow the bell to work comfortably. Besides answering the purposes of a relay, it tends to reduce sparking at the bell contacts.

A. H. GIBSON.

[68579.]—**Concrete Walls.**— 1. Make your bottom story 2ft. thick, diminishing to 1ft. 6in. above. 2. You can make the concrete 6 to 1—that is, 6 parts of broken stone, sand, &c., to 1 of Portland cement. 3. You can reckon the cube yards required in above; but the quantity of cement will vary somewhat with the quality of sand and broken stone: be most careful that this is perfectly clean—everything depends on this—and use coarse sand. 4. There is a cheap work on concrete, published, I think, by Weale. BOFIN.

[68582.]—**Medical Electricity.**—The best work I know of is one published at 21s., by Wood, Walker-street, New York; "Medical and Surgical Uses of Electricity," by G. M. Beard and Rockwell.

VOOGHT.

[68582.] — **Medical Electricity.**—Beard and Rockwell's treatise (Lewis, Gower-street, London), price about 25s., is a good one. Kimpton, medical book publisher, High Holborn, would advise as to what works he has in stock—that by Smith, of Dublin, being a cheap, useful pamphlet. Still, after all, electricity, galvanism, &c., is but a toy—a placebo, a *pour passer le temps*—prescribed by M.D.'s as an admission of their being able to do no good by drugs, counter-irritants, &c. That relief from pain often does for the moment result under an electric or galvanic current I admit; but radical cures are very rare indeed. Rheumatism in its various forms proceeds from so many different causes that, as may be surmised, no panacea, heal-all, elixir, or philosopher's charm has, or ever will, be discovered. Many years ago I read in the *Field* of an instance of a well-known racing man being cured of rheumatism in a long-standing chronic form by a stable-boy's prescription—i.e., a plaster of soft soap over the seat of pain, in this case lumbago. Now, it so happened that I, too, from youth had suffered thus; for some years it occurred in the daytime only, relief being obtained by rest; but after a prolonged treatment by hot-air baths, electric baths, acetic acid, the mineral waters of Bath, under the cold douche after the Turkish bath, the pain now changed to night, became intense, rendered the joints too tender to bear pressure of my body when in bed, and, above all, prevented sleep. Now I tried the soft-soap plaster (fish oil and potash, not modern so-called soft soap), and with the best of results for the actual pain, while every succeeding return became less intense. I, however, found out that the causticity of the soap prevented me using it longer than three nights consecutively; it was spread on stout brown paper. As to the *rationale* of the therapeutic action of the soap, Mr. Allopath would say, "Oh! 'tis counter irritation"; the homœopath, "'Tis absorption of the potash; see how kali and its salts influence rheumatism." As for me, I am content with the fact, and I leave theories to be argued over by those who are of all others the most competent to form an opinion—i.e., those who have never felt the pain of rheumatism and its effects. Amongst the kali salts, bichromate of potash figures highly in the materia medicas of homœopathy for rheumatism, and justly so; rhus, bryonia, arnica, mercury and salts, sulphur and salts, nux vomica, sedum, antimony and salts, arsenic and salts, &c., one and all have done much in the hands of

THE LYDNEY DISPENSER.

[68586.]—**Alum in Baking Powder.**—The "Chemist's and Druggist's Diary for 1888" gives the following as an illustrative case:—A baker, charged before the Cambridge magistrates with selling buns mixed with alum, pleaded that he merely used a certain baking powder. He was convicted, and proceedings were taken against the local vendors, who were also committed. Upon appeal to Quarter Sessions the magistrates' decision was reversed, and costs to the amount of £100 allowed, the Recorder holding that the alum was neither an adulteration nor injurious to health.

ARTHUR HUNTON.

[68590.]—**Portable Steam Bath.**—Any tin vessel will do for boiler, provided it is raised so that a spirit lamp can be placed under it. The top should be contracted, and fitted with a cover on short legs, to allow free egress to steam, and at the same time preventing it scalding you. Place it under a wooden chair—perforated bottom if you like—and use for covering when in (or on) the bath two thicknesses of flannel or blanketing, covering you all up to neck, and well down over floor. BOFIN.

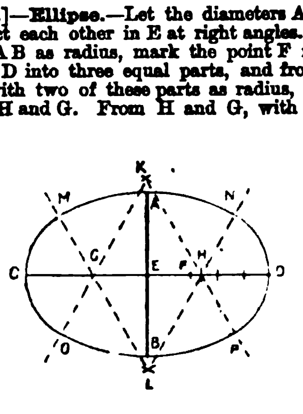
[68593.]—**Dry Mangle.**—In reply to "Wood," if you mean the rollers on which the clothes are wound before being put under the mangle, I should recommend you to use well-seasoned beech, taken as far from the heart of the tree as possible. Sycamore would also do, or sally if you could get it stout enough; but wood with the end exposed must be seasoned. If everything goes against you, I should advise you to get rings of brass cast about 1in. wide and $\frac{3}{16}$in. or $\frac{1}{4}$in. thick, neatly sunk on ends of rollers, and screwed on with three or four screws, heads sunk, and all turned true. This is bound to give satisfaction, and you will have a comfortable feeling about the splitting.

SEMPER FIDELIS.

[68597.]—**Iron Melting.**—Would the furnace I described in February, 1886, help you? It melts rapidly, and heats the crucible uniformly all round.

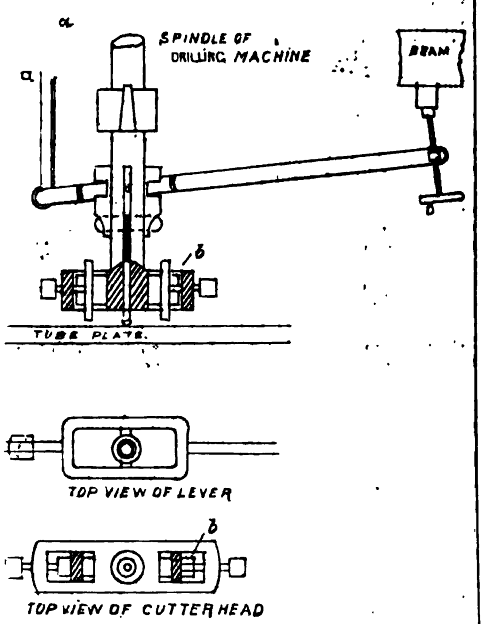
T. F. S. T.

[68604.]—**Ellipse.**—Let the diameters A B and C D bisect each other in E at right angles. From C, with A B as radius, mark the point F in E D. Divide F D into three equal parts, and from E as centre, with two of these parts as radius, cut line C D in H and G. From H and G, with H G as radius, describe arcs intersecting in K and L. From K and L, with radius K B, describe arcs O P and M N, and from H and G, with H D as radius, describe arcs N P and M O to complete the ellipse. Lines drawn from K and L through G and H will show where the four arcs unite.



J. L. D. PARTRIDGE.

[68609.]—**Cutting Tube Holes in Tube Plate.**—The best I know is Whitworth's pattern, of which I send sketch. Bracket *a* is fixed in suitable position on drilling machine, of which *c* is the spindle, and forms fulcrum for lever, which acts on a sleeve, which revolves within the lever but slides on the spindle. A cotter held firmly in the sleeve works in a slot through the spindle, and presses down a steel centre into a good big "centre dab," in the middle of where tube hole is to be. Around this steel centre the cutter-head revolves, carrying two steel bits, which are held in position by set pins. The slots *b* are made long enough to enable various-sized holes to be cut, packing pieces keeping the cutters in correct place. Pressure is kept on the centre pin by a screw, as shown, or by a weight hung on end of lever. Pressure (or feed) is put on the cutters by the drilling spindle, which acts *through* the lever. T. F. S. T.



[68610.]—**Hot-Air Engine.**—I have no description of the engine you mention; but believe it was called the "Gee," and was advertised from 150, Leadenhall-street, E.C. T. F. S. T.

[68611.]—**Land and Engineering Surveyor.**—About four years ago I landed in New York with photographic apparatus; on board the vessel there was also a civil engineer, who had a level with him. We were the only passengers requiring the services of the valuer as well as the Customs examiner. My apparatus was packed in an easily accessible box in top of one trunk, and after examining that, and asking if the value was about £12, they scarcely troubled to look at books, clothes, and tools. The civil engineer had more trouble, owing to the box containing the level being surrounded by an outer packing-case, space between being filled with smaller articles. After satisfying themselves that it was not a theodolite, we received their chalk-marks and got through free of any duty.

SILVER PRINTER.

[68623.]—**Storing Negatives.**—I put mine each in an envelope, numbered to correspond with an index number gummed on corner of negative. Outside envelope I put name of subject, plate, and any other particulars required. An index-book does the rest. T. F. S. T.

[68624.]—**Photographic.**—I took our Editor's advice some time ago and bought Spicer's paper, advertised in the "E. M.," since when I have never had a failure with reasonable care. The paper has twice crossed the Atlantic, with no special precautions as to packing, and prints and tones well, without any "black spots" unless there are "pin-holes" in the negative. Perhaps there are small holes in whatever you "preserve" your paper in. Have you any iron or brass filings dusting about your paper? They might cause spots.

T. F. S. T.

[68628.]—**Pressure.**—Rather uncertain; but if pipe is, say, 1in. bore, I see no objection, if the fluctuation of pressure is not frequent, but steady.

Bristol. T. C.

[68629.]—**Bulk of Sphere**— = $\frac{4}{3}$ of 3·1416 of (radius)^3. SM.

[68629.]—**Bulk of Sphere.**—The solidity of a sphere = cube of diameter × ·5236. O.'M.

[68629.]—**Bulk of Sphere.**—Diameter cubed by 0·5236.

Bristol. T. C.

[68629.]—**Bulk of Sphere**—Multiply the cube of the diameter by ·5236.

Plymouth. B.Sc.

[68629.]—**Bulk of Sphere.**—Multiply the cube of the diameter by ·523598775. Suppose the sphere to be 36in. in diameter, then ·523598775 × 36 × 36 × 36 = 24429·024 solid inches. ECNAL.

[68630.]—**Punching Brass, &c.**—You can cut and punch the holes by a small press, as you suggest; but the inscription will require a powerful affair.

Bristol. T. C.

[68632.]—**Boat Motor.**—A Siemens armature, 4½in. dia., 6in. deep, will develop sufficient power to drive a boat 20ft. long by 3ft. 6in. beam, at six miles an hour, if energised by 12 two-quart chromic acid cells. But you must not expect to get eight hours' work out of chromic-acid cells; if these are of the single-fluid type, three hours' work is about as much as you can reasonably expect. But if you fit up 18 or 20 cells of the Fuller type, with chromic acid as the depolariser, you will be able to run for eight or ten hours at a stretch. S. BOTTONE.

[68633.]—**Watch Repairing.**—Harden the steel for staff, and temper to 500°—i.e., dark brown. Have your centres (runners) perfectly in line, and hold the file underhand, as you would a penholder.

WOODFORD.

[68633.]—**Watch Repairing.**—The fault is in your having your steel too soft: harden and let down to nice blue. When you get to such a fine pivot as you require in Geneva pallet staff, have steel runners, and use a flat steel polisher, with oil-stone dust and oil, finishing with bell metal polisher and red stuff mixed with oil. It requires application to make a good job of such work.

AN EX-WATCHMAKER.

[68634.]—**Bushing Pivot Holes.**—There is no better way than that you describe, except the use of a depthing tool. WOODFORD.

[68634.]—**Bushing Pivot Holes.**—Your system is very old fashioned. When I was a boy I used a similar system, only with spring dividers, putting one leg in another pivot hole, and scoring a segment of circle through centre of hole to be bushed, repeating same from another place, say, at right angles to first, putting in your solid bush, and drilling your new hole where the two circles cross; but you can buy hollow bushing wire, which only requires you to open your old hole and drive in new bush, cut off and rivet, and your hole is in old place.

AN EX-WATCHMAKER.

[68635.]—**Jewels.**—Fully detailed information can be found in Vol. XI. page 428.

WOODFORD.

[68636.]—**Cycles Up-Hill.**—I would suggest three reasons for this decided fact. (1) When walking, your pace or speed is slower than is possible on a machine, and hence mechanical advantage; (2) on the cycle you have two dead points each revolution; and (3) when walking up hill you lean forward more than is possible on the cycle. AGNEW.

[68636.]—**Cycles Up-Hill.**—There is no defect in the principle of the cycle, as it is intended to economise time, not labour. To accomplish this, the machine is driven by pressing on a short lever (the crank), which turns a long one (the spoke). The latter being about five times the length of the former, a resistance of 10lb. at the end of it requires a pressure of over 50lb. at the crank to it; but this is compensated by the fact that the end of spoke moves 30in., whilst the crank only moves 6in. This fact enables the cyclist to cover 12 miles while a pedestrian is doing four; but the cyclist has worked three times as hard. The machine always being the same, when a hill is encountered, the resistance at the rim is increased to, say, 20lb., to overcome which, and to maintain his speed "Cyclist" must push with a force of over 100lb.; but if he dismounts, he will no longer have to work the crank, and therefore one-fifth only of the power he has been applying will be necessary to overcome the resistance; but he will move at only one-fifth of the speed. The principle is summed up by saying that "What is gained in speed must be paid for in power." W. B. G.

[68639.]—**Megascope.**—Yes; it can be used; but the instruments to produce the effects would be very expensive, or, at the least, very troublesome to make. I speak from experience, as when one was described a few months back in "E. M." I tried to make one, and it was only by a vast deal of time, trouble, expense, and labour that I succeeded. I use with mine a small arc lamp, and even this does not give quite the result I should like.

F. W. MASON.

[68640.]—**Accumulator Box.**—Try the following: Rosin, 6lb., melt and stir in 1lb. red ochre (highly dried and still warm), and calcined plaster of Paris, 8oz., and linseed oil, ¼lb. You could use india-rubber, thinned with bisulphuret of carbon; but I, myself, much prefer the first-named recipe.

F. W. MASON.

[68644.]—**Dynamo.**—I think T. D. Watkins must be labouring under some mistake, to ask for a machine capable of running five 16c.p. lamps in series. Taking the voltage of the 16c.p. lamp at 48 volts, the voltage required would be 240 volts. This could be got from a machine with a 6in. Pacinotti armature, wound with 250 yards of No. 20 wire. The field magnets should be 3in. dia., 7in. long, of the Manchester type, and should be wound with 25lb. of No. 24 wire, connected up in shunt. But I fancy you mean a series-wound machine to feed the five lamps in parallel. If so, write again.

S. BOTTONE.

[68645.]—**Joints in Indiarubber.**—Bicycle tires are made and vulcanised in one without a joint. No satisfactory joint can be made in vulcanised rubber. Rubber is vulcanised by first mixing it with sulphur, and then subjecting it to heat and pressure. 60DY.

[68646.]—**Air-Pump.**—"Tara" must bear in mind that the uncondensed vapour has to be lifted every stroke, in addition to the water, the former passing into the atmosphere, the latter into hot well. In the event of circulating pump breaking down, the air-pump can be used to do the work of both. I believe this to be the reason of its greater capacity. CERTIFICATED ENGINEER.

[68647.] — **Coupling Dynamos.** — Couple in series. The other is subject to a patent.

F. W. MASON.

[68647.]—**Coupling Dynamos.**—Join up the machines in parallel.

W. PERREN MAYCOCK, A.I.E.E.

[68649.]—**Fitting Reeds to Piano.**—There is no particular difficulty in doing what the querist desires; but there is one point in the scheme which demands consideration. It is well known that the strings of a pianoforte do not keep in tune so well as the reeds, the result being that when the strings get the least out of tune the effect of such a combination is discordant and offensive to a musical ear. When once a set of good reeds are properly tuned, they will keep in tune for a considerable time. This cannot be said in favour of the best piano that was ever made; for however good a piano may be, it requires a periodical tuning of at least once in three months. If the querist carries out his scheme, he will find it necessary to tune his piano oftener than otherwise would be required. If he will write to me, I will send him all the particulars he requires free of charge. Reeds have been used in combination with the piano many years back, but without sufficient success to merit universal approval.

Swansea. G. FRYER.

[68652.]—**Wood Labels.**—Rub with chalk.

SM.

[68652.]—**Wood Labels.**—Soak the labels in a weak solution of glue size and dry; or, better still, rub the parts of the label you wish to write upon with finely-powdered rosin. W. A. S.

[68653.]—**Electro-Motor.**—The pole-pieces are at such a distance apart that the armature can rotate in the tunnel with a clearance of about $\frac{1}{16}$ all round. The sides of the tunnel, as shown in the cut on p. 45, are semicircular, to admit of the armature turning in it. Yes, five layers will be sufficient on the F.M.'s. S. BOTTONE.

[68654.]—**Harmonium.**—If Mr. James Day is desirous of having an harmonium artistically constructed, he must not expect to be able to do it himself, apart from sufficient practical experience. The pan, or soundboard, forms a very important part in the production of good tone. Characteristic tone, generally speaking, depends on the "voicing" of the reeds. If Mr. Day wants a good harmonium soundboard, he had better write to a good manufacturer, and he will then be able to get a really good soundboard, if he is willing to pay a reasonable price for one. For ordinary people (such as those who have no particular musical taste), an ordinary instrument will suffice; but the querist aspires beyond the limits of ordinary musical taste, and evidently requires something good. It is not unreasonable to conclude that it requires some practical experience to make a good instrument. I could certainly give him a good scale to work from, but I fear it would be of little use without experience in the work. I should say, Buy one from a good maker. Try Mr. Willis, who advertises in the "E. M."

Swansea. G. FRYER.

[68655.]—**Spirit Lamp.**—The favourite hydropathic method of obtaining the rapid, profuse sweat; the rousing of the often torpid blood-circulation; the liver and viscera stimulation; the increased waste of the system, and the throwing-off of the effete matter; of stimulation to the appetite and to the digestive process generally, is by means of a spirit-lamp made of tin, the regulator of the flame being a sliding tin ring. There is (or was), however, a defect in the arrangement, for the annular wick was without any admission for a current of air up through its centre or interior. When I rearranged the lamp its heating effect was much increased—in other words, the volume of the ascending current of heated air, its rapidity of motion, and degree of caloric were more than doubled. Any handy tinsmith could make the first for 5s.; then, having his pattern and his hand in, 2s. 6d. would be ample.

THE LYDNEY DISPENSER.

[68658.]—**Beet Sugar.**—In 1884, seven weeks after starting, the sugar factory at Lavenham, Suffolk, was stopped, the reason being, I believe, that the strontia process was not properly understood. The machinery is still standing, and in the market.

F.C.S., F.I.C.

[68658.]—**Beet Sugar.**—The late Sir F. Bolton commenced the manufacture of beet sugar at Lavenham, in Suffolk, in 1884. It is not carried on now, although the buildings and machinery are still there, and, I believe, in working order.

T. D. F.

[68660.]—**Electrical Repairs.**—Gassner cells are chiefly used for bells. I expect they failed owing to some great heat affecting them. Run through the cells a little weak solution of permanganate of potash.

F. W. MASON.

[68660.]—**Electrical Repairs.**—I am not particularly smitten with the Gassner battery, though some authorities speak very highly of it for bell work. The Gassner cell can be re-charged by sending the current of a dynamo through it, just the same as an accumulator.

S. BOTTONE.

[68660.]—**Electrical Repairs.**—The Gassner cell is, I believe, unique, in that it is both a primary and a secondary cell. Your exhaust cells may be recharged by passing a current through them from some fairly constant battery for a few hours. If you have any Daniell cells by you, join up three of these to work through one Gassner, and leave them all night. Or you may recharge two or more Gassners in series, using three Daniells for every Gassner. Failing this, you must fall back on the bichro., using two cells for each Gassner, and charging for about 3½ hours. Send the current through cells from + to − pole; not in the same way as cell gives its current.

W. PERREN MAYCOCK.

[68660.]—**Electrical Repairs.**—The Gassner dry cells are eminently suited for this purpose, and I don't think you are acting wisely in substituting Leclanché cells. I myself prefer them in spite of the extra expense, and now always use the dry cells where possible. In large hotels, &c., I find the dry cells are much better able to cope with the spasmodic character of the work required of them, while they give infinitely less trouble than the Leclanché. The round form are preferable for this class of work, and each individual cell should be wrapped in paraffined brown paper. There was probably a short circuit in the wiring somewhere, which thus ran the battery down. The cells are easily recharged by passing an electric current of about three ampères through them for three or four hours. The current being sent in the opposite direction to that given out by the cell.

F. C. ALLSOP.

[68661.]—**Tables of Measurement.**—The ratio of the Cape land-measure foot to the British imperial foot was investigated by the Land-measure Commissioners appointed by the Governor on 19th June, 1858. They ascertained that 1,000 Cape feet are equal to 1,033 British imperial feet; hence, since 12 Cape feet are equal to 1 Cape rood, 1 English mile is equal to nearly 425·944 Cape roods. Also, since 144 Cape square feet are equal to 1 Cape square rood, and 600 Cape square roods are equal to 1 Cape morgen, one Cape morgen is equal to 2·11654 English acres; 100 English acres are equal to nearly 47·247 Cape morgen, and a square mile equal to 302·380 Cape morgen.

Methley. JOHN RIPLEY.

[68662.]—**Telephone Circuits and Call.**—If "F. C." will turn to page 67, Vol. XXXV., he will find Mr. Tolman's plan of the connections used with the Blake transmitter. Anything clearer it would be impossible to find.

M.M.I.Sc.S.

[68663.]—**Albumen** could be obtained by boiling an albumen, coagulate with heat, and also largely diluted. Is precipitated by strong mineral acids. It exists in the blood at the rate of 7·00 per cent., or 22oz. in 1 gallon.

F. W. MASON.

[68663.]—**Albumen.**—Let blood coagulate, strain off the serum, acidify with acetic acid; boil, filter, wash with boiling water; boil with alcohol and with ether to free it from fat. Albumen constitutes about 7 per cent. of normal blood, and about 9 per cent. of serum.

SM.

[68664.]—**Keeping Meat in Vapour.**—I expect "J. W. W." means the process of sterilisation, which is carried out for the preservation of articles of food by keeping them out of contact with the microbes of the air. It is done as follows: A little water is placed in the tin and vigorously boiled nearly all away, the consequence of this is that the air is boiled all out, and all the germs in the air killed; the tin is thus filled with the vapour of water only, this little water is quickly poured out, the substance is quickly put in, and rapidly soldered down. It is then, practically speaking, in a vacuum, as before the tin was filled with vapour, and this, then, in its turn would be condensed.

F. W. MASON.

[68667.]—**Photographic Scrap Books.**—The only means with which I am acquainted, which entirely obviates buckling, is fastening them down with indiarubber solution.

S. BOTTONE.

[68667.]—**Photographic Scrap Books.**—In reply to "Glatton," I would advise him to use the best glue to mount his photographs with. Steep a little glue in water a few hours before using, mix up the glue very thin, and add a little sugar. It is best to soak the prints in water, and also to glue them and not the paper.

P. K.

[68667.]—**Photographic Scrap Books.**—If your book is of ordinary paper the only way to avoid buckling is to insert the photos without a mountant and by means of slits cut in the scrap-book leaves. On the other hand, if the leaves are as thick as C.D.V. mounts, proceed as follows: Put the photos in water for five minutes, lift out, and lay face downwards on a piece of clean glass, taking care to put the largest photos at the bottom; slant the glass to let all the water run off. Brush over the back of the topmost photo with fresh starch paste previously squeezed through a muslin rag; lift up corner with a pin and lay it down with a handkerchief in its place on the scrap-book, and so on with the rest; when dry they will be perfectly flat.

Plymouth. B.Sc.

[68670.]—**A Proportion Sum.**—If a hen and a half can lay an egg and a half in a day and a half, it is evident that one hen could lay one egg in one day, so that she would lay seven eggs in a week of seven days; hence, six such hens would lay in seven days 42 eggs.

S. BOTTONE.

[68670.]—**A Proportion Sum.**—I should say that the answer 42 is incorrect, and that, as "R. A." observes, the correct answer is 28. If 1½ hen lays 1½ egg in 1½ day, therefore 1 hen will lay 1 egg in 1½ day, therefore 1 hen will lay ⅔ egg in 1 day, therefore 6 hens will lay 4 eggs in 1 day, therefore 6 hens will lay 28 eggs in 7 days.

T. D. F.

[68670.]—**A Proportion Sum.**—This query is hardly worth the name, it is so simple. It is founded on the old one which is said to have puzzled Dr. Johnson, viz., "A herring and a half for three bawbees (1½d.), how many is that for 11d.?" Take off the halves, and "R. A." will see at once that the answer 42 is right; then if one hen lays one egg in one day, six hens will lay 42 eggs in seven days.

B.Sc.

Plymouth.

[68670.]—**A Proportion Sum.**—This ridiculous sum seems to puzzle a great many; 28 is undoubtedly the correct answer. If a hen and a half lay an egg and a half in a day and a half, that is equivalent to 1 hen laying 1 egg in 1½ day, or 6 hens 4 eggs in 1 day, which gives the answer 28 in 7 days. If, however, we were to take 6 hens, and compel them to lay one egg every day and a half (36 hours), at the end of 7 days we should find that only 4 eggs each would have been laid (total, 24); but each hen would have gone 24 hours towards another. It being, therefore, only a sum intended to puzzle by its tautology, must be taken *pro rata*, giving the answer as above—28.

SCOTT.

[68670.]—**A Proportion Sum.**—This is an old catch. At first sight the reply usually is, "Of course, if 1½ hen lay 1½ egg in 1½ day, by proportion, each hen lays one egg each day; therefore, six hens in seven days lay 42." But consider, if 1½ hen lay 1½ egg in a given time, then four times that number, or six hens should lay six eggs in same time—viz., 1½ day; therefore, mathematically, the number laid in seven days should be 6 times 7 divided by 1½, or 28. But let us look further. Four complete 1½ days are six days, during which 24 are laid; but the next six may perchance, through animal idiosyncrasy, be all laid in the latter half of the following 1½ day, consequently outside the given seven; but, on the other hand, they may have been all laid within that period. Therefore, the practical result to the basket may be anywhere from 24 to 30 inclusive, with the probability only, not certainty, of 28.

F. G. LL.

[68670.]—**A Proportion Sum.**—"R. A." must be joking when he says a "high-class girl's paper." There are thousands of girls in our Board schools in the Fourth Standard who would give the correct answer in thirty seconds. I asked several children independently; they gave the answer as 42—could give no other—and that without slate or paper or pencil, as it is a simple question easily solved by mental arithmetic, thus: one hen, one egg, one day; six hens would lay six eggs per day; that multiplied by 7 = 42 eggs. There is no necessity to ask the aid of mathematicians, as high-class girls should possess a slight knowledge of "Euclid," which is of great value in reasoning. Perhaps "R. A." would put the question to himself or a Fourth Standard boy thus:—A boy eats an orange and a half in a day and a half—that costs a penny and a half. How many oranges would six boys eat in seven days? This would elucidate a "high-class girl's" proportion sum. How "R. A." can make 28 eggs is a mystery to a night-school

SCHOLAR.

[68670.]—**A Proportion Sum.**—Their reasoning has probably been:

If 1½ hens lay 1½ eggs in 1½ days,
(1) 1 hen would lay 1 egg in 1 day
(2) and 6 hens „ 6 eggs in 1 „
(3) „ 6 „ 6×7 „ 7 days

= 42 eggs, which is incorrect, as (1) should be: 1 hen would lay 1 egg in 1½ day (not 1 day). The correct way of working is:

$$\frac{6\ \text{hens}}{1\frac{1}{2}\ \text{hens}} \times \frac{1\frac{1}{2}\ \text{egg}}{1\ \text{egg}} \times \frac{7\ \text{days}}{1\frac{1}{2}\ \text{day}} = \frac{42}{1\frac{1}{2}} = 28\ \text{eggs}.$$

COLEMAN.

[This, of course, is the correct answer. We insert others as specimens of dozens which have reached us from the principal public schools and other places, where it might have been thought more 'cuteness was cultivated.—ED. "E.M."]

[68671.]—**Micro. Photo.**—Do you mean micro-photographs (that is, large objects or views photographed down very small to be viewed in the microscope) or photo-micrographs (that is, small objects magnified by the microscope and photographed, thus enlarged)? If the latter, you will find P. Jennings's work on "Photo-micrographs," published by Piper and Carter, the book you require; if the former, write again, and I will assist you.

S. BOTTONE.

[68671.]—**Micro. Photography.**—There are several articles on this subject in the *British Journal Photo. Almanac*, 1888. The process is simple enough, but it requires a lot of practice to get good effects. All you have to do is either to substitute your microscope (minus the eyepiece) for the lens in the camera, or to make a little camera to suit ½-plates, divided into four, as recommended by Dr. Maddox Brown, and fix it on your microscope instead of the eyepiece. The first method is most commonly adopted. The camera is fixed on a kitchen table, the microscope is turned down to a horizontal position, the joining of the eyepiece end of the M. to the C. must be perfectly light-tight. You also get a large condenser to throw the light of a paraffin lamp at a proper angle through the object to be photographed, and through the object-glass of the M. on to the focussing screen (and subsequently the dry-plate) in the C. For high power work you will require a substage condenser, but at first a 1in. objective will be high enough till you get a little experience.

B.Sc.

Plymouth.

[68673.]—**Hardening Lathe Tools.**—"Running them down" can be depended upon if you will always get the temperature the same, and is universally used amongst practical men.

Bristol. T. C.

[68674.]—**Link-Motion in Centre.**—When the link-motion is in dead centre the steam enters at both ends of cylinder; as it acts with equal pressure on each side of the piston, it is impossible for the engine to move, although the regulator may be open.

GEO. W. OATES.

[68674.]—**Link-Motion in Centre.**—When the link-motion is in dead centre the slide-valve covers both ports, therefore no steam can enter; and if the engine were moved in any way other than by steam the valve would remain stationary, there being no play in the link. If the regulator lever broke, the engine could be driven and regulated solely by reversing lever.

VOOGHT.

[68674.]—**Link-Motion in Centre.**—This depends on the amount of lap and consequent advance of eccentrics, and also the attachment of eccentric rods to ends of link. There is always some movement of middle of link, but the lap is usually more than this; and, consequently, steam would not be admitted if rods were crossed when both eccentrics were towards cylinder cover.

Bristol. T. C.

[68675.]—**Telephone Transmitter.**—It might, in certain cases, be advantageous to increase the current; but taken as a rule, it is not wise to increase the current too excessively, and it also depends in a certain degree on the fineness of the resistance.

F. W. MASON.

[68675.]—**Telephone Transmitter.**—I would refer "F.R.Met.Soc." to a paper by Dr. Silvanus Thompson, "Telephonic Investigations," in *Journal* of the Institution of Elec. Eng. No. 65, 3s. 6d., Spon; or to Preece and Maier's work, "The Telephone," 12s. 6d., Bell and Sons.

W. PERREN MAYCOCK.

[68675.]—**Telephone Transmitter.**—Up to a certain point an increase of battery power increases distinctness of articulation; beyond that, jarring and buzzing supervene. You will find a good deal of useful matter on this subject in the last three months' numbers of *The Telephone*.

S. Bottone.

[68677.]—**Leg Irons.**—Feed your youngster on oatmeal porridge, as the Scotch and Welsh do, and thus bring up strong-boned progeny, this food containing material for bones. The pampered town child, fed on white bread and other fancy children's food deficient in the necessary phosphates, must become weak in legs, the more so if otherwise hearty. 'Tis bones your child wants, not irons.

F. G. Ll.

[68680.]—**Faulty Telescope.**—I would recommend "Astron." to find out if the o.g. is fixed truly square on his telescope-tube; if not, alter it. If its position be not perfectly true with the axis of tube, it will distort the image of a star, and planetary definition will be bad. If this is not the fault let him put the cap over o.g., unscrew the eyepiece, and bring a small candle-flame to the opening, and, looking up the tube to the o.g., observe the images formed by reflection from its back surfaces, if they are not in a straight line with each other and with the centre of the opening, which he can easily see by gently moving the light a little sideways to and fro; then the lenses composing o.g. are not truly centred as they should be before they are put in cell, and he must send it to some skilful optician to have them truly centred. I have an o.g. with this fault, and purpose doing it myself.

Hadleigh, Suffolk. C. May.

[68682.]—**Chemical.**—(1) Oxidation by alkaline nitrates. (*a*) If the sulphides do not lose S on heating, mix with 3 parts sod. carb. and 4 pot. nit. Heat in crucible to fusion. The solution in water will contain all the S, ppt. is barium, and weigh as sulphate. (*b*) If the sulphide loses S on heating, mix with 4 soda carb. 8 nitre, and 24 sod. chloride. (2) Oxidation with pot. chlorate. 1 part sulphide, 3 pot. chlor., 3 sod. carb. Look out for explosions. (3) Oxidation by chlorine. Pass pure dry chlorine over the sulphide contained in a bulb tube, heat gradually. Sulphur chloride distils over, and is collected in bulb U tube. This tube is exposed to air to allow any metallic chlorides to absorb moisture and become soluble. The sulphur is separated by aid of heat, dried, and weighed. (4) Oxidation by fuming nitric acid. (5) Oxidation by chlorine in alkaline solution. Dissolve in pot. hydrate, pass Cl. Filter, acidify, and ppt. as $BaSO_4$. (6) Expel the sulphur in the form of sulphuretted hydrogen, and estimate the gas by arsenite of soda, or pass into standard alkaline copper solution, and determine the amount of copper left unprecipitated by standard stannous chloride. (7) Titration of alkaline sulphide by zinc sulphate solution with lead acetate indicator.

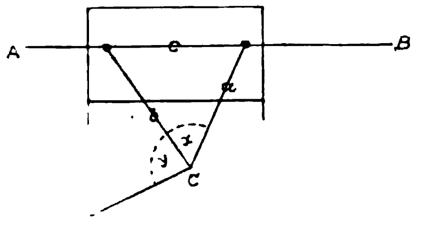
Sm.

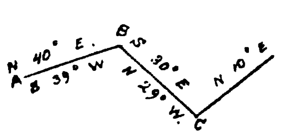
[68684.]—**Underground Surveying.**—The theodolite is the most reliable to use, and those manufactured by John Davies and Son, Derby, and J. T. Letcher, Truro, have special features for underground work. The direct effects of ferruginous matter cannot be avoided, as a magnetic insulator has not yet been discovered. The attraction is of no importance in using the theodolite after the first draft or datum line has been determined, and if triangulation can be adopted the needle may be dispensed with (*vide* "Magnetic Surveying," by W. Lintern, published by Crosby Lockwood and Son, London). The scales used in metalliferous mines are 6, 8, and 10in. to the fathom; the top survey should be plotted to the same scale as the underground survey.

Geo. W. Oates.

[68684.]—**Underground Survey.**—The theodolite, carefully adjusted and used, will give "Miner" the best results. Range a line, A B, over the top of the shaft; clamp a straight-edge accurately on it. From the straight-edge suspend two good heavy plumbobs by means of copper wire. Let them hang as wide apart as possible in the shaft, and, if possible, let them dip into bowls of mercury to reduce vibration. The surface-line is thus carried down below, and the work can be commenced thus. Measure, with exactness, lengths *a*, *b*, and *c*, and take angles *x* and *y*. If the circumferenter be used, eliminate the evils of local attraction by using it only to get included angles—that is to say, read the bearings of your lines both ways thus. No matter what local attraction exists at B, it is evident that the angle A B C is that contained between S. 39° W. and S. 30° E., and so the direction of B C is correctly fixed.

C. C. W.





[68685.]—**Holder for Small Incandescent Lamp.**—Would not one of the ordinary Woodhouse and Rawson holders suit you? I have always found them very convenient. Use Nos. 12 or 14 B.W.G.

F. W. Mason.

[68687.]—**Division Plate.**—I have passed through exactly the same difficulty, and will, with great pleasure, advise you how to act. Take your wheel off mandrel, make a pattern as large as your wheel will allow, let it be $\frac{3}{16}$in. thick to bear upon boss of wheel, and shaped to fit the wheel at base of teeth, leaving it hollow between to save weight; file the slot in wheel down close to boss and lengthen the gearing bolt at back of wheel accordingly; this will give you plain space on brass plate sufficient for three or four rows of holes. Tin brass plate and wheel, then sweat together and turn up to $\frac{1}{8}$in. thick; cut three or four rings for centre of holes, then mount your mandrel (if possible) in a friend's lathe having a division plate, and mark off by scriber, or with drill fixed in slide-rest and driven by overhead gear; drill them at once. If you divide by hand, first quarter your plate and mark with fine point centre-punch. Then with point of dividers in each dot halve the distance between by cutting small arcs of circles, centre-punch these, and repeat this to the end. Do not divide by walking dividers around from hole to hole. Use fine point drill to start your holes, and finish with drill $\frac{1}{64}$in. for size of holes; 120, 96, 56 would be good numbers; you can double these by lengthening or shortening your index rod half the distance between two holes. This will give you sufficient range of work no doubt.

W. P. W.

[68687.]—**Division Plate.**—I will tell "H. E. W." how I made the division plate to my lathe. Decide the largest number of holes you will make, say 360. Take a strip of brass about $\frac{1}{2}$in. or $\frac{3}{4}$in. wide, of a suitable length to make the required number of holes, about $\frac{1}{10}$in. or $\frac{1}{12}$in. apart, file up edges parallel, scarfe the ends, and solder into a hoop. Chuck a piece of wood (beech will do well) large enough to turn to the size of hoop; if the lathe-centre is not high enough set up the headstock a bit higher, and, taking very light cuts, turn up the disc of wood accurately to the size to take the brass hoop on fairly tight, then turn the edges of hoop true, and scratch a line round middle to drill the holes in, which will make them nicely in a line with each other. Then make a double-ended dot, punch the points about $\frac{1}{10}$in. or $\frac{1}{12}$in. apart according as you have previously decided, and one point of punch a little, but not much, longer than the other. Unsolder the brass hoop you have turned up, and gently punch along the line you have drawn, putting the deeper point of punch into the dot last made, and so mark the required number of holes and one over. Drill the holes with a fine drill; make into hoop again, putting a pin through the two last holes to hold it in place while you solder it together again. Make an index-peg on spring piece of thin steel (saw-plate will do) and screw it firmly in place at the back, put the hoop on the wood, put the peg in a hole, and if you are careful it will hold the mandrel and plate you have previously prepared in place; fix drill-stock in slide-rest with suitable size drill, drive by overhead, and make the first row of holes (through the plate is best), then take off hoop, unsolder, and shorten to the required number of holes for second row, put on wood again, and proceed as before, and so on, until all the rows of holes are made. The plate should previously be faced true, and bored to fit mandrel exactly, and the place where to fix marked on plate and mandrel. If truly chucked will be true when fixed, and the amount of error in spacing of holes will be very small indeed if great care is taken in drilling holes in hoop.

Hadleigh, Suffolk. C. May.

Salt is among the oldest of our manufactures. The brine-springs in Cheshire have been used for industrial purposes since the days of the Saxon kings. Droitwich, in Worcestershire, also is an ancient seat of the salt industry. "Wich" is the old name of all places where salt was manufactured, and still survives in the names "Northwich" "Nantwich," and the like. In 816 Kenulph, king of the Mercians, gave "Hamilton, and ten houses in Wich," to the church at Worcester, and in 906 King Edwy bestowed on the same establishment "Jepstone and five salt furnaces."

There are now 32½ miles of cable tramway in Melbourne. The number of persons carried during the last half of 1888 was over 19,750,000, being an increase of 9,400,000, as compared with the returns for the same period of the previous year.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

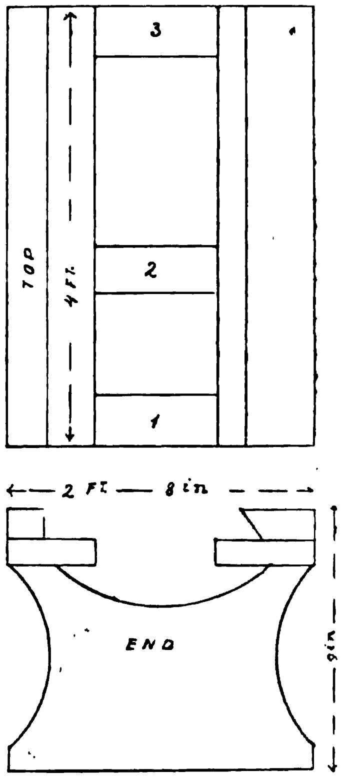
Since our last "Vooght" has replied to 68035.

68074.	Coppers, 60.
68079.	Trigonometry, 61.
68088.	Preserving Vegetable Colourings, 61.
68093.	Colouring Benzoline, 61.
68101.	Engine Query, 61.
68104.	Catering, 61.
68106.	Clock and Watch Springs, 61.
68112.	Incubator Regulator, 61.
68117.	Derrick, 61.
68118.	Holland, 61.
68121.	Screw-cutting, 61.
68133.	Grey Parrot, 62.

68324.	Rebronzing Urn, p. 140.
68333.	Force of Explosions, 140.
68354.	Mensuration, 140.
68360.	Prof. Lodge and the Leyden Jar, 142.

QUERIES.

[68688.]—**Making Pattern of Planer.**—I wish to make pattern of planer bed, but am ignorant as to which way it should be made so as to leave the sand easily. In the sketches, ribs 1, 2, 3 go flush with bottom, and are hollow except where the sweep comes at the top. Will there be any core boxes required? A sketch showing the way such a pattern is moulded will greatly oblige. Also how are the core prints formed and core boxes made to core the square holes and slots that take bolt heads usually seen in planer beds and lathe saddles?—Leicestershire.



[68689.]—**Electrically Recording Anemometer.**—I have a small Robinson anemometer, which at present registers in the ordinary way. Could I make it register electrically by means of a metallic pin attached to dial which would, at a given point in each revolution, press upon a metal spring whereby an electric current would be completed and an automatic registration effected on an ordinary counter. Perhaps some reader of "Ours" would give me further information as to how to fit it up. The anemometer is fixed on a pole, 22ft. high, at a distance of 50ft. from the house.—R. C. M.

[68690.]—**Pocket Coil.**—I have a small pocket coil made by A. Gaiffe, of Paris, and it has two small ebonite cells. Would you kindly inform me how to charge them?—An Amateur.

[68691.]—**Grease, to Remove from Granite Paving.**—Will one of "ours" kindly tell me how to remove grease out of a kitchen floor paving with granite—viz., Granolithic paving?—G. R.

[68692.]—**To Clean and Protect Gunmetal Fittings to Hydrants Exposed to all Weathers.**—Will any correspondent kindly tell me the best article to use in cleaning the above, and to protect it from the influence of the weather?—A. B.

[68693.]—**Mandrel.**—Will "T. C., Bristol," or others give me the size and thickness and the amount of taper it requires in a lathe mandrel for a 5in. centre back-gear conical headstock?—Moulder.

[68694.]—**Boiler.**—Will some practical boiler-maker give me dimensions of vertical boiler, 4H.P., to work at 120lb., not omitting thickness of plate?—ROBERTO.

[68695.]—**Naval Architecture.**—In the Honours Exam. in naval architecture, held by the Science and Art Department, the candidate is required to send in before the middle of June a "complete building draught" of the vessel given out at the exam. Can anyone tell me how much precisely this expects? Does it imply only the sheer, body, and half-breadth plans, or more than this? Could Frank Caws help me?—MAC.

[68696.]—**Cast-Iron Pipes.**—I have about 100 5in. cast-iron socket pipes to make, and should be glad of any information as to making cores. I have heard that in some foundries they do not dry the cores, but make them of green sand. If so, what kind of core bar do they use, so that the sand will adhere to it? I have also been told that by putting certain things in the loam that cores can be put in the mould, and will not be injured for a few days. Any information on above will oblige; also name of good book on moulding. —W. TIN.

[68697.]—**Paper Bottles.**—Can anyone tell me the cementing material used in manufacturing above? They are made to hold liquids and acids of all kinds, I believe. I want to protect millboards or papier mâché made with paste and glue from the action of salt water, having made a boat of that material. I have painted with lead and oil, and am finishing with anti-fouling composition. I want a cementing material which will stand sea-water. Tar will not do.—BOFIN.

[68698.]—**Pewter Solder on Glass.**—Would some one kindly tell me how to make solder take on glass? The cut-glass brooches in fashion some time since were soldered on to the metal backs. How is it done?—JEWELLER.

[68699.]—**Copper Sulphate Deposition.**—I am the owner of a disused copper mine, 1,200ft. deep, and half full of water. This water contains a considerable quantity of copper sulphate in solution. About half-a-mile distant, with a hill 300ft. high intervening, is a large stream, from which, as I calculate, I can get 80H.P. at summer level. I should be glad if any of your scientific correspondents would inform me if by means of a dynamo on the river I could effect deposit in the mine—so as to pay—of either copper or crystals of the sulphate; and in what manner I should set about the work?—SAUROS.

[68700.]—**Faulty Beam-Engine.**—Having a beam engine which does not work smooth, standing on two columns, I should be glad if any of your readers could tell me how to find out by trammel and lines, whether radius and parallel rods, gudgeons, and crank-shaft is true? Also how to set about it; or any book upon the same.—CONDENSER.

[68701.]—**Blast Fan.**—I shall feel greatly obliged if any of the readers of your valuable paper can inform me how I could make a kind of blast fan that could be attached to a canister, so as to draw out a hot chemical vapour, and also to distribute the vapour with good force through a pipe or tube. I had one made the size and shape of a knife-cleaning machine, so as to draw the vapour in from the centre of the fan; but that does not give the required force. I should like it made of galvanised iron, and the smaller the better; also I shall require a pipe that would stand chemicals, so that I could bend it, about six feet in length.—F. W. A.

[68702.]—**To Mr. Bottone.**—I have castings for dynamo or motor. The dimensions of the shaded parts are 2½in. high by 2¼in. long by ½in. thick; the tunnel for armature is 3½in. long, diameter 2in. Please give sizes and weights of wire for magnets and armature; also what volts and ampères it will give, with how many revolutions per minute. I have no armature. Will a solid H armature do?—if not, what will be the cost of the punchings for a laminated one? Shall be much obliged for help.—INDOCTUS.

[68703.]—**Dynamo.**—To MR. BOTTONE.—Would you be so kind as to tell me whether there is any book in which practical rules for the building of dynamos are given, that is to say, given the external resistance, the current required, and the potential and speed, a simple rule for finding the length, diameter, &c., of the wires, and the sizes of the different parts of the machine. I have S. P. Thompson's book "Dynamo-Electric Machinery"; but it deals with the theory and theoretical amounts. I also have the "Electrician's Pocket Book," but do not find any simple rules for building dynamos in them.—R. H. H.

[68704.]—**Electro-Motor for Circular Saw.**—Will some of our electrical friends give me some hints on the following:—I have a circular saw taking 1½ man-power to drive, and wish to drive by means of an electro-motor, as steam power would be too expensive to fit up, and there is no convenience for gas to drive a gas-engine. As I should construct motor myself, I should be glad if anyone would give me size of castings, Siemens type, also the size and amount of wire for F.M., and armature. I should only require to use it about two or three hours per week. How long should the chromic-acid solution in the cells last, or does it lose its strength after standing for some time? A reply will greatly oblige.—R. A. G.

[68705.]—**Hydrocarbon Engine.**—I am a mechanic, and wish to make a hydro-carbon engine. I have a 5in. working cylinder, 8in. suction and compressing cylinder, and a receiver, valves, &c., crank, fly-wheel all mounted; but I do not understand the management of the hydro carbon. I can buy benzoline easily, and also paraffin oil and petroleum spirit. Now, would it be best to pass air through benzoline, and then dilute it with more air, or to mix benzoline with paraffin, and simply draw the air through it? I find I cannot buy raw natural oil. I do not want to heat the hydrocarbon outside the cylinder, as in some engines; and lastly, what precautions as to safety must I take? My shop is detached, and in a large open space.—CYRUS.

[68706.]—**Cleaning Mercury in Barometer Cistern.**—The mercury in a standard barometer of Foster's pattern has got very dirty, so that the ivory point is not clearly reflected, so the glass cistern will have to be unscrewed off, and its contents filtered. In doing this, an old meteorological publication I happened to come across states the tube must be kept horizontal whilst taking off the cistern, or the mercury in the tube will escape. Is this not a mistake? I think it must be a misprint for inverted, because I know well that is the proper way to carry a barometer from place to place. I shall be glad of the opinions of skilled correspondents, and thankful for references to any books treating barometer repairs generally.—M.M.I.Sc.S.

[68707.]—**Screwing to Wedges in Walls.**—Will some of our practical electrical friends please tell me the best method of wedging walls, and screwing pushes, &c., to them. I can generally succeed in driving the wedges in fast; but the screws almost invariably draw out easily, on account of the screw entering the long way of the grain of the wood. Should a hole be made in the wood previous to inserting the screw?—or should the screw be compelled to draw itself in? I have tried many times, but cannot succeed in getting one to take any strain: it draws at once, bringing the fibre of the wood around the thread. A writer in the first number of the *Telephone*, on page 6, says "the wedges hold faster if made hexagonal shape—much better than square." My difficulty is not with the wedges, but with the screws drawing out. Any help will oblige.—M.M.I.Sc.S.

[68708.]—**Grease Tinning.**—In No. 1245 "Bijli," in answering query 67612 about tinning bright parts of bicycle, advises to have the parts grease-tinned. Could you tell me what is meant by grease-tinning, or how it is done.—TINMAN.

[68709.]—**The Harp.**—Kindly inform me if there is any book published treating upon harp making. Will they also give me the name of a good instruction book for learning the harp?—PIANIST.

[68710.]—**Legal.**—Will "B. Sc." or some other legal correspondent of "Ours" give his attention to the following:—A, a solicitor, holding securities (deeds) in the interest of B, his client, pawns, without B's knowledge, the securities belonging to B. A becomes bankrupt. What remedy has B? "B. Sc." is assured the above is not an idle query.—B.

[68711.]—**Great Western Locomotives.**—To what is due the hissing sound "hiss, hiss" made by these engines, most noticeable when running without steam. I never hear it in any other locomotives. Can any reader explain the peculiarity, which must be in construction?—FERRO.

[68712.]—**German Yeast.**—I have read with interest Mr. Frederick Davis's answer (68483). He says that yeast very often makes bitter bread. To what cause can this be attributed? In what way does he use hydrochloric acid with the bicarbonate of soda? In the case of yeast, how is it known when fermentation is complete? He says that adulteration by alum is easily detected by the logwood test. What is this test? Can name of any book giving practical instructions on bread-making be stated please? —DRIAB.

[68713.]—**Electric Lamp for Lantern.**—The Edison-Swan Co. now make focus lamps for optical lanterns, 80 to 100 volts 100c.p. I want to use one of these with the aid of accumulators, the latter to be charged with one of Siemens early pattern 1-200c.p. dynamos (not shunt-wound), which I now have in constant use supplying 25 16c.p. lamps. Would Mr. Bottone or other correspondent kindly say whether this arrangement would be likely to answer, also the number of cells and probable weight of suitable accumulator? Would they be conveniently portable for taking about for schoolroom lectures?—A. WATKINS.

[68714.]—**Electric Light.**—I have a simple battery—viz., two plates of carbon, one of zinc—for the electric light, charged with bichromate of potash and sulphuric acid. When the plates are first put into the acid, I get a very brilliant light, but it gradually goes dull. Could any of "ours" tell me how I could prevent that without having to keep shaking the battery? I have tried chromic acid with the same effect.—AMATEUR.

[68715.]—**Hot-Air Engine.**—I wish to call the attention of those of your readers interested in hot-air engines to a small model of Robinson's patent, which is exhibited in a shop-window in Cheapside, driven by a Wanzer lamp. This engine was described in "Ours" about a twelvemonth ago, but I wish some one would explain the means by which the air is cooled. The horizontal bed plate on which the engine rests seems to be hollow, but without any opening for the admission of water, which is usually used to cool the air for the return stroke. The heater is underneath the bed-plate, as in the original diagram, but if some reader will kindly explain the cooling arrangement, which seems more simple than usual, he will greatly oblige.—EXCERPTA.

[68716.]—**Piano.**—I have a three-pedal piano, which is constantly getting out of tune. The last time it was tuned the tuner said that the soundboard was cracked, and that a new one, which would cost from £12 to £15, would be required. The soundboard is cracked just below the tuning keys in several places. Each crack is about 1¼in. long, and they are all at the treble end, where there are three strings to each note. Gan anyone tell me of a way of mending the soundboard, or of fastening the tuning keys? —A. G. G. C.

[68717.]—**G.E.R. Tank Engines.**—Can "East Anglian," "Stratford," or others oblige me with a sketch of anyone or all of the different classes of tank engines on this line? What colour are they painted, when built, and with what dimensions?—NO SIG.

[68718.]—**Steel.**—I purpose making out of an old square file a screw-plate, and, after I have drilled and tapped the holes, I want to know how to harden the plate again, and also how to harden the taps. A little advice on steel hardening and tempering would be thankfully received.—C. G. WHITE.

[68719.]—**Canvas Hammock.**—Information required how to make a canvas hammock. I have looked up numbers of "E. M." for years back, but information is only given for the manufacture of netted string ones. What length of span shall I require? I can afford 9ft. Can I use a small piece of wood to keep the ends pulled out? I am over 6ft. in length, fairly broad, and not quite 14-stone weight. How are the hammocks made for the men in the Royal Navy?—D. K.

[68720.]—**Man and Truck.**—You have a perfectly level surface. You find it requires a certain amount of force to push a truck on wheels along this surface. You then put a man inside. Does the difference between the forces required to push the truck when empty and with the man inside give the force required by the man to walk? —O'M.

[68721.]—**Metal Speculum.**—Would Mr. Linscott or any reader advise an amateur, who intends trying to grind and polish a speculum, whether I should have to get the metal disc cast to order, or can they be procured ready made, and the probable cost of disc of metal, say, 5in. or 6in. in diam.?—SPECULUM METAL.

[68722.]—**Methods of Studying Organic Chemistry.**—I should much like to have the opinion of some of our correspondents as to the best way of studying organic chemistry. The various reactions made use of in "analysis" are, of course, only to be learnt by constant practice; but besides these test-tube experiments there are two large divisions of the subject which, no doubt, present great difficulties to many beside the present querist. First, what I will call a theoretic-practical part, and second, more or less pure theory. By the first, I mean that part of organic chemistry in which we are supposed to know the properties and ways of preparation of an enormous number of componds, many of them only interesting from the side of pure theory. Now, unless one spends all one's time on the subject, it is impossible to do more of actual preparation than that of a very small proportion of the bodies one is supposed to be acquainted with, and in the case of complicated processes one preparation is scarcely sufficient to impress it vividly enough on the memory. I take up an examination paper quite at random, and in it I see asked for a description of Perkin's process for making coumarin artificially. Now, how ought one to get up such things as this, and keep them in one's head? My query is really due to an ardent desire to avoid "cram"; the sciences, in my humble opinion, ought to be the very last places to which cramming should be admitted, and yet there are in chemistry (e.g., examination chemistry, I mean) many things to be only retained for examination by a cramming process of the very worst kind. I am aware that the examination system (which, as I think the late Mr. Proctor well said, we had so slavishly copied from the Chinese) is largely at fault, and although examiners sometimes disclaim on this point, the fact remains that those students who cram well pass well, while those who strive for a real lasting knowledge of the subject often fail. But as it is no of use grumbling about examinations or examiners, I should like to ask in the "E. M." what means can be recommended for priming one self with all the uninteresting processes (those which have any connection with our daily life seem to be studiously avoided by examiners) in organic chemistry one has to get up with a minimum amount of cram. In the more theoretical part of the subject it is even more bewildering, and one would like to ask first if experience has taught any means of remembering the heap of ugly-looking formulæ supposed to be remembered. I should like to go into some details on the theoretical side, but fear I have already made my query too long. If, however, I have succeeded in provoking a discussion, I may have an opportunity to say something on this eminently practical thing.—AURORA.

[68723.]—**Collar and Shackle Illusion.**—Can any of your scientific readers inform me how this illusion is performed, which was done for a wager? It is as follows: There were two pieces of wood made in the shape of a cross, to which a man was locked, one iron collar placed round his neck and secured by a padlock, and the two arms outstretched and the wrists held by a shackle, secured by a padlock at each. All three were locked with three different keys and given to one of the company to hold. Now a cloth was drawn round to form a screen, and in three minutes by the watch the man was free from his bonds when the screen was withdrawn. The locks were still fastened as when first locked on the man. Was there any main spring hidden in the locks to move the bolts, or any arrangement in the ironwork?—JONES.

[68724.]—**To Mr. Bottone.**—Would a thermo-electric generator light incandescent lamps? If so, would you please give me dimensions for a generator to light a 2½c.p. lamp?—F. C. LEES.

[68725.]—**Sound.**—If a string 24in. long weighs ¼oz., and is stretched with a weight of 81lb., find its rate of vibration when bowed or struck.—G. H. W.

[68726.]—**Alcohol.**—In a mixture of alcohol and water 17° under proof, what are the proportions respectively of the two components?—OWL.

[68727.]—**Moulds.**—Will some one kindly say what would be the best and cheapest method of obtaining a model (wax) of one's hand, with accuracy for purposes of palmistry? Could a hand be photographed to show all the markings faithfully?—NEBRAWH.

[68728.]—**Electro-Motor.**—To MR. BOTTONE.—Will you kindly say what thickness of wire it will take for Diehl's electro-motor, described in the "E. M." for Oct. 14th, 1887? Also how many Bunsen cells will drive a sewing-machine with it?—E. L.

[68729.]—**Electric-Bell Fixing.**—Can any reader kindly inform me how to join up 24 stations, fitted with trem. bells (without using relays, if possible), and how many Leclanché cells will be required? All bells to be rung from one push piece.—R. C.

[68730.]—**Mildew in Clothes.**—Will any reader state how to remove spots of mildew from woollen clothing? —NEMO.

[68731.]—**Engine.**—I am in charge of a pair of compound beam-engines, and would like to know the H.P. of them. Also the way in which the mean effective pressure is found. Diam. of h.p. cylinders 36in., diam. of l.p. cylinders 40in., length of stroke in h.p. cylinders 7ft., and l.p. cylinders 14ft., 22 strokes per min. Boiler pressure 45lb. per square inch, steam cut-off at ½ stroke.—ENGINE DRIVER.

[68732.]—**Petroleum Engine.**—Having a model hull of a steamer, I wish to know if I could substitute a petroleum engine to drive it. If so, I shall be glad of a few particulars as to size suitable for the boat, which is 4ft. by 7in. by 7½in. I have also been told that there is an engine worked by colza oil. Is this so? If so, can any reliable result be got from such an engine?—PETROCOLZA.

[68733.]—**Moulding Rubber.**—Can any of our readers kindly tell me the best means of preventing vulcanised indiarubber, when moulded, adhering to the mould?—J. G. S.

[68734.]—**English Concertina.**—Can any one assign a reason for the following:—I have an English concertina, a 13-guinea instrument, by Wheatstone; but at times I find that it is impossible, owing to the lack of readiness of utterance in the vibrators, to play with any degree of expression; at other times they respond to the lightest movement of bellows. Readiness of utterance is, of course, a *sine quâ non* in an English concertina, an instrument which, to hold its own high position, should be capable of interpreting the finest gradations of tone. I may mention that the above instrument has steel vibrators. What is the opinion of professors in general as to the use of steel vibrators? I cannot say, although my opinion may not be worth much, that I am at all partial to them. When playing thirds on upper octaves especially, the tone is anything but sweetly pronounced, the creation of that discord termed the "wolf," I believe, by organists, is rather too unpleasantly demonstrative to be passed over. Lastly, please explain away the following effect. Reverse the position of instrument in holding—i.e., right hand for left hand, and play, and the tone will have far more character and sweetness than when it is played in the orthodox position. I have an idea as to what this is to be attributed to, but would prefer an opinion first.—JOS. LEANEY.

[68735.]—**Reversing Gear.**—Would "T. C." or some other reader kindly answer the following? I am making a half-horse power horizontal engine, and should like to have reversing gear to it, but do not quite understand how to get the curve and length of link, the distance from centre of crank-shaft to centre of slide. Rod eye is 9¼, that is, when the valve is on dead centre, and the travel of valve is ⅜in. A simple sketch would much oblige, showing link and lever, and attachments for same. Also please give a simple rule for setting the eccentrics. I might say I should like to attach link to a parallel bar underneath the bed-plate—the thickness of bed-plate is ⅝in.—JUNA.

[68736.]—**Sun Crossing the Line.**—Can any of your readers give the exact dates when the sun crosses the line? Whitaker, in his *Almanack*, gives date of most sunlight in the year as June 23rd, and date of least sunlight as December 22nd; but the Astronomer Royal gives the dates as July 1st and January 1st.—HARRY J. PYWELL.

[68737.]—**Kitten and Parasites.**—I have a Persian kitten, which leaves an extraordinary number of small white nits—which are very hard and shiny—on every chair or cushion it lies upon. I have washed it in warm soap and water containing carbolic acid, and also have tried some of the usual insect powders, but with no satisfactory result. Are the nits those of the flea, or some other insect? Is there any fear of them hatching in the carpets or hearthrugs?—TABBY.

[68738.]—**To Mr. Nelson.**—Would you kindly enlighten me on the following points? English makers of microscopes sell two qualities of objectives. One they call their second series, which are of moderate angle, recommended for general medical and botanical students; and the other they call their best series, and which are of higher angle. What advantage would there be in having, say, a 2in. of the latter (best) series for use with a binocular? Could the compensating eyepiece used with new apochromatic objective be used with advantage with a good 1-6in. ordinary achromatic objective instead of a D eyepiece? If I know the angular aperture, how can I find out what natural angle it is? What N.A. would 120° be? What is the difference between angular aperture and N.A.—L'IGNORANCE.

[68739.]—**Organ.**—I am about to make a reed organ with four rows of reeds, two rows of 4ft., and two rows of 8ft., two rows in front, two at back. The back pallets will be operated by the front pallets, as the sub-bass is shown in back numbers, and divide the reeds with eight stops. How should I have the reeds voiced? I am not seeking noise, but variety and sweetness of tone. Will it be better if any of these reeds were enclosed in a swell-box; or should I have a better organ with two rows of reeds, 4ft. and 8ft., and about 2½ octaves of 16ft at back. The case is 3ft. 8in. high, 3ft. 9in. long, 24in. deep. If any reader will kindly give me a few hints I should feel obliged.—A LOVER OF MUSIC.

[68740.]—**Steel Name Stamps.**—Will anyone kindly say what tools are used for cutting out small letters for steel name stamps? Any hints will oblige.—A POOR BLACKSMITH.

[68741.]—**Tarnished Steel Mirrors.**—To "Eos."—Being at a friend's I was shown two mirrors. They were round, about 7in. in dia., by 3-16in thick, plain, and slightly convex on plain side, and cut away on the reverse very deep, ⅛in. in some places, forming different figures. The mirror side looks like silver, the back like bronze, though I was assured it was all steel. My friend told me that you could see a coin through them by holding them up to the sun. Is this so? He wants a safe remedy to clean them, as they have only been cleaned by a clean chamois leather, dusted as a glass mirror. They were made and bought in Tokio, Japan, and brought here in good condition, and was put upon the mantelpiece, and was all right until a fire was used in the room, when he supposed the smoke tarnished them.—J. H. B.

[68742.]—**Largest Organ in the World.**—My attention has been called to a statement with this heading in *Tit Bits*, May 4. It says that Messrs. Hill and Co. have just completed an organ for Australia with 150 stops, including a 64ft. reed and five manuals, at a cost of £12,000. Is this a fiction founded on fact; and *if* so, will some one kindly furnish me with as full particulars as possible of the fact?—SNGATI.

[68743.]—**Large Tree.**—In the Great Exhibition of 1851, the bark of the trunk of an enormous tree was exhibited. I shall be glad if some correspondent will kindly furnish particulars as to where it grew, its height, diameter, age, name, &c.—B. R.

[68744.]—**Regenerative Gas Lamps.**—I had always understood that one of the most desirable points to secure in a regenerative gas lamp was to have the gas highly heated before ignition. I have been much disappointed to find that this super-heating of gas did not increase its brilliancy. Since then I have met with a foreign maker who boasts that "he burns the gas cold, and so avoids the formation of graphite in the burner holes." Can any of "ours" say if my experience is right or reasonable, or if super-heated gas is likely to leave graphite in the holes?—D'EVLYN.

[68745.]—**Tempering Watch Drills.**—I have some drilling to do sometimes at watches, but I cannot temper my drills properly. I have tried with water, rosin, quicksilver, and a solution of cyanuret of potash and rain water; but I cannot drill into a piece of iron, as it takes the point off my drill before it will enter, and I would be glad if any of our readers will kindly help me with a few hints.—YOUNG WATCH AND CLOCKMAKER.

[68746.]—**To "Engineer, Govan," or Others.**—Will you kindly say what special precautions are used in running insulated leads for alternating currents as a D.P. of 2,000 volts, either in making joints or attaching to insulators? How do transformers, arranged in parallel distribution, adjust the amount of primary current flowing through them to meet the wants of the secondary, if the lamps are being gradually turned on or off one by one, both being entirely independent circuits. I do not quite follow S. P. Thompson's explanation. What is the best method of calculating mains and branches? The only way I know of is with a table of wire resistances; guess the nearest one, find resistance for length required, and if loss of potential is too great, to go on until the most economical is found. Can you give me a better one?—VOOGHT.

[68747.]—**Violin Strings.**—I wish to make some violin strings for my own use, not for profit. And I would be very glad if some friend will give me some reliable information as to the way I can make gut violin strings.—WEALTHY AMATEUR.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 22, and unacknowledged elsewhere:—

E. B. FENNESSY—A Very Old Reader—Nimrod—O'M.—M.I.C.E.—Chas. H. G.—Silical—Hall, Birmingham—Pryce—X. Y. Z.—Ventilator—B. P. A.—Prime Cost—Lux—Trew—Chas. E. Sohn—B. J. Hopkins—Easter—S. Maddison—An Ex-Watchmaker—S. Bottone—Phos. Bron.—A Fellow of the Royal Astronomical Society.

C. W. W. (Particulars of all examinations for degrees can be obtained of the Registrars of the respective Universities. The B.Sc. is given by Glasgow, Edinburgh, and London. The course of study can be found in the "Calendar" of the University; but for London, at any rate, it involves a great deal of work.)—W. J. GRIFFITHS. (Whether you can accept what you call an "axiom" or not, the fact remains that the top of a wheel attached to a cart in motion *must* at any given moment be moving faster through space than the bottom—or the vehicle would make no progress along the road. Take note of the terms as stated. The question is rather an old one, and has been discussed at quite sufficient length in our early volumes. There is no "tremendous strain" about it, except the "strain" necessary to drive so simple a fact into the heads of people who cannot apparently think. See, amongst other works, Proctor's "Geometry of Cycloids.")—MIKE. (We do not think it at all likely that there is a work on the construction of weighing machines; but there are articles in technical serials and in the cyclopædias; but even they would be mostly descriptive. Books devoted to such subjects are rarely published because there is not sufficient demand to render them a paying speculation.)—A COUNTRY LAD. (We have frequently explained that engineers on board steam-vessels have to obtain a certificate. The chief engineer can take assistants, and after they have served four years in the engine-room "on the watch" they are competent to sit for the certificate; but they are not recognised "engineers" until they obtain that.)—CHICKEN. (The temperature at which an incubator should be kept is about 103° Fahr. A good incubator was described in No. 1,195. The question has been frequently answered.)—A CONSTANT READER. (For what purpose is the charcoal required? We suppose the purest kind of charcoal would be made from biscuits of the finest white flour. They should be packed in some air-tight vessel, and heated to redness. Good pure charcoal can be made, say, from "luncheon biscuits" packed in a piece of iron pipe, and after carefully luting up, heating to a dull red for several hours. But pure charcoal can be made easily from any wood which is not resinous—say, sycamore, willow, poplar, or box. What is wanted is to heat it to a red while it is protected from the action of the atmosphere.)—CAP. GEO. TOPPING. (The required information has been frequently given. Do you want to plate with copper by means of the battery, or merely by simple immersion? The solution is a saturated solution of sulphate of copper, with the addition of a little sulphuric acid.)—R. A. R. BENNETT. (If you refer to the answer again and weigh the terms in which in which it is expressed, you will see the matter clearly. Every part of a revolving wheel is moving relatively with the same velocity; but in the case of a wheel which is rolling a vehicle along a road that part which at any given moment is at the top *must* move with greater velocity *through space* than any other part. But it is "top" only for a fraction of a moment, and each part in turn becomes "top." You will comprehend at once if you will cut a disc of cardboard and roll it along a line on a sheet of paper, putting a pencil point through a hole in the top while a quarter or half-revolution is made, and the disc is at same time made to roll along the line. If you refer to any treatise on the geometry of the cycloids (Proctor's, for instance) you will understand at once.)—STANNUM. (The screw-shafts of steamships are generally in three pieces—the propeller-shaft, the main-shaft, and the crank-shaft; but sometimes the crank-shaft is in pieces. All are fitted together by collars and flanges. The crank-shaft probably breaks most frequently. Iron is plated with tin or zinc by first thoroughly cleansing the surface, and then dipping in molten metal. See indices of back volumes.)—DEMON. (The Indian box trick was described some time ago. One of the ends is movable.)—RHANDIRMWYN. (Get Sprague's work on "Electricity," if you can, as we believe it is out of print; and for the rest consult the catalogues of the publishers.)—J. P. (It would seem that you ought to be examined by an expert; but drinking copiously of hot water or cooled boiled water should help to cure such rheumatism as you describe.)—N. T. A. (If by cheap you mean low priced, you can find the best directions in Vol. XXXII.; but many opticians supply lenses and instructions. 2. It is doubtful if you can put an octave coupler to the harmonium without rebuilding, as there is not room enough under the keys of instruments that are not fitted with stops.)—ALCHEMY. (Better advertise in the "Wanted" column. We can suggest no other means.)—E. RUTTER. (Second sketch comes too late, we regret to say.)

Rupture Sufferers should call at the MEDICAL BATTERY COMPANY'S INSTITUTE, 52, OXFORD STREET, LONDON, W. (corner of Rathbone-place), and personally inspect Mr. C. B. Harness' valuable Hernia Appliances, which have been so strongly recommended by the medical profession. An experienced and skilful surgeon attends daily, and examines patients free of charge. Pamphlets gratis and post free.

USEFUL AND SCIENTIFIC NOTES.

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IN some experiments on the effect of high temperature and pressure on carbon, by C. A. Parsons (*Jour. Chem. Soc.*), carbon rods were surrounded by benzene, paraffin, treacle, chloride or bisulphide of carbon, and submitted to great pressure in a hydraulic press, the rods being meantime heated by passing an electric current through them. In some cases a considerable amount of gas was evolved, and a soft, friable deposit of carbon produced. In no case was the density of the carbon increased. When the rod was surrounded with silica the latter fused, and the rod was largely converted into graphite; the same occurred with hydrated alumina in lime or magnesia, the rod being rapidly destroyed with evolution of gas. With layers of coke, lime, and silica, the rod was rapidly corroded, and was found after the experiment to be coated with a coke-like layer of great hardness, sufficient to scratch rock-crystal and ruby, and to wear down the cut facets of a diamond. It resists the action of a mixture of hydrofluoric and nitric acids. The conditions of temperature and pressure with presence of moisture, lime, and silica, resemble those which appear to have existed in the craters of the Cape diamond mines. The part played by the lime and silica is not clear.

A PATENT taken out for a steel process in France and America, by Gustave L. Robert, is attracting a good deal of attention in the latter country. It consists in making the air tuyeres in the side of the converter, instead of at the bottom, and thus the air blast is directed upon the surface of the melted metal instead of through it, and it is caused to impinge at a greater or less angle by tilting the converter.

THE Midland Railway Company is stated to have in course of construction at its plant works at Derby a number of passenger vehicles with lavatory accommodation for third-class as well as first-class passengers. The carriages are on the bogie principle—composite first and third-class compartments, with separate lavatories between them. This will be a great comfort in travelling on long journeys.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK WRAPPER, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

Holloway's Pills offer relief in all the disturbances of digestion, circulation, and nervous tone which occasionally seize on a vast portion of the population. These Pills possess the most estimable property of cleansing the entire mass of blood, which, in its renovated condition, carries purity, strength, and vigour to every tissue of the body.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 31, 1889.

PRACTICAL ELECTRICAL TESTING.—IV.

By E. J. Wade and F. C. Allsop.

The Metre Bridge.

THE metre bridge is one of the forms of apparatus employed for taking measurements of resistance by means of the "Wheatstone Bridge" method, so-called after Sir Charles Wheatstone, who was the first to employ this test, although the idea had been published by Christie some time previously.

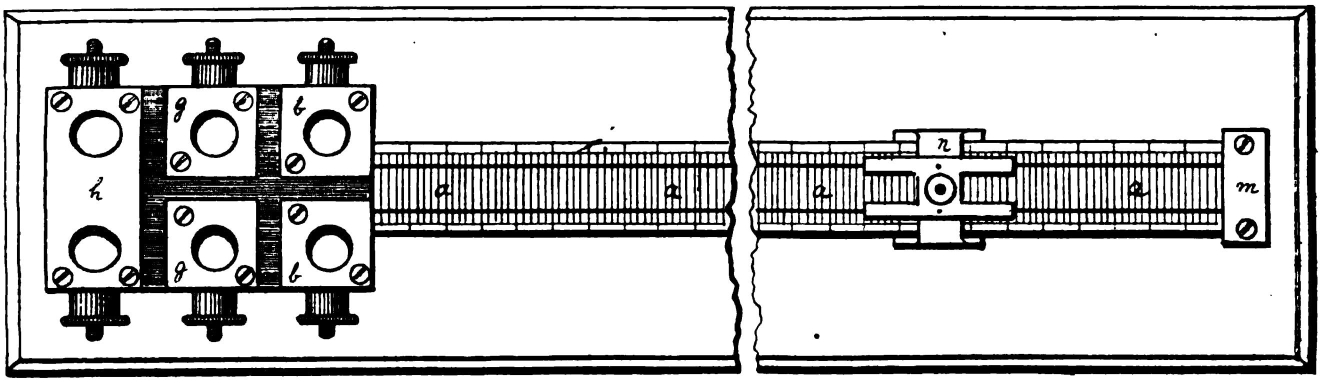

Fig. 8.

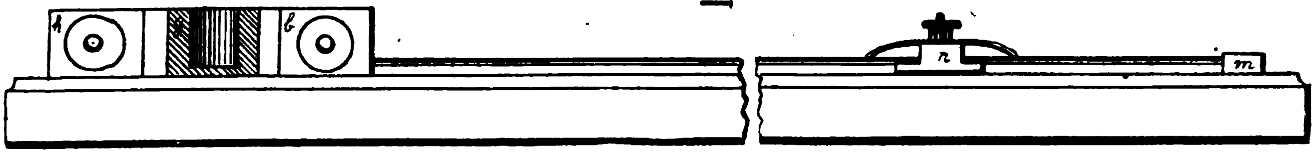

Fig. 9.

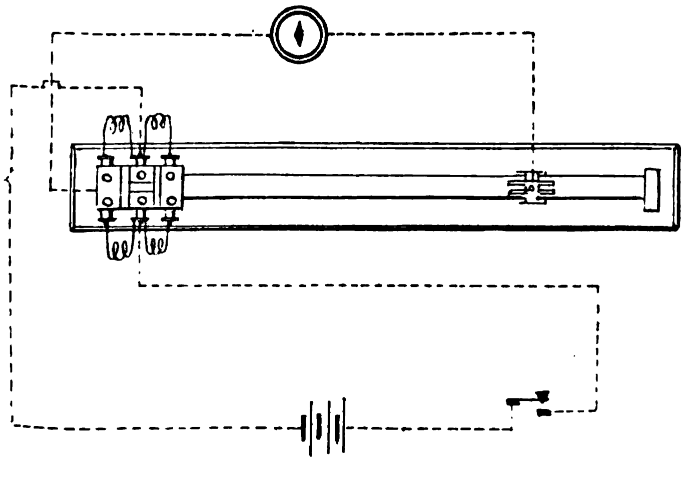

Fig. 10.

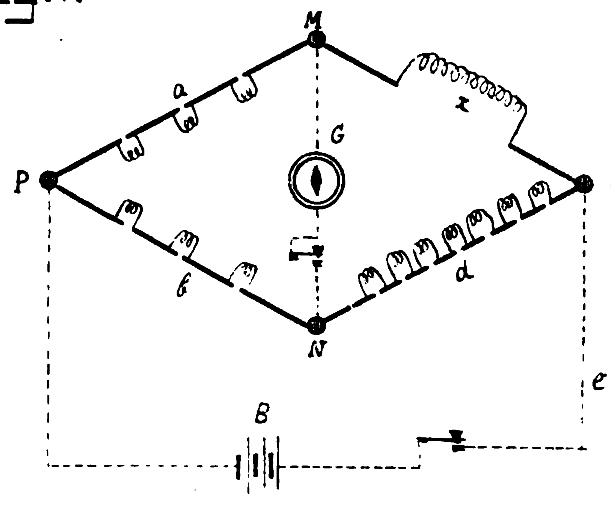

Fig. 11.

We shall not here deal with more of the theory of the test than is necessary to enable one to understand the practical working of the apparatus founded upon it, for the subject is beyond the scope of these articles, and is more or less fully treated of in every textbook of electricity.

Fig. 11 is a diagrammatic view of the Wheatstone Bridge, as usually made up for taking ordinary measurements of resistance. We shall speak of this form in detail later, but it will serve for the present to illustrate the action of the one we are now dealing with.

The current from a battery B branches at P into two paths P M Q and P N Q, which unite again at Q and return to the battery by the wire *e*. Between two points, M and N, one on either circuit, is connected the galvanometer G. The four portions of the circuit, M P, M Q, N P, N Q, are called the four "arms" of the bridges; it may be proved that when the resistances in these are such that $\frac{MP}{MQ} = \frac{NP}{NQ}$ no current will pass through the galvanometer, and, consequently, no deflection will be produced; but under any other conditions there will always be a current of more or less strength through the galvanometer in one direction or the other.

In the metre bridge, M Q is the resistance that has to be measured; M P a resistance of known value; while N P, N Q is a length of wire, usually one metre in length—hence the name—of uniform diameter and resistance throughout. The galvanometer connection N is a sliding one that can be made at any point on this wire, and it is shifted about until a position is found where the galvanometer gives no deflection, and the above equation then holds good. Now, the wire being of uniform diameter throughout, its resistance is proportional to its length, and the ratio, therefore, of the length of wire on one side of the galvanomer connection to that on the other will give the ratio of their resistances—that is $\frac{NP}{NQ}$. M P is also known and, therefore, the unknown resistance M Q may at once be found, for $MQ = MP\frac{NQ}{NP}$

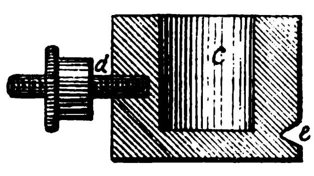

Fig. 12.

Figs. 8 and 9 give plan and side elevation, one-half real size, of a form of metre bridge designed by us, which will be found to be both simple and inexpensive to construct. The usual practice in these instruments is to employ a single length of wire, and to run heavy metal bars from its two extremities, bringing them round till they nearly meet; but we think that the plan of using two lengths of wire side by side, and thus bringing their extremities close together, will be found to offer great advantages in the matters of compactness and convenience of connections. The boxwood scale *a* is 50 centimètres long, 1in. wide, and ⅛in. thick. It is graduated into centimètres and millimètres by divisions running nearly its whole width, and the centimètres are numbered from 1 to 50 along one edge, and then back again from 50 to 100 along the other edge. Such a scale may be procured for about five shillings. If, as will probably be the case, there is an ungraduated portion about ⅛in. long left at each end, it must be cut off, and the length reduced by very carefully filing and glass-papering until the first graduations are reached. This having been done, the scale is now screwed to a wooden base by means of small countersunk brass screws down its centre.

Butting hard against the left-hand end of the scale are the two brass blocks *b b*, 1in. square by ¾in. deep. Fig. 12 gives a full-size view of one of these block; *c* is a hole ½in. dia. and ⅝in. deep, drilled out of the centre of the block, and *d*, a brass stem 3-16in. diameter, with a milled terminal threaded on to it, screwed and soldered into one side. Care must be taken in drilling the hole for this stem that it does not go through info the hole *c*, but a wall of metal about 1-16in. thick should be left between the two.

The triangular groove *e* in the side of the block opposite to the terminal is for the purpose of receiving one end of the scale wire. Its central line is ⅛in. above the bottom of the block; it is fully ⅛in. deep, and should be cut with a three-cornered file, and finally well-tinned and filled with solder. To the left of this pair of blocks are another similar pair, *g g*, and beyond these a larger block, *h*, 2¼ by 1 by ¾. This latter has two holes and two terminals; in fact, it corresponds to two of the smaller blocks joined together. All these five blocks are ¼in. apart, and when they are finally screwed down into position after the scale wires have been attached, this space should be filled in with pieces of ¼in. sheet ebonite flush to the surface of the blocks. At the other end of the scale is the brass block *m*, 1¼ by ½ by ¼. A full-sized plan and section of this is given in Fig. 13. The two grooves receive the other ends of the scale wires, and are similar to those in the blocks *b b* described above. No. 18 B.W.G. platinoid (an alloy of German silver with a small percentage of Tungsten) is used for the scale wires. German silver is sometimes used; but as it has only two-thirds the specific resistance of platinoid, the latter is to be preferred. The cost is the same in either case. In the best instruments of this class very expensive wires of platinum, platinum-iridium, or silver-iridium are employed, on account of their great hardness and freedom from oxidation. The whole accuracy of the bridge depends on the uniformity in size of these wires and the accuracy of their attachment to the terminal blocks, and great attention should therefore be paid to these two points.

The first is best attained by procuring the wire a size or so larger than will be used, and reducing it in a draw-plate, taking care not to use more force than is necessary. When brought to the right size, it must be kept in a straight length until fixed in position. This is done as follows:—One of the blocks, *b b*, is removed from the base, supported with the grooved face uppermost, and heated either with a blowpipe flame or a good-sized soldering-iron, until the solder in the groove is thoroughly melted. One end of a piece of the platinoid wire, about 30in. long, is then gently laid in the groove, both the wire and the solder having first been sprinkled with a little powdered rosin. Spirits of salts must on no account be used. The solder should "take" on the wire the whole length of the groove, and then end sharply off. If this is not the case, or if the solder extends along the wire in the slightest degree beyond the edge of the block, the operation must be repeated until a satisfactory result is obtained. A length of wire having been attached to the other block in the same way, they are both replaced in position with the wires lying along the face of the scale.

Preparatory to soldering the other ends of the wires to the block *m*, they must be stretched tight and straight. This is best done by twisting some of the spare length of wire beyond the block into a loop, fastening a piece of stout string through this, and after carrying it back horizontally for a foot or so, let it turn down over the edge of the bench or table on which the instrument stands, and attach weights to its lower end until a sufficient tension is obtained. The weights attached to each wire should be approximately the same, and not more than is necessary for the purpose in view.

While the wires are thus kept stretched, adjust them to lay over the grooves of solder in the block *m*, then heat the block with a soldering-iron until the solder melts, and the wires will sink down into the grooves. When the block is quite cold the weights may be removed and the spare length of the wires cut off.

The wires should lie close to the scale throughout their length, and just ½in. apart. This will be the case if the grooves have been carefully cut, and the wires well down in them. As we said before, the proper fixing of the wires is the most important point in the construction of the apparatus, and no pains should be spared to obtain the best results.

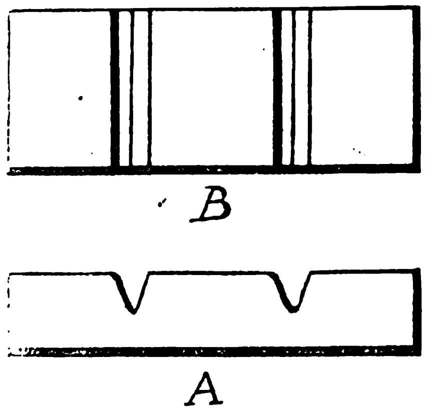

Fig. 13.

The sliding contact is very simple, and needs but little description. The brass bridge piece *n* should fit comfortably over the width of the scale without any side play. If preferred, it may be cut out of a single piece of hard wood. On the top of the bridge rests a piece of thin German silver sheet cut into the shape of a letter H. It is fixed in position by a brass terminal screwed through its centre, and a brass pin on either side to prevent it from twisting. The tongues should be curved downwards until they almost touch their respective wires, and the ends rounded off, first with a file, and then on an oilstone, so that they will not cut or scratch the wires.

The holes in the blocks are intended for use as mercury cups, and must be amalgamated by pouring in a few drops of nitrate of mercury and a globule of mercury, and working it round the cup with a little piece of wood. When it has well taken all over, pour off the residue, which can be used over again, rinse out well with water, and, when dry, half fill the cups with pure mercury.

Commercial mercury is very impure, containing large percentages of lead, zinc, and other metals, and, when exposed to the air, it very rapidly becomes covered with a thick, black scum of oxide. It may be very considerably purified by pouring on strong sulphuric acid and letting it stand for some days, with occasional shaking. It is then well-washed with water, and squeezed through chamois leather. Nitrate of mercury is prepared by adding an excess of mercury to strong nitric acid, and leaving it till all action has ceased; but, as it is very poisonous, great care must be taken to prevent it from getting into cuts or scratches on the hands.

When using the bridge, a pair of adjacent blocks will often require connecting together by a short-circuiting piece. A short length of very stout copper wire bent into the shape of a letter U, and with one limb dipping into each mercury cup, may be used for this purpose. A better method is to have some pieces of 1-16in. copper or brass, 2¼ by ¾, and with two ¼in. holes drilled through their central line, 1¼in. apart. These will slide over the terminal stems on the sides of the blocks, covering the whole side surface of the blocks, and when the terminal heads are screwed up tight, an excellent contact will be obtained, providing the surfaces are clean.

ELECTRO-MOTORS: HOW MADE AND HOW USED.—VII.*

By S. R. Bottone.

§ 27. PREVIOUS to winding, the armature must be fitted on a spindle, and furnished with a commutator, and the field magnets fitted with bearings to take the spindle. The bearings should be cast from patterns similar in general outline to those shown at Fig. 11, but stouter in proportion, the back bearing being 5in. long, and the front bearing (the one near the commutator) being 2¼in. in height, from base to centre of aperture through which the spindle passes. For the spindle, a piece of ⅜in. mild steel rod; about 8in. long should be selected, turned down about 1/16in all round at each end, to allow it to enter into the ¼in. hole in the bearings. A little end-shake should be allowed, as this prevents grooving in the commutator. The end to which it is intended to attach the pulley destined to transmit the motion set up must project about an inch beyond the back bearing. The mode in which the bearings are fastened to the field magnets is precisely similar to that described at § 19, last fifteen lines—that is to say, holes are drilled in the flat portions of the brasses, to allow flat-headed screws to pass; corresponding holes are drilled and tapped in the flat faces of the field magnets, and the brasses are screwed up in place. It is better to delay the placing these brasses in position until the armature itself has been mounted on its spindle, as we can then insure its running in the tunnel centrically, without which it might strike against the sides of the tunnel. To mount the armature we need two brass spiders of the form illustrated at Fig. 21. A wood pattern should be made for this, and sent to the brassfounder's. The castings can then be cleaned up with a file, and fitted so that when the slotted portions are pushed into the ring, in front of three out of the twelve teeth, the width of the arms should not exceed the thickness of the underlying teeth. Holes should then be drilled in the extremity of each arm, corresponding holes being drilled and tapped in the rim of the armature just below the three teeth. Three screws put through each spider will hold armature and spiders firmly together. A central hole, to take the ⅜ spindle, must now be bored through the centre of each spider. Care must be taken that these be coincident, or else the armature will *wobble*. A small flat is now filed on the centre of the spindle, and a corresponding keyway in the central hole of the spiders. A nicely-fitting "key" is made to fit the flat and keyway, but need not be driven home until the armature is finally mounted. The commutator may now be made, precisely as described at § 10, with the difference that as there are 12 sections in the armature, so there must be 12 separate segments in the commutator. (Here it has been supposed that the armature has 12 cogs; but in point of fact there may be, in these ring armatures, any number of sections from 4 to 48, &c.; but whatever be the number of sections in the armature, the number of segments in the commutator must correspond.) The best way for the amateur to make this and similar commutators is to turn a piece of boxwood to fit the spindle.

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mount it on the spindle, turn it to a cylinder about 1¼in. in diameter, and 1in. long, fit over it tightly a piece of brass tubing, about 1¼in. internal diameter, about $\frac{1}{16}$in. thick, then space it out with the callipers into 12 equal divisions; and when this has been done, bore one small hole at each extremity of each line to take short screws, which *must not reach* to the spindle or shaft. (If they do, there will be a short-circuit, and the machine will not act.) When these holes have been bored, those at one of the cylinders must be countersunk and fitted with *flat*-headed screws; those at the other end can be fitted with round-headed screws, as they will serve to take the free extremities of the wires wound on the armature.

Twelve lines are now drawn at equal distances between these screws, and then the ring divided by cutting through these lines with a fine hack-saw into 12 equal segments, as shown at Fig. 22. When the armature has been thus fitted and mounted, as illustrated at Fig. 23, the ring must be temporarily dismounted from its fittings (which must be marked to insure them being replaced in the same position, and then the ring must be carefully "dressed" or "taped" (see § 18). To this end a piece of thin silk (the economical amateur may use the silking of an old umbrella) is cut, a little wider than the ring, and of sufficient length to line the entire inside of the ring. This is glued to the inside of the ring by means of a little good hot glue; and if the silk has been cut a little wider than the ring, the excess must be glued round the edges of the ring. In like manner another strip is cut off such a length as to go all round the outside of the ring, and in between the cogs. This piece is also glued on, special care being taken to make it fit squarely into the channels. Lastly, two circles are cut to fit over the front and back edges of the ring, these being likewise carefully glued on, so that at no place does any bare iron appear. When quite dry, the inside of the ring, its faces, and the channels should receive a coating of good shellac or white hard varnish. (The silk at the top of the cogs need not be varnished, as it will be cut away after winding). Six pieces of oak or other hard wood are now cut to about the same size as the arms of the spiders, where they screw on to the ring. These are bored to take the screws belonging to the spiders, and after being cut a trifle longer than the thickness of the ring, are screwed down over their respective holes. The office of these pieces of wood is to prevent the wire encroaching, during winding, on the spaces in which the arms of the spiders must fit. It is therefore essential that they should be a trifle wider than the said arms. The armature is now clamped by its edges at a convenient working height, say, about 36in., from floor level, to a firm bench, by means of a vice or clamp. A shuttle of the general form shown in Fig. 24 is now cut out of a piece of any hard wood (a piece of cigar-box lid will do very well for this particular armature), the width of which must not exceed one half the inside diameter of the ring. On this shuttle must be wound sufficient wire to fill one channel of the armature. Since the entire armature of this size will take somewhat less than 1lb. of wire, each of the twelve channels will take about 1¼oz. of wire. It will be well to weigh the armature before winding one channel, then weigh again when one channel has been wound in, and then to cut off eleven similar lengths of the same wire, so as to insure that each channel or "section" has the same amount of wire upon it.

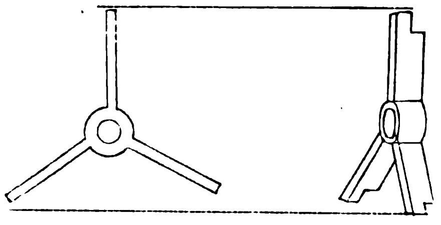


FIG. 21

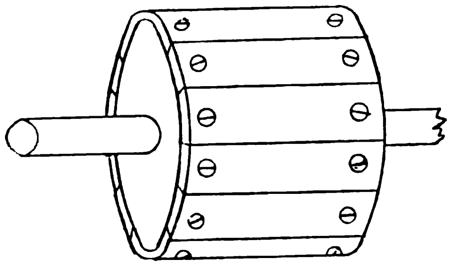


FIG. 22

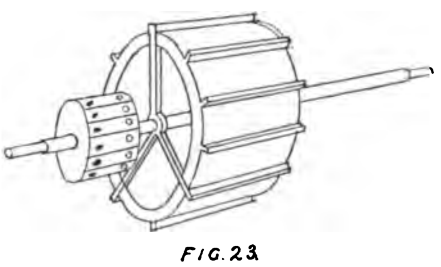


FIG. 23

It is much easier for two persons to wind the armature than for one alone to do it, and in the following directions I shall suppose two persons to be at work upon it. The one who has the most skill I shall term the *operator*, the other the *assistant*. Standing at that side of the armature which when fitted is the nearer to the commutator, the operator bends about 2in. of the wire round to the left of the top cog, and then lays the wire tightly and flatly along the right hand of that same cog, as shown at Fig. 25. The assistant then takes the shuttle and passes it inside the ring to the operator, who draws it through, and lays a strand straightly and tightly along the inside of the ring, pulling pretty hard to insure the wire lying flat and tight. He then passes the shuttle to the assistant, who again pulls towards himself, in so doing laying another strand of wire over the ring, close against the one previously laid on. If there is any unevenness, or space between the wires, a smooth wooden or bone paper-knife may be used to press the wire flat into its place. The assistant again passes the shuttle inside the ring to the operator, who, in his turn, lays another strand inside, close against the first one, and again passes the shuttle to the assistant, and so on until the next cog is reached. Continuing in the same manner, and winding over the layer just laid on, coming back towards the cog from which the commencement was made, a second layer is put on, and so on until all the wire on the shuttle is wound on, and the channel filled. In order that the wire may not uncoil, it will be well to turn the bent end of the starting wire straight, and twist it pretty tightly to the finishing end. This finishing end should, in view of avoiding mistakes in after-operations, be marked in some distinctive manner—say, by colouring an inch or two of its length with red Aspinall's enamel, or other quickly-drying colour. Before proceeding to lay the wire in the other sections, it will be advisable now to test whether the insulation of the coils just laid on is perfect. As this is of the highest importance, and *must* be done to each section as each section is in it turn laid on, the modes of testing are here described.

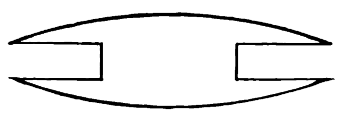


FIG. 24

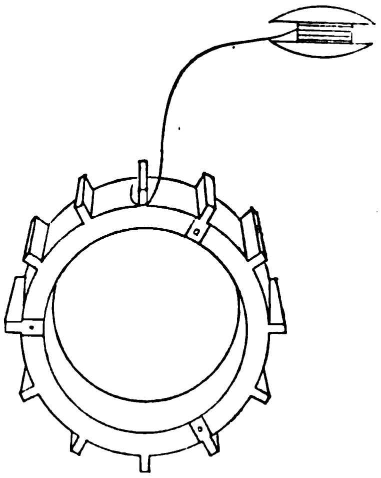


FIG. 25

§ 28. The first and simplest if a pretty strong battery or other source of current electricity be at hand, is to connect one pole of the battery with the finishing extremity of the wire laid on (which must, of course, be bared of its covering at this point to insure good electrical contact), and then draw the other pole of the battery along some bared portion of the ironwork of the armature. As it has been recommended to cover the armature *entirely* with silk, the available points of contact in the present case will be the heads of the screws, which hold on the wooden blocks that hold the places of the arms of the spiders. On touching the iron with the free pole of the battery, if the insulation is perfect, *not the slightest spark should appear*. If any spark is seen, on drawing the wire along the iron it shows that the current is leaking through to the iron, and the insulation is defective. The second method, which is much more delicate, necessitates the employment of a galvanometer. As before, one pole of the battery is connected with one of the ends of the wire just laid on, the other pole is then connected to one terminal of the galvanometer. A piece of wire is now connected to the other terminal of the galvanometer, and the free end of this latter wire is made to touch the bare iron or screw of the armature. *No deflection should take place.* If under these tests it should appear that the insulation is defective, the section must be unwound, the bare place in the iron again carefully dressed, and, when rewound, again tested until perfect insulation has been attained. In precisely similar mode in which the first section has been wound, the remaining channels are to be filled in.

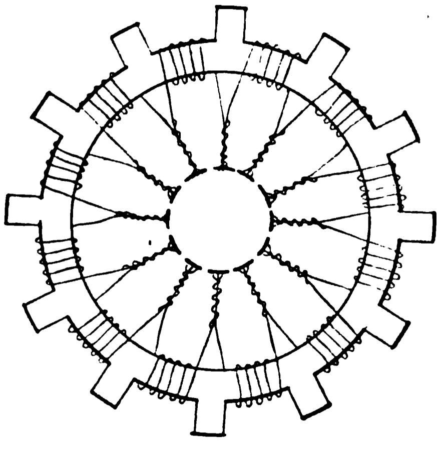


FIG. 26

§ 29. Another mode of winding, specially adapted to larger motors and dynamos, is the one recommended by Mr. F. W. Walker, in his excellent little work, "Practical Dynamo Building for Amateurs," which originally appeared in the pages of the English Mechanic, and which I reproduce here, with trifling modifications, to fit it for the cog or Pacinotti form of armature. Having described the shuttle for the wire, Mr. Walker proceeds to say: "Two shuttles of hard wood, nicely rounded, a mallet, and a hard wood wedge, with rounded and smooth edges and surface, now complete the winder's outfit. Upon one shuttle should be wound, with a little to spare, the length of double cotton-covered wire that has previously been calculated for one coil; then, if the winding is to be four layers deep, four full perimeters of wire should be wound off upon the second shuttle. In describing this operation, in order to render the use of the two shuttles more clear to the amateur, the first, holding the bulk of the wire, will be termed No. 1, and the other with four layers upon it, No. 2. Beginning close to the cog to his right, the winder passes No. 2 through the armature to his assistant, who thereupon hangs a weight to it, and then he receives No. 1 from the winder over the top of the armature, passes it back to him through the interior, receives it again, and so on, straining tight each time, and bringing the strands level with the mallet and wooden wedge. A short piece of tape is laid upon each edge of the core, so that the last two turns pass over it, leaving an end of tape free when the other cog is reached. The last turn being laid close to the cog, the tape end is brought up between the wire and cog, then the first turn of the second layers is made by the assistant over the top with No. 1 shuttle, No. 2 remaining neutral all this time. The second turn of this layer should bind the tape end over the first, thus securing it from slipping. Then a weight should be attached to No. 1 by the winder while he gives the layer a good coat of shellac varnish. The tape ends should again be laid ready to bind in the last turn, and the winding proceed until one turn is required to bring the second layer close to the starting cog. Instead of performing this turn with No. 1, the winder hangs a weight to it when he receives it from his assistant at the finish of the last turn but one, and this final turn completed with No. 2 shuttle, which the winder passes back, and again receives from the assistant over the top, and returns through the armature, so that No. 2 makes the last turn of second layer and first turn of third; then is weighted by the assistant, and again remains neutral for a time. The third layer now proceeds with No. 1 to the other cog, the last turn being taped as before, and the first turn of the fourth and last layer is begun with No. 1 shuttle, and wound until the last turn but one, when the assistant passes it through to the winder, when it should be nearly empty. No. 1 shuttle is then passed over and completes the last turn, and with the end of wire from No. 1, and the end from No. 2 respectively, coming through and over, the winder pulls taut, and makes a neat and tight twist with the pliers, taking care to place some tape between the wires in case of a short-circuit. By this arrangement of two shuttles, the final ends are brought out in the last layer, over and under, and the distortion and risk of short-circuit consequent upon leaving the first end to protrude through the whole winding prevented."

§ 30. Whichever plan of winding has been adopted, the armature will now be ready for being properly coupled up. For this purpose the operator will begin by untwisting the ends of one of the sections, and having bared the *finishing* end of this said section, and sandpapered it to get a good clean surface, will cause his assistant in like manner to untwist the wires on the next section, and bare and clean the *beginning* extremity of this next section. He will then twist up together pretty tightly, and afterwards solder the *end* of the first section to the *beginning* of the next, and so on until all the sections are thus joined, using two precautions—1. To place a piece of tape or paraffined paper under the wires previous to twisting up, to prevent any chance of short-circuiting with the layers of wire beneath. 2. To leave about 2in. of free ends of wire for after attachment to the commutator. When the sections have been all thus properly connected, as shown at Fig. 26, the layers of wire should receive a coating of some insulating material. Some operators employ thin shellac varnish, others place the armature in a gentle oven, and place over it lumps of paraffin wax, and allow the heat of the oven to melt the paraffin until the layers of wire are permeated with it. For small armatures I prefer the latter plan; for large ones, the former. When the operation of varnishing or paraffining has been completed, the armature may be mounted on the spindle (the wooden blocks having been previously removed to allow the arms of the spiders to fit in their places), and the twisted ends of the wires fastened down, each one to its own segment of the commutator, by means of the round-headed screws, as shown at Fig. 26.

THE INTENSITY OF TELEPHONIC EFFECTS.—II.

IN a recent number of this paper (May 17th) we described some researches on the intensity of telephonic effects which M. E. Mercadier has been carrying on in France. The curve which accompanied this description represented the variation of these effects according as the thickness of the iron diaphragm was varied.

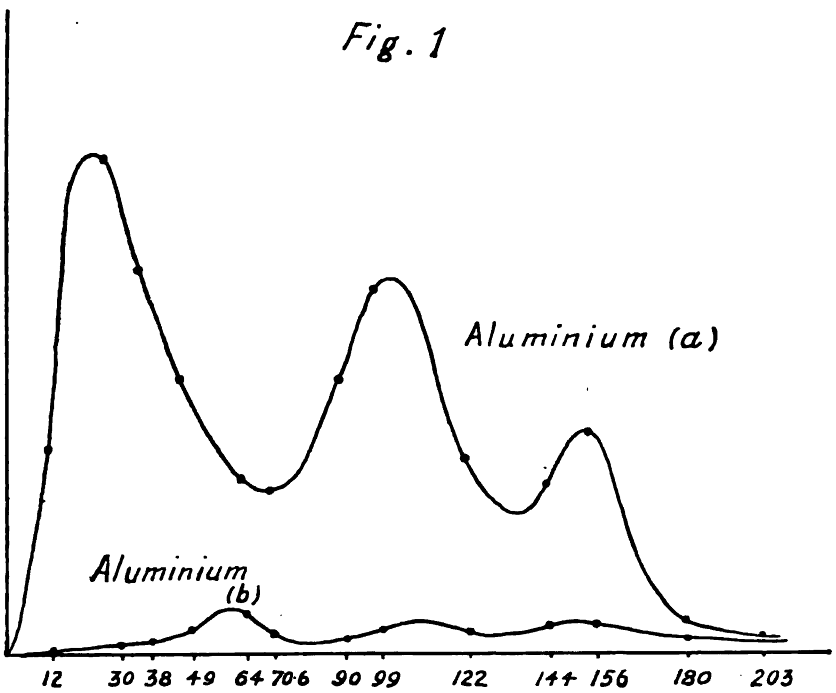


Fig. 1

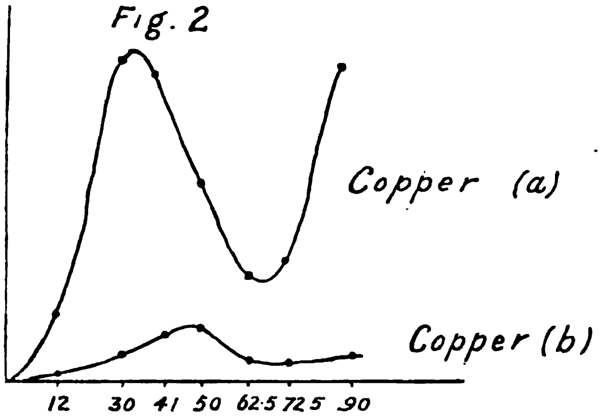


Fig. 2

The same method of observation and the same mode of representing the results have been applied in some further experiments with diaphragms made of diamagnetic metals. M. Mercadier has just communicated the conclusions he deduces from these latter investigations to the Académie des Sciences at Paris.

Aluminium and copper were chosen as fair types of diamagnetic metals. Experiments of the same order and character were made with diaphragms composed of these substances as were previously made with the magnetic diaphragm. The accompanying curves illustrate the results. A telephone by Arsonval was used.

Fig. 1, *a*, refers to aluminium. Observations were made with three separate diaphragms, of which the thicknesses varied from 0·12mm. to 2·03mm. This curve greatly resembles in character that obtained when the diaphragm was composed of iron, but the alternate maxima and minima decrease a good deal more gently.

Fig. 2, *a*, represents what takes place when the metal copper is substituted in the diaphragm. The curve, again, has a somewhat similar form. It shows that, taking for a diaphragm discs of copper ranging in thickness up to 2·00mm., the maxima and minima decrease still more slowly. It demonstrates the fact that when sounds or words are received by a copper diaphragm, the intensity of the effects perceived is almost as great with a thickness of 0·90mm. as with a thickness of 0·30mm.

These curves have been obtained by taking as abscissæ the thicknesses of the diaphragms expressed in hundredths of a millimètre, and as ordinates the squares of the distances at which an observer is just unable to hear the telephone reproducing the noise of a metronome fixed to the plate of a microphone in a distant room. But it was found necessary to double the intensity of the current which traversed the primary wire of the induction coil of the microphone, and to bring it to 0·3 ampère; and in order to facilitate the working of the experiment it was desirable to leave out the resistance of 17,000 ohms, which in the previous experiments with iron diaphragms had been introduced into the secondary wire.

It seems that the effects produced with diaphragms of aluminium and of copper are, *cæteris paribus*, much more feeble than those which can be obtained by using iron. The scale of the curve which relates to aluminium in Fig. 1, *a*, which is about ten times greater than that of the copper curve in Fig. 2, *a*, is many hundred times smaller than that for iron, which was shown in the first part of this paper. But a chemical analysis of the aluminium used showed that it contained 1·65 per cent. of iron, a proportion of impurity which in this case must have some marked influence, and cannot be neglected. The copper showed only traces of iron.

One is led at first to think that this considerable difference of effect in passing from iron to aluminium, and then to copper, must be due to the fact that the specific magnetic power of these latter metals is so extremely small compared with that of iron, and this is really an important cause. But there is another influence which must be considered—that is, the electrodynamic induction resulting from variation of magnetism in the core of the telephone magnet, and which produces currents in the mass of the diaphragm; the consequence is that the effects which are produced by these currents increase those due to the magnetic induction, properly so-called.

In endeavouring to find out what part of the whole effect is due to electro-dynamic induction, it must be observed that the currents which arise from it in the diaphragm should be circular, or nearly so.

M. Mercadier, therefore, had the cap and mounting of his telephone made of ebonite, a non-conducting material, and, further, cut a very fine slit in each diaphragm from circumference to centre. The matter thus removed being extremely small, had, therefore, a negligible influence on the magnetic induction.

Working thus upon eighteen discs of iron, identical with those used in the first experiments, and then constructing a second curve on the same principle, M. Mercadier found that it had the same form; the ordinates were only reduced about a fourth in the region of the first maximum, and about one-half for the rest of the curve.

As regards the aluminium and the copper, the curves plotted in Fig. 1, *b*, and Fig. 2, *b*, show what reduction in intensity takes place when diaphragms of these metals are similarly treated. A radial slit was made in thirteen aluminium diaphragms and seven copper diaphragms identical with those used in the experiments represented by the curves in Fig. 1, *a*, and Fig. 2, *a*. These curves represent approximately the effect due to magnetic induction and those other slight causes arising from the vibration of the core of the magnet, the direct action of the coil which surrounds it, &c.

From these investigations the following conclusions can be drawn:—

(i.) That telephones with iron diaphragms are much louder than others, and that this effect is chiefly due to magnetic induction.

(ii.) That telephones with copper or aluminium diaphragms show (as do those with iron diaphragms) alternate maxima and minima of intensity and owe their effects principally to electro-dynamic induction.

In conclusion, it may be observed that if these latter effects are very small, they are very remarkable, for it was noticed that copper and aluminium diaphragms reproduced the *timbre* or *quality* of articulate words very much better than those which were made of iron.

ASTRONOMICAL NOTES FOR JUNE, 1889.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 57 36·39 A.M.	4 38 15	22 7 22	4 40 38·33
6	11 58 26·80 ,,	4 58 48	22 42 27	5 0 21·12
11	11 59 24·29 ,,	5 19 28	23 7 33	5 20 3·91
16	0 0 26·54 P.M.	5 40 13	23 22 30	5 39 46·70
21	0 1 31·20 ,,	6 1 1	23 27 9	5 59 29·48
26	0 2 35·52 ,,	6 21 48	23 21 30	6 19 12·27

The method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 348 of Vol. XLVIII.

On June 21st, at 6h. a.m., the Sun is said to enter Cancer, and summer is supposed to commence. He is, at this instant, situated a little to the N.W. of η Geminorum. This is the theoretical date of the longest day; but in London no perceptible difference will be observable in this respect from the 18th to the 24th, on all of which days the Sun will be 16 hours and 34 minutes above the horizon, and, obviously, only 7 hours and 26 minutes below it. Of course, there is no real night throughout the month.

From the 19th to the 22nd inclusive is the most favourable time in the whole year for obtaining the meridian by the old method of equal altitudes. The Sun continues, for the ordinary observer's purpose, quite spotless. As the

Annular Eclipse of the Sun

on June 28th will be invisible in this part of the world, the mention of its occurrence will suffice here.

The Moon

Enters her First Quarter at 8h. 1·6m. p.m. on June 6th, and is Full on the 13th at 1h. 58·2m. in the afternoon. She will enter her Last Quarter at 7h. 35·1m. on the morning of the 20th, and be New on the 28th at 8h. 53·6m. a.m.

The Moon.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	2·8	2 12·6 p.m.
6	7·8	6 11·7 ,,
11	12·8	10 23·3 ,,
16	17·8	2 35·0 a.m.
21	22·8	6 52·1 ,,
26	27·8	10 32·9 ,,

The Moon will be in conjunction with Saturn (1° 47′ N. of him) at 8h. a.m. on June 4th; with Jupiter at 9h. a.m. on the 14th (Jupiter 0° 29′ S.); with Venus at 6h. a.m. on the 24th (Venus 1° N.); with Mercury at 8h. a.m. on the 27th (Mercury 3° 4′ S.); and with Mars at 3h. a.m. on the 28th (Mars 1° 32′ N.) For obvious reasons nearly the whole of these phenomena will be invisible.

At noon on June 1st the Moon is in Gemini, in which constellation she remains until 4h. 30m. p.m. on the 2nd, when she quits it for Cancer; leaving Cancer, in turn, for Leo at 9h. a.m. on the 4th. Her journey across Leo terminates at 4h. a.m. on the 7th, at which hour she enters Virgo. Here she remains until 11h. a.m. on the 10th, when she passes into Libra. As she travels through Libra she arrives, at 2h. 30m. a.m. on the 12th, on the western edge of the northern spike of Scorpio, which she has traversed by 10 o'clock the same morning, and come out in Ophiuchus. Her passage through Ophiuchus occupies until 8h. p.m. on the 13th, when she leaves it for Sagittarius. By 11h. 30m. p.m. on the 15th she has traversed Sagittarius and entered Capricornus. She remains in Capricornus until 5h. 30m. p.m. on the 17th, when she enters Aquarius, and leaves Aquarius, in turn, for Pisces at 8h. p.m. on the 19th. At 11h. a.m. on the 20th she passes into an outlier of Cetus, whence she emerges in Pisces again at 8h. p.m. on the 21st, only however, to plunge once more into another portion of Cetus at 4h. 30m. p.m. on the 22nd. When she finally quits Cetus, at 6h. a.m. on the 23rd, it is to enter Aries. She remains in Aries until noon on the 24th, and then leaves it for Taurus. Having traversed practically the entire length of Taurus, she comes, at 2h. 30m. p.m. on the 27th, to the extreme northern part of Orion, and when by 7h. o'clock the same evening she has crossed this, it is to emerge in Gemini. Her journey across Gemini terminates at 11h. p.m. on the 29th, and then she leaves it for Cancer. She is still in Cancer when our notes terminate.

Near Approaches to Two Fixed Stars by the Moon.

Day of Month.	Star's Name.	Magnitude.	Time of Nearest Approach.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°
13	B.A.C. 6088	6	11 26 p.m.	S. by E.	9	19
20	36 Piscium	5	2 34 a.m.	N.N.W.	336	7

No visible Occultations of stars by the Moon will occur during June.

Venus

Is a morning star throughout June, and is a splendid and conspicuous object in the East before sunrise. She attains her greatest brilliancy on the 6th; and about this date may be easily picked up with the naked eye when on or near the meridian, in brilliant sunshine, by anyone who knows precisely where to look for her. Her angular diameter diminishes from 40·6″ on the 1st to 26·2″ by the 30th. She still presents a beautiful crescent in the telescope.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	2 11·0	11 33·2	9 30·7 a.m.
6	2 19·8	11 40·2	9 19·9 ,,
11	2 30·8	12 5·3	9 11·2 ,,
16	2 43·7	12 44·7	9 4·4 ,,
21	2 58·3	13 34·4	8 59·3 ,,
26	3 14·2	14 31·2	8 55·5 ,,

Whence it will be seen that Venus travels from Aries into Taurus, through a very blank region of the sky.

Mars comes into conjunction with the Sun at 2 a.m. on the 18th. Saturn is rapidly leaving us for the season; but may be picked up after dark in the West at the beginning of June, roughly half-way between Regulus and δ Cancri; and Neptune is, of course, invisible.

Mercury

Is an Evening Star up to the 19th, on which day, at 11h. a.m., he comes into Inferior Conjunction with the Sun, and, of course, then travels to the West of him, and becomes a Morning Star. At the beginning of June Mercury is still visible to the naked eye after sunset to the North of West. His angular diameter increases from 9·8″ on the 1st of the month to 12″ at the time of his conjunction; subsequently diminishing again to 10·4″ by the 30th. He presents a beautiful crescent in the telescope as long as he can be followed.

Day of Month.	Right Ascension.	Declination. North.	Souths.
	h. m.	° ′	h. m.
1	6 8·1	24 9·5	1 27·1 p.m.
6	6 12·8	22 55·5	1 12·2 ,,
11	6 9·4	21 32·9	0 49·2 ,,
16	5 59·8	20 13·8	0 20·0 ,,
21	5 47·9	19 12·7	11 48·4 a.m.
26	5 38·4	18 43·2	11 19·3 ,,

The looped path indicated by the above Ephemeris commences in Gemini and terminates in Taurus. On the evening of the 1st Mercury will be a little more than 1½° N. of η Geminorum; but this is the brightest star he will approach.

Jupiter

Comes into opposition to the sun at 7h. p.m. on the 24th; but from his great South Declination is as badly situated for the observer as he well can be. He rises about 9h. 50m. p.m. at the beginning of June, and a little more than two hours sooner at the end of it. To be seen with the telescope, however, he ought to be observed as near the meridian as possible, as at no time during the month is he 16° above the horizon, even at transit. His angular equatorial diameter increases from 42·8″ at the beginning of June to 43·8 at the end of it.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	18 27·1	23 5·3	1 48·1 a.m.
6	18 24·7	23 7·3	1 26·1 ,,
11	18 22·2	23 9·3	1 4·0 ,,
16	18 19·6	23 11·3	12 41·7 ,,
21	18 16·9	23 13·2	12 19·3 ,,
26	18 13·5	23 15·2	11 52·4 p.m.

This short retrograde arc is described in Sagittarius. About the 21st, Jupiter will be on a line joining the 3rd and fourth magnitude stars λ and μ Sagittarii.

Uranus.

Is now rapidly approaching the West, and must be looked for as soon as ever the sky is dark enough. His angular diameter remains constant at 3·8′ throughout June.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	13 7·8	6 30·9	8 25·8 p.m.
6	13 7·4	6 29·1	8 5·8 ,,
11	13 7·2	6 27·7	7 45·8 ,,
16	13 7·0	6 26·8	7 26·0 ,,
21	13 6·9	6 26·3	7 6·2 ,,
26	13 6·9	6 26·4	6 46·6 ,,

It will be seen from this Ephemeris that Uranus continues to travel in a direction approximately towards θ Virginis.

Jupiter's Satellites.

Day of Month.	Satellite.	Pheno-menon.	H.	M.	S.	Day of Month.	Satellite.	Pheno-menon.	H.	M.	S.	Day of Month.	Satellite.	Pheno-menon.	H.	M.	S.
1	II	Oc R	1	56	A.M.	14	*I*	*Sh E*	9	53	P.M.	22	III	Tr I	11	47	P.M.
5	III	Ec D	1	53	52,,	14	*I*	*Tr E*	10	7	P.M.	23	III	Sh E	2	29	A.M.
5	I	Ec D	2	7	23,,						A.M.	23	*III*	*Tr E*	2	39	,,
5	I	Sh I	11	14	P.M	15	*II*	*Ec D*	3	21	3	24	II	Sh I	1	0	,,
5	I	Tr I	11	41	,,	15	III	Sh E	10	30	P.M.	24	II	Tr I	1	2	,,
6	I	Sh E	1	30	A.M.	15	III	Tr E	11	23	,,	24	*II*	*Sh E*	3	40	,,
6	I	Tr E	1	58	,,	16	II	Sh I	10	24	,,	24	*II*	*Tr E*	3	41	,,
6	I	Oc R	11	16	P.M.	16	II	Tr I	10	47	,,						P.M.
					A.M.	17	II	Sh E	1	4	A.M.	25	II	Ec R	9	47	38,,
8	II	Ec D	12	46	30	17	II	Tr E	1	27	,,	28	I	Oc D	2	12	A.M.
9	*II*	*Sh E*	10	28	P.M.	20	*I*	*Sh I*	3	2	,,	28	I	Tr I	11	18	P.M.
9	II	Tr E	11	11	,,	20	*I*	*Tr I*	3	9	,,	28	I	Sh I	11	24	,,
13	I	Sh I	1	8	A.M.	21	I	Ec D	12	24	26,,	29	I	Tr E	1	35	A.M.
13	I	Tr I	1	25	,,	21	*I*	*Oc R*	2	44	,,	29	I	Sh E	1	41	,,
13	*IV*	*Ec D*	3	4	49,,	21	*I*	*Sh I*	9	30	P.M.	29	*IV*	*Oc R*	8	24	P.M.
13	*I*	*Sh E*	3	24	,,	21	*I*	*Tr I*	9	35	,,	29	*I*	*Oc D*	8	38	,,
13	*IV*	*Ec R*	3	33	16,,	21	I	Sh E	11	47	,,	29	*IV*	*Ec D*	8	47	43,,
13	*I*	*Tr E*	3	42	,,	21	I	Tr E	11	51	,,	29	IV	Ec R	9	54	55,,
					P.M.	22	*I*	*Oc R*	9	10	,,	29	I	Ec R	10	59	35,,
13	I	Ec D	10	30	9	22	III	Sh I	11	35	,,	30	*III*	*Tr I*	3	3	A.M.
14	I	Oc R	1	0	A.M.												

Ec, Eclipse; Oc, Occultation; Tr, Transit of Satellite; Sh, Transit of Shadow; D, Disappearance; R, Reappearance; I, Ingress; E, Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

Shooting Stars

Are by no means plentiful during the twilight nights of this month. From the 4th—13th and 10th—28th some may, however, possibly be seen. Fireballs appear, if at all, during the first of these intervals.

Greenwich Mean Time of Southing of Eight of the Principal Fixed Stars on the Night of June 1st, 1889.

Star.	Souths. h.	m.	s.	
η Ursæ Majoris	9	1	4·15	p.m.
Arcturus	9	28	25·36	,,
α Libræ..	10	2	28·43	,,
α Coronæ Borealis	10	47	36·10	,,
α Serpentis	10	56	23·32	,,
Antares..	11	40	4·53	,,
α¹ Herculis	*12	26	55·65	a.m.
α Ophiuchi	*12	47	4·03	,,

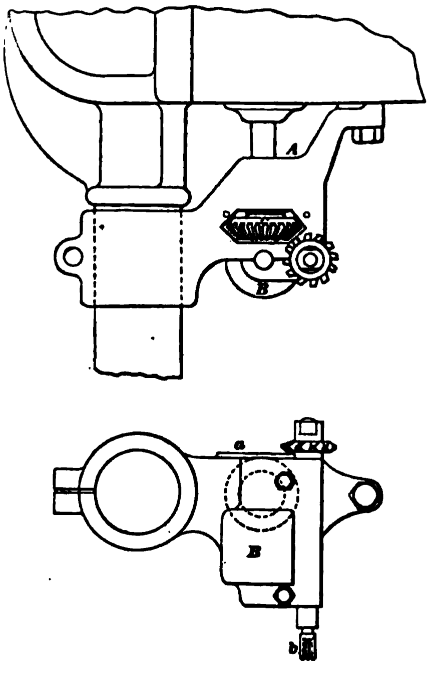
* Early morning of June 2nd.

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list for any other night in June, as also that of determining the Local instant of its Transit at any other station, will be found on p. 350 of Vol. XLVIII.

THE MILLING MACHINE AND ITS OPERATIONS.*

AS most milling machines do not have any attachment for cutting racks, I herewith illustrate one which I made for use on the No. 3 Brown and Sharpe machine. Upon inquiry I found Brown and Sharpe did not make any attachment for this size machine, and, as I needed one, I designed the one here shown. It will be seen that all the gearing is entirely cased up, fully protected from any cuttings, and no danger of getting the fingers hurt. The casting is bored to fit the supporting arm, and split through at the top; a lug provides a means for a bolt to clamp it rigidly. The lower end is bolted to the body of the machine, which makes it a very firm attachment. To get the arbor hole in correct alignment with the spindle, I had the surface A dressed off smoothly and true; then with a pointed piece of steel held in a short arbor I scribed a circle by revolving the arbor; then I chucked it in a lathe, and trued it carefully by the circle described. Bevel gear *c* gears into a similar wheel, which has a long hub, upon which is slipped and secured a steel sleeve, which has a face 2¼in. in width with 12 pitch teeth cut upon it, which mesh into teeth cut upon the cutter arbor. It will be noticed that a very small cutter can be used. A cap B is bolted over the wheels, and also forms one-half of the bearings of the shafts. The opposite end of the cutter arbor can be drilled with taper hole to fit the small end mills used on the machine, and can be used to good advantage for milling work on the dividing head, and thus avoid the trouble of arranging the dividing head to face the spindle of the machine; a cap or plate *a* covers the bevel gear shown, and is held in place by small screws.

For the tool-room, this device (or any other that answers the purpose) will be found of great value, as there is where the tool repairs are expected to be supplied from; and how often do we have to make repairs on racks on machines in the shop that are too long to be cut on this machine in the ordinary way. The inserting of teeth is not a sure and reliable one. The great convenience afforded with this attachment, and the quick time it can be done in, will always make it pay to replace the racks with new ones, and they can then be made of steel, which will in all probability avert any future replacing or trouble.



STONYHURST OBSERVATIONS OF THE SUN.

AT the Royal Institution last Friday the Rev. S. J. Perry, director of Stonyhurst College Observatory, delivered a discourse on "The Solar Surface During the Last Ten Years," in the course of which a large number of photographs were exhibited by means of the lantern. Father Perry first described the equipment of the Stonyhurst Observatory available for solar observations, and mentioned that many years ago, in consequence of there being three Government observatories where sun photographs were taken, he thought it would be useful to have drawings. An examination of old drawings led him to the conclusion that observers had not with sufficient care restrained their fancy, and he therefore made an arrangement by which an actual picture of the sun, 10½in. in diameter, was made by itself through a telescope on paper. He calculated out the allowances to be made for effects of foreshortening, and arranged a scale with small squares, which made the work of copying the picture merely mechanical. He thought this gave a more accurate representation of sunspot areas than photographs did, where foreshortening necessarily came into play. Notwithstanding the badness of the Lancashire climate, he had been able to take an average of 258 drawings a year. He had been careful always to compare the drawings with the photographs of the Government stations, and, in fact, the photograph records and the drawings were kept together for reference. The difference of shape seen in the Indian photographs as compared with the English was to be attributed to the rapid changes in the spots themselves. All observers have noticed that the increase and decrease of sun spots go in cycles of about seven years. The increase continues for, roughly speaking, 3½ years, and then decrease sets in. Sabine, years ago, showed that terrestrial magnetism varies in similar cycles, and the natural inference is that there is some connection between the two sets of phenomena. We are now within a few months of the period of minimum spots. The rate of change of spot area is at times very rapid, as sometimes there is as much as a difference of 100 million square miles a day. Our magnetic records follow the rate of such change with great consistency. The magnetic swing has been found to begin about 8 a.m.; it reaches its maximum at midday, followed by a return in the evening. The year 1882 was that of maximum spots and of magnet swing. Although the difference of longitude between Greenwich and Stonyhurst is so small, spots have been known to disappear in the short interval. There was one idea that had been gradually forcing itself on him that these great changes in the solar surface could hardly have been due to any cause located in the sun itself. He thought we must try to seek an explanation in connection with meteoric streams. The first point, however, was to have our data about the sun itself quite accurate. We had already found the cycle theory to be so far correct, and he thought the details in the drawings by the system he had originated was a step in the direction of accurate record.

DOUBLEDAY'S INSULATING CUT-OUT JOINT.

IN the accompanying engravings, Figs. 1 and 2, we illustrate a novel insulating cut-out joint, designed and patented by Mr. H. M. Doubleday, of the Marr Construction Company, Pittsburgh, Pa.

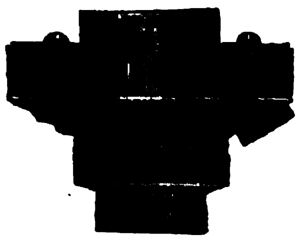


FIG. 1.

Practical workers in incandescent wiring will appreciate the efforts of the designer in attempting to combine an insulating joint with a cut-out in a neat and compact way. Fig. 1 illustrates the insulating cut-out joint, complete, as in practical use.

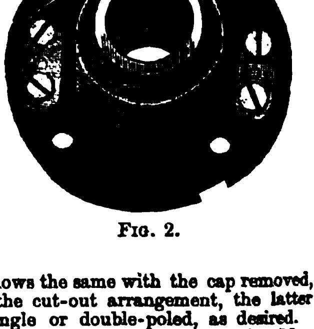


FIG. 2.

Fig. 2 shows the same with the cap removed, illustrating the cut-out arrangement, the latter being made single or double-poled, as desired. These cut-out joints are manufactured by Mr. H. T. Paiste, of Philadelphia, Pa.

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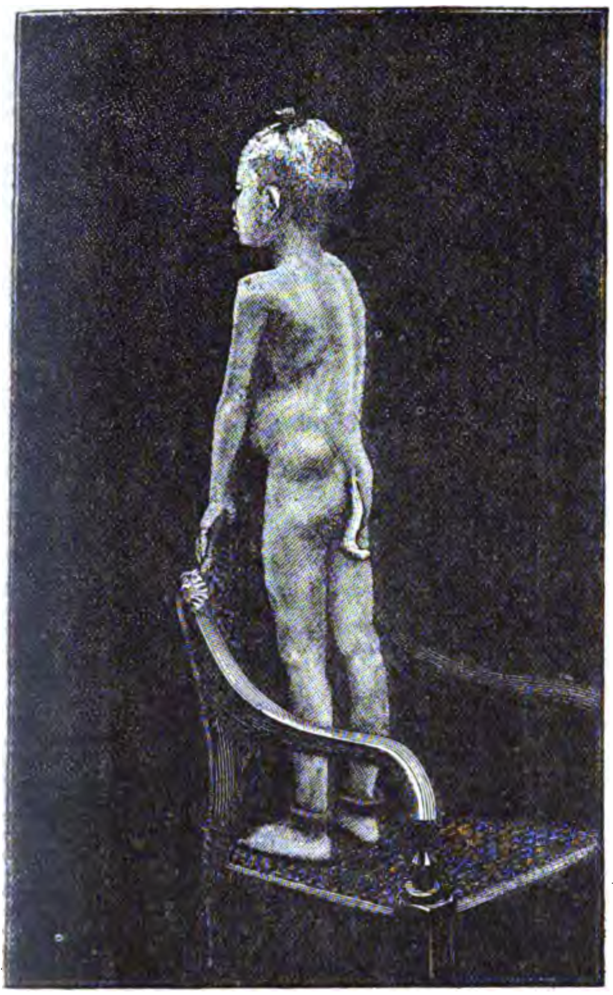
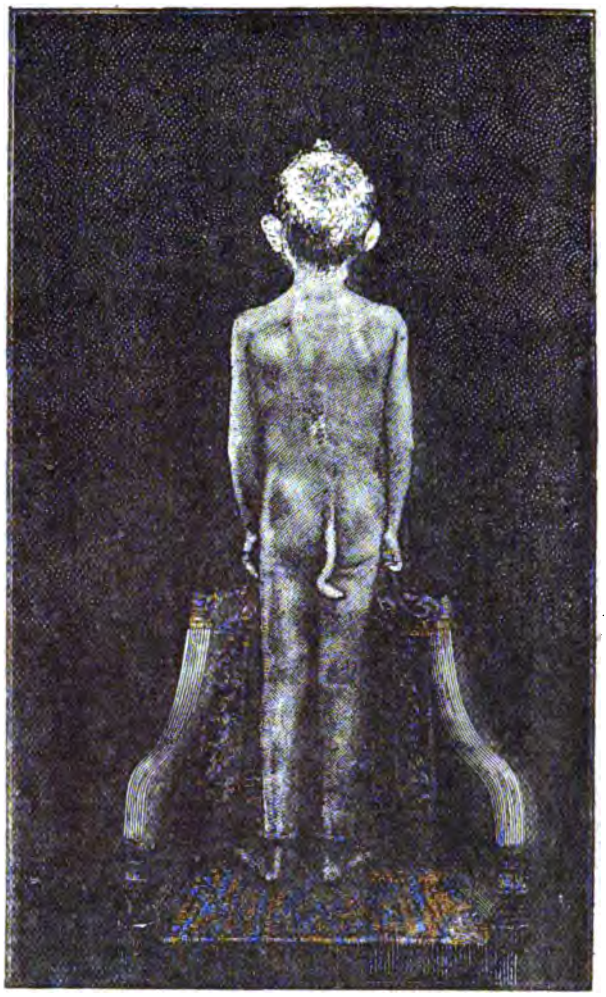
* By A. B. LANDIS, in *American Machinist* (extract).





CAUDAL APPENDAGE IN MAN.*

NATURALISTS have up to the present time given little attention to the study of tailed men. Such an organ has simply aroused the curiosity of any one who has seen a specimen, quite as a bearded woman arouses interest in a dime museum. The works on this subject are very incomplete, a few lines here and there scarcely throwing any light on the subject. There is one monograph† on this subject. There are few documents on the subject, the monstrosity is seldom found, and few of the well-known cases could bear close scrutiny.

It is not our intention to translate or give an abstract of this German production, but we have the good fortune to be able to reproduce an engraving from two very good photographs taken from life of a Moi boy with a tail 9in. long, and we shall accompany them with a few descriptive words.

A number of travellers in South Africa have testified to the existence of men of the Nyams-Nyams tribe who had tails. This may or may not be true. If such is the case, Mr. Quatrefages does not consider that the evidence to that end is very trustworthy, and rather comes to the conclusion that it has not been absolutely proved, although he believes the fact not improbable. Mr. Ecker, on the contrary, after examining this subject, thinks that the testimony of explorers is credible.

Although there may not be a race of human monkeys, it must be admitted that there are some cases of individuals having a caudal appendage. When I say "some" cases, it should be understood that Pliny and Ptolemy, and after them Marco Polo, Strup Maillet, and others, speak of this anomaly, and their citations would comprise in all not 15 or 20 cases, but from 150 to 200. The well authenticated cases, however, are very few in number.

Bartels enumerates and describes twenty-one cases, which he classifies as: 1. Tail connected with body. 2. Tail with free movement. 3. Cutaneous prolongation. The first includes the triangular base bone unusually developed, and which extends to the anus and partially covers it. The second includes those tails that form a sort of projection at the back which separate from the body at the sacrum. The third will not be reviewed, as it does not seem necessary, as it could take either of the other forms mentioned, and still be simply a cutaneous prolongation.

The specimens already observed enable us to give a general description, which will be done, however, with due caution. The tail is conical or spherical in shape, rarely cylindrical. The end nearly always curls slightly, and sometimes is twisted like that of a pig. It is seldom more than 3 or 4in. in length. It is sometimes covered, and sometimes it is quite smooth. In the former case the hair grows in places and resembles somewhat the tail of a cow. Bartels cites and has shown a case of this kind, while Quatrefages, who lived before his time, had considered this condition a mere legend.

Whether these tails are soft or rigid, they possess in general no movement of their own. This physical peculiarity is usually accompanied with some other defect, with atresia ani in particular, and almost always with general constitutional weakness. Such are the general characterists of this class of monstrosities. Can the cause of this be discovered? Adhuc sub judice lis est. Bartels considers that it is due to imperfect development, induced perhaps by inheritance from an ancestral type, while Quatrefages had not believed in this, but considered that it was caused by some abnormal development in the embryo. It is not for us to decide which theory is to be accepted. It is a curious circumstance, however, that this peculiarity is found principally among the male species. I do not think that the females of the lower orders are less favoured in this respect than the males. It is also curious that the white races appear not to be privileged in this respect. If we admit that they are a superior race to the others, then perhaps atavism would explain it. In none of the cases that have been examined, however, could vertebræ be found in the tail; while the specimen that was dissected by Virchow simply consisted of fat and muscles. Atavism would explain alone the existence of an hereditary monstrosity.

The question of heredity was, at an early day, discussed by Mr. De Quatrefages. He came to the conclusion that such an organ, whatever its origin might be, could be transmitted from father to son. Such a conclusion is affirmed in the case of other monstrosities in which this is found to be the case. The subject of the engraving, however, which we have not as yet described, is a very remarkable case. He is a young Moi, twelve years of age, who was taken to Saigon some time ago, where he was examined and photographed. Although so young, his tail was already nearly a foot in length. With the exception of its great length, this specimen resembled in almost every other respect those that had been examined by Bartels. From the information we have been able to procure, it appears that the organ is soft and smooth and has no bony frame. Bartels cites only four cases of this kind, while its cylindrical shape appears to be very rare. We stated above that, as a rule, this peculiarity was accompanied with other malformations, and such is found to be the case in the present instance. By examining the photograph it will be observed that a small mound or bunch is found upon each buttock. The shoulder blades seem to project abnormally, but it should be borne in mind that the subject is very thin.

The tail seems ordinary and possesses none of the peculiarities described by Mr. De Quatrefages. He describes tails two or three inches in length, while Bartels describes them as long as 5in., but this young Moi's tail is about 10in. in length. Therefore, up to the present time this is the best specimen on record. This matter ought not to be passed over carelessly, but it merits a thorough and complete investigation and study which should be no longer neglected.

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* By Etienne Rabaud in *La Naturaliste*.

† Max Bartels, Ueber Menschenschwanze, Archiv für Anthropologie, 1880, p. 1 a 41, 1 pl.

APPARATUS FOR SOLDERING AND MELTING.*

NO laboratory is complete without an efficient blowpipe and some means for operating it; and while it is, as a rule, advisable to purchase apparatus of this class rather than make it, a few hints on the construction of a bellows, a blowpipe, and a small furnace may not be out of place. The bellows and furnace are of the kind devised by Mr. Fletcher, and made by the Buffalo Dental Manufacturing Company. The blowpipe differs in some respects from those furnished by the above-named house.

In the construction of the bellows the following materials are required: Two hardwood boards 10in. by 11in. and $\frac{5}{8}$in. thick; one circular board 1in. thick and 9in. in diameter; one piece of heavy sheepskin 30in. long, 7in. wide at the middle, and tapering to 2in. at the ends; two discs of elastic rubber, each 11in. in diameter, and $\frac{1}{32}$in. thick; one small scoop net; 3in. of $\frac{3}{8}$ brass tubing; three small hinges; a spiral bed spring, and two iron straps.

The 10in. by 11in. boards are rounded at the ends, as shown in Figs. 1 and 2, and their square ends are connected together by the hinges as shown in

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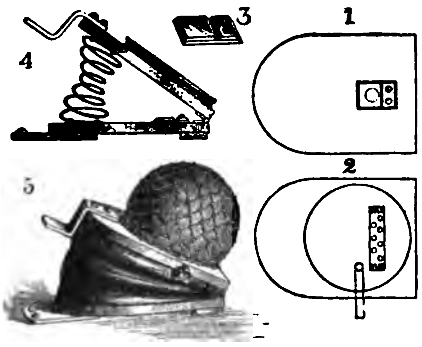
* By GEO. M. HOPKINS, in the *Scientific American*.

Fig. 4. A hole is made in the lower board near the hinged end, and covered by the valve shown in Fig. 3. The valve consists of a soft piece of leather, having attached to it two wooden blocks, one of which is fastened to the board in position to hold the other in the position of use. These blocks are beveled so as to give the valve sufficient lift, and at the same time limit its upward motion. The circular board has a groove turned in its edge, and in a hole formed in its edge is inserted the brass tube. A hole is bored into the top of the circular board, which communicates with the inner end of the brass tube, and a series of holes are made in the circular board, which also pass through the upper board of the bellows. Over these holes is placed a strip of soft, close-grained leather, which is secured by nailing at the ends. This leather strip forms the upper valve.



Figs. 1 to 5.—Blowpipe Bellows.

The bed spring is secured to the upper and lower boards, and the bellows is ready to receive its covering. The springs, the hinges, and the valves should be secured with great care, as they are inaccessible when the leather covering and the rubber discs are in place. The boards are closed together, reducing the space between them to about 5½in. They are held in this position in any convenient way until the cover is attached. The leather covering is glued, and tacked at frequent intervals. The leather is carried around the corner and over the hinged ends of the boards. An additional piece of leather is glued over the hinged end, and a narrow strip of leather is glued to the edges of the boards to cover the tacks and the edges of the leather covering. The job will be somewhat neater if the edges of the boards are rabbeted to receive the edge of the covering and the tacks.

The rubber discs are stretched over the circular board and secured by a strong cord tied over the rubber and in the groove in the edge of the board. The net is afterwards secured in place in the same way. The net should not be so loose as to allow the rubber, when inflated, to assume a hemispherical form, as shown in Fig. 5. A cleat is attached by screws to the hinged end of the lower board, and a straight iron strap is attached to the rounded end of the same board. The corresponding end of the upper board is provided with an offset strap, upon which the foot is placed when the bellows is used. The hole closed by the lower valve is covered by a piece of fine wire gauze tacked to the under surface of the lower board to prevent the entrance of lint and dust.

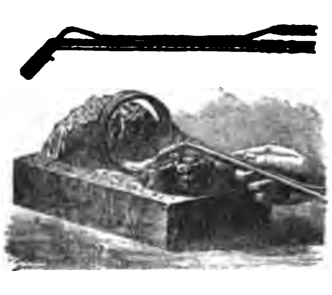


Fig. 6.—Brazing.

The blowpipe, which is connected with the brass tube of the bellows by means of a rubber pipe, is shown in section in the upper part of Fig. 6. It consists of two pipes attached to each other and adapted to receive the rubber pipe connections at one end. At the opposite end they are arranged concentrically, the aperture of the smaller pipe—which receives the air—being reduced 0·05in. The outer and larger pipe, which receives the gas, is provided with a sliding nozzle, by means of which the flow of gas can be easily controlled. The internal diameter of the smaller end of the nozzle is ¼in. These dimensions are correct only for a blowpipe for small and medium work—i.e., for brazing or soldering the average work done in the making of physical instruments, for melting two or three ounces of gold, silver, brass, and other metals, and for forging and tempering tools and small articles of steel, and for glass-blowing on a small scale.

The gas is taken from an ordinary fixture by means of a rubber tube, the supply being regulated entirely by the movable nozzle of the blowpipe. The force of the blast varies with the manner in which the bellows is operated.

One of the best supports for articles to be brazed or soldered is a brick of pumice-stone. It heats quickly, is very refractory; it admits of securing the work by tacks or nails driven into it. It has the further advantage of being incombustible. The work to be brazed or soldered must be well fitted—i.e., there must be a good contact between the abutting or overlapping edges, and the contact surfaces must be well painted with a cream formed by grinding borax with a few drops of water on a slate (Fig. 7). When necessary, the work may be held together by an iron binding wire. The solder is coated with the borax cream before it is applied to the joint. For most work silver solder is preferred, as it is very strong, being both ductile and malleable.

Fig. 7.—Grinding Borax.

The work is heated gradually until the water of crystallisation is driven from the borax; then the work is heated all over until the solder is on the point of melting, when a concentrated flame is applied to the joint until the solder flows. Care should be taken to use the reducing flame rather than the oxidising flame. Should it be found difficult to confine the heat to the work, pieces of pumice-stone may be placed around the part containing the joint, as shown in Fig. 6.

A large number of small articles may be easily and quickly soldered by placing them on a bed formed of small lumps of pumice-stone and proceeding from one article to another in succession.

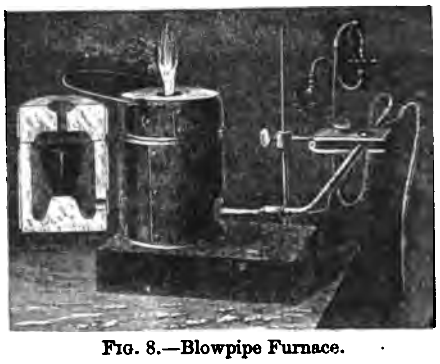


Fig. 8.—Blowpipe Furnace.

For supporting small work, having a number of joints and requiring much fastening, the slabs of asbestos are very desirable. For very small work to be done with the mouth blowpipe, the prepared blocks of willow charcoal are used.

After soldering the borax may be removed by boiling the article in sulphuric acid.

The small gas-furnace shown in Fig. 8 may be used in connection with the blowpipe and bellows already described by arranging the blowpipe on a stand and placing the furnace upon the pumice-stone brick or a firebrick. The blowpipe is adjusted to deliver a blast to the opening of the furnace. The crucible in which the metal is melted rests upon an elevation at the centre of the furnace, as shown in the sectional view in Fig. 8. The crucible contains, besides the metal, a small quantity of borax for a flux. A roaring flame is required, and the blowpipe must be carefully adjusted with reference to the opening of the furnace to secure the best results. With this furnace and blowpipe 2oz. of metal can be melted in ten minutes. Its capacity, however, is greater than that. After the metal is rendered sufficiently fluid it may be poured into an oiled ingot mould, shown in Fig. 9, thus giving it a form adapted to rolling or hammering, or it may be poured into a sand mould, giving it any desired form. The crucible is handled by means of the tongs shown in Fig. 10.

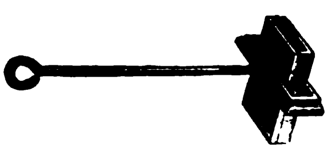


Fig. 9.—Ingot Mould.

The body of the Fletcher furnace is formed of clay treated in a peculiar way to render it very light and porous. It is 4¼in. in external diameter and 4¼in. high; its internal diameter at the top is 2¾in., at the bottom 2¼in.; the hole at the side is ¾in. diameter; the cover, which is 1¼in. thick and of the same diameter as the body, is concaved on its under surface and provided with a ⅝in. central aperture. The cover and body are encircled by sheet iron.

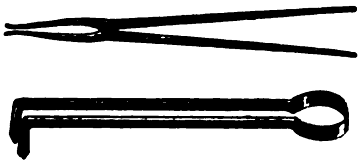


Fig. 10.—Crucible Tongs.

It is not difficult to make a furnace which will compare favourably with the original article. Any tin or sheet-iron can of the right size may be used as a casing for the furnace, provided it be seamed or riveted together. A quart wine bottle having a raised bottom serves as a pattern for the interior of the furnace. The upper portion of the raised bottom is filled in with plaster of Paris or cement to give the crucible support a level top. The material used in the formation of the furnace is clay of the quality used in the manufacture of firebricks, or even common bricks, moistened and mixed with granulated firebrick. The material known as "stove fix," used in repairing the lining of stoves, answers very well when mixed with granulated firebrick or pumice-stone.

The can is filled to the depth of an inch with the material. The chambered bottom of the wine-bottle is oiled and filled with the material and placed in the can, as shown in Fig. 11. A ¼in. wooden plug is inserted in a hole in the side of the can, to be afterwards withdrawn to form the blast aperture. The can is then filled with the clay mixture, which is tamped in lightly. The material should not be too wet, and it is well to oil the bottle to facilitate its removal. When the filling operation is complete the bottle is loosened and withdrawn. The cover is formed by filling a suitable band with the clay mixture. The furnace is allowed to dry for a day or so. The first time the furnace is heated the temperature should be increased very gradually.

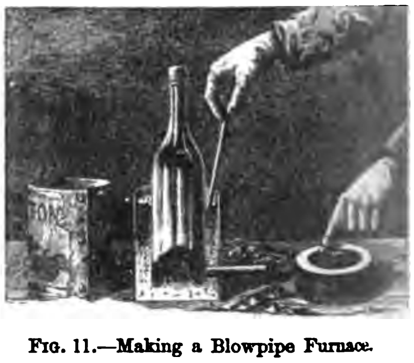


Fig. 11.—Making a Blowpipe Furnace.

Aquarium Cement.—Whiting, 6 parts, by measure; plaster of Paris, 3 parts; white beach sand, 3 parts; litharge, 3 parts; powdered rosin, 1 part. Mix the ingredients together thoroughly; then make into a putty with the best coach varnish. Only enough to set one glass should be made up at once, as it soon becomes too hard to work. The glass should be thoroughly bedded in the putty, and left about a week to harden. Cover the joints with two parts of asphaltum. Cover over on to the glass. This cement will stand water for an indefinite period if properly done.

The new Germanic twin-screw steamer *Augusta Victoria*, from Hamburg for New York, has made the voyage in eight days and one hour, covering the distance from Southampton to New York in seven days two and a half hours, this being the best first voyage ever made. The longest run in one day was 474 knots.

SCIENTIFIC SOCIETIES.

QUEKETT MICROSCOPICAL SOCIETY.

ON Saturday, the 18th May, a field meeting of this society was held under the directorship of Mr. Sydney T. Klein, F.L.S., F.R.A.S., when between 70 and 80 microscopists met at Harrow station, each carrying the orthodox stick-net and black bag containing phials and other appliances for the capture, preservation, and examination of minute life. The walk was commenced across the fields towards Belmont, and it was at the foot of that beautiful elevation that the first practical microscopical investigation began. The surface of the pool was completely covered with Lemna trisulca and L. minor, and the first dip showed this spot to be marvellously rich in all species of Rotifers, Polyzoa, Entomostraca, &c. Volvox globator was so abundant that the water had a distinctly green appearance. The walk was then continued to the top of the mount, from whence a beautiful panorama of the surrounding country was enjoyed from the Cotswold Hills and St. Alban's on the north, to Windsor and the Surrey Hills on the south. The party then entered the grounds belonging to Stanmore Hall, the seat of Lord Wolverton, and for two miles the path lay through woods blue with hyacinths and carpeted with ferns. Several rivulets and pools were examined *en route*, and numbers of specimens were collected for future investigation; the company emerged from the woods close to the site of the old church of Stanmore, dismantled A.D. 1650, the only relic left being the tomb of the last rector, which now stands solitary under the shade of two old fir-trees. The party then passed through shady lanes to the lodge gate of Canons Park, the ancient seat of the great Duke of Chandos. A short walk through the woods brought the party to the round pond, on which a temporary bridge had been thrown over for the occasion to enable the members to get on to the island. The Lemna, Anacharis, and Myriophyllum, with which the surface was covered, were found abounding with rotifers, polyzoa, trichopterous and coleopterous larvæ of all descriptions, and among which the beautiful Stephanoceros Eichornii was taken in unwonted numbers. The party was then conducted to the Old Red House, Stanmore, on the beautiful lawn attached to which they were hospitably entertained by Mr. Klein.

USEFUL AND SCIENTIFIC NOTES.

New L. and N.W. Compounds.—The new or "Teutonic" class of locomotives on the L. and N.W. Railway have larger driving-wheels than those of the "Dreadnought" class, and the following dimensions may be useful:—*Cylinders:* Two high-pressure, 14in. diameter by 24in. stroke; maximum travel of slide valves, 3⅞in.; lap of valves, ⅛in.; lead, ⅛in. One low-pressure, 30in. diameter by 24in. stroke; maximum travel of valve, 5⅛in.; lap of valve, 1in.; lead, ½in. *Wheels:* Diameter of leading, 4ft. 1½in.; of central and trailing, 7ft. 1in. *Boiler:* Diameter of boiler outside middle ring, 4ft. 3in.; length of barrel, 11ft.; thickness of plates, ½in.; number of tubes, 225; diameter (outside), 1⅞in.; length between tubeplates, 11ft. 3in.; height of centre of boiler above rails, 7ft. 10in.; boiler pressure, 175lb. per sq.in. *Heating Surface:* Tubes, 1242·4sq.ft.; firebox, 159·1sq.ft.; total, 1401·5sq.ft.; firegrate area, 20·5sq.ft. Weight of engine in working order on leading wheels, 14 tons; on low-pressure driving wheels, 15 tons 10cwt.; on high-pressure driving wheels, 15 tons 10cwt.; total, 45 tons.

Vibration of Telephone Discs.—At a recent meeting of the Berlin Physical Society, Dr. Frohlich described some new experiments on the objective demonstration of the vibrations of a telephone disc. He attaches a small mirror to the iron plate of the telephone, and from this the light of an electric-lamp is reflected on to a polygonal rotating mirror, from which it falls upon a screen. The vibrations of the plate are thus made visible on the screen, and since each side of the polygonal mirror casts its own image, when the mirror is rotated the curves are seen moving over the screen. The more rapidly the mirror is rotated the slower do the curves move over the screen, and when the rotation is as rapid as the vibration of the plate the curves become stationary, and can thus be exactly observed and drawn. These luminous curves can also be photographed. He said he had employed this method in a series of researches on certain electrical phenomena which might influence the efficiency of the telephone. Thus the action of alternating currents, of self-induction, of the rise and fall of the current on making and breaking, of the introduction of electro-magnets, and of other conditions, were studied by means of the altered mode of vibration of the telephone plate. He had further obtained a graphic record of the vibrations of the telephone plate when vowels and consonants are sung and spoken into it.

SCIENTIFIC NEWS.

THE Wolsingham Observatory Circular No. 24, announces that bright lines were seen in the spectrum of Chi Cygni on May 19, 21; D_3 very plain. The observations were confirmed by Mr. Taylor, at Ealing.

The Pope has decreed, according to the wish expressed by Padre Denza, of Moncalieri, more than a year ago, that the works for the Astronomical Observatory, to be erected in the Vatican, are to be begun at once. The site selected is the tower over the rooms occupied by the Master of the Sacred College, it being the most elevated building of the Vatican Palace. The cost is estimated at a million francs.

Mr. George Bertin will deliver a course of four lectures on "Babylonian Astronomy" in the British Museum during June, beginning on Friday, June 7, at 3.30 p.m.

The death is announced of M. Gaston Planté, a real student of science, whose discoveries rendered much help to those who have since utilised them for commercial purposes. At one time he was chemist to the famous firm of Christofle and Co., Paris, and his work there led him to study the phenomena of polarisation, which resulted in the discovery of the secondary battery or accumulator, as it is now termed. It was in 1859 that Planté made his great discovery and published it to the world, and it is on that discovery that the later inventions of the "patentees" have been based. Planté was, in fact, to the secondary battery, what Faraday was to dynamic electricity. He lived a retired life near the Bastille, and his health being far from robust, he had been little seen or heard from during recent years. Mr. Sprague in his "Electricity," &c., says Planté "is a striking instance of a man doing thoroughly good work, and doing it with little profit, while others, taking up his labours, have patented every imaginable variation in the form and arrangement of his battery, and obtained in some cases large sums of money therefrom. But Planté's name will be associated with the secondary battery when these are all forgotten."

The death is recorded at the age of eighty-two of Miss Agnes Catlow. Her name is hardly familiar to the present generation; but at an earlier period she was successful in the work of popularising science. Botany and conchology were her specialities; and her "Popular Conchology" still holds its ground. She was a skilled, patient, and accurate observer with the microscope; and her "Drops of Water," an account of the Infusoria in water, ran through several editions. She died at her house in Addlestone, Surrey, on May 10th. Her works, besides the two named above, were "Popular Field Botany," "Popular Greenhouse Botany," and "Popular Garden Botany"; also, in combination with her sister Miss Maria Catlow, who still survives, "Sketching Rambles;" "The Children's Garden," dedicated to the Princess Beatrice; and "Garden Recreations."

The death of a famous botanist, a specialist in orchids, has to be announced in the person of Dr. H. G. Reichenbach, professor of botany and director of the Botanic Garden, at Hamburg, since 1863. He was in his sixty-seventh year. Well known to all orchid growers throughout the world, he was not an exclusive student of those plants, but contributed largely to his father's "Icones Floræ Germanicæ et Helvetiæ," for which he drew, it is said, no fewer than 1,500 of the illustrations.

Mr. W. P. Johnston, Government Electrician, Calcutta, who had served for more than twenty years in the Indian Telegraphs, and done much to improve the telephone, died last month at Darjeeling.

Dr. August Breisky, professor of gynæcology at the University of Vienna, died there on May 25, at the age of 57, after a long and painful illness. The deceased was a specialist of considerable repute, and his death is a great loss to the Vienna medical school.

The annual meeting of the Royal Geographical Society was held last Monday, when it was stated that the income for the year exceeded the expenditure. The Founder's Medal was awarded to Mr. A. D. Carey (Indian Civil Service); the Patron's Medal to Dr. G. Radde (Director of the Natural History Museum, Tiflis); the Murchison Grant for 1889 to Mr. F. S. Arnot; the Back Premium for 1889 to Mr. F. C. Selous; the Cuthbert Peek Grant to Mr. F. S. Arnot; and the Gill Memorial to Mr. M. J. Ogle (Indian Survey Department). The scholarships and prizes of the society to students in training were presented. The ballot for the council was declared. The Right Hon. Sir E. Mountstuart E. Grant Duff, G.C.S.I., was elected president; the new vice-presidents are General Sir F. Goldsmid and General R. Strachey (the retiring president), and the new members of council are Sir George F. Bowen, Mr. R. N. Cust, LL.D., Sir A. Dent, General R. Maclagan, R.E., General Sir H. Rawlinson, Mr. P. S. Sclater, and Mr. S. W. Silver. The Murchison Grant to Mr. F. S. Arnot is towards providing and conveying to the chief Chitambo, of Ilala, a suitable present as a recognition of his services in connection with the removal of the body and property of Dr. Livingstone.

The Croonian lecture before the Royal Society was delivered last week by Dr. Roux, the chief of the Pasteur Laboratory, Paris, the subject being "Les Inoculations Préventives," mainly referring to Pasteur's discoveries that the virus in many infectious diseases is due to microbes, especially in fowl cholera, splenic fever, or charbon in cattle, and rouget or "red soldier," a form of swine fever, and to the fact that, by suitable action of heat in absence of air, the virus could be weakened so that by inoculating animals with it immunity would be provided against the disease. The practical results are that the agricultural societies of France, Italy, and Austria practise this means, and the various insurance societies compel the adoption of the treatment. Some 250,000 sheep and upwards are annually treated in France. Pasteur's labours in regard to rabies or hydrophobia were next noticed, and the steps from the protection of dogs to the treatment of man, the present result being stated at 1 per cent. mortality after treatment and 15 per cent. without treatment.

At the meeting of the Royal Botanical Society last week Mr. R. J. Lecky read a paper on an edible seaweed found on the coast of Ireland which he described as a simple and wholesome luxury. Dr. Prior exhibited a Dendrometer in the shape of a small instrument to be carried in the waistcoat pocket, by means of which the height of a tree, of a house, or of a tower, can be easily and accurately measured.

The anniversary meeting of the Linnean Society was held last week, and the Linnean medal was awarded to Alphonse de Candolle, and received by his grandson, recently a "Rugby boy." Mr. W. Carruthers, F.R.S., was re-elected president for the fourth time.

In response to an invitation sent out two years ago by the Council of the Meteorological Society more than a hundred photographs of lightning flashes have been received by the Society. The June number of *Knowledge* contains photographic copies of thirteen of the most remarkable, showing knotted lightning, ribbon lightning, and flashes which appear like a lace curtain suspended in the air. The photograph of the celebrated dark flash, about the meaning of which there has been considerable discussion, has also been reproduced, by permission of the Council of the Meteorological Society. The paper describing the photographs is by Mr. Ranyard, jointly with Mr. Marriott, secretary of the Meteorological Society. They suggest that the dark flash is due to the smoke of dust floating in the air burnt by the lightning.

Dr. W. Huggins, F.R.S., has been "approved" as visitor of the Oxford University, in place of Dr. Warren de la Rue, deceased.

Lord Ribblesdale has done a service to peripatetic photographers by calling attention to the manner in which Custom House officers deal with packets of undeveloped photo. plates. The duty leviable on anything is not so great that the Custom House could not afford to run the risk of being duped; and it might therefore be sufficient to make the photographers sign (and, if absolutely necessary, swear) a document that the package contains only undeveloped plates. Otherwise the Customs officers should have an expert to examine the plates in proper conditions; for it is vexatious to have the labours of a trip to the Antipodes spoilt because an officious Exciseman refuses to believe the statement that the contents will be spoilt if the package is opened in daylight.

The Electrical and Industrial Exhibition to be held in Bingley Hall, Birmingham, next August, promises to be a great success. An electrical switchback telpherage system will most likely be erected, on which visitors may take what have been called "aërial" flights.

Prof. Kennedy is about to resign his potition as Professor of Engineering and Mechanical Technology in University College, London. He will be always remembered as the founder of the engineering laboratory of that college, an establishment which has done an incalculable amount of good.

Mr. A. F. Yarrow read a paper last week before the Society of Arts on the use of "Spirit as an Agent in Prime Movers." He traced the modern history of the subject from the time when Du Tremblay in 1856 endeavoured to utilise ether as the motor fluid in the cylinder, the failure being due to loss of the vapour from leakage, just as the Brunels failed to utilise carbonic acid as suggested by Faraday. Given appliances of requisite tightness—and there is a possibility that they can be made nowadays—steam would soon be ousted from the leading position. Mr. Yarrow has so far achieved a decided advance with the use of petroleum spirit as the motor vapour, and it may be that his "Zephyr" launches mark the era when steam began to lose its position.

The Union Steamship Co.'s steamer *Moor* has recently made a rapid run from Cape Town to Southampton—the fastest, in fact—taking only 17 days 5 hours 6 minutes of actual steaming time. It is safe to predict that before long that will be beaten, as the average speed was only 14·52 knots per hour.

The *City of Paris*, of the Inman line, has now the record for the fastest eastward Atlantic passage, having arrived at Queenstown 5 days 22 hours 10 minutes after leaving Sandy Hook.

A paper on "The Origin of Bronze," by M. Berthelot, was read at a recent meeting of the Paris Academy of Sciences. The author has analysed specimens from a statuette from Tello in Mesopotamia, and from the sceptre of the Egyptian king, Pepi I.—sixth dynasty—both dating back to about 4000 B.C., and both consisting of pure copper. From this he argues that, as in the New World, the stone age was followed by a copper age in the Eastern hemisphere, and that the bronze period cannot be more than some fifty or sixty centuries old.

It is stated that the cars of the Julien Electric Traction Company in New York run over 57 miles without recharging, and the cost of motive power per car per day of 60 miles is 310 cents., or, say, thirteen shillings.

Waterproof Electro-Motors.—Mr. S. D. Greene, of the Sprague Motor Company, New York, reports that they have now made a waterproof electro-motor. An armature, after being heated, was allowed to soak in a barrel of fresh water for 24 hours, and upon removal it was tested and found to be perfectly sound. It was then put into a barrel containing a strong saline solution, where it was allowed to remain for another 24 hours. At the expiration of this time it was taken out, and immediately put into a machine and run for 2½ hours on a load averaging one-third greater than the proper load. The armature at the end of the run was as sound as when the experiment began. The Sprague Company have made arrangements by which this method of waterproofing their motor-armatures can be carried out on a large scale, and in future all their street-car motors will be treated in this way.

Temperance Beer.—We can recommend the "Temperance Beer" made from the "beer essence" manufactured by Messrs. Newball and Mason to all who like such drinks. The sample sent us is sparkling, thirst-quenching, and of a very pleasant flavour.

Cottage Hospital for Consumptives.—An effort is being made to open a cottage hospital at Shanklin for the cure of poor consumptive patients by the system advocated at the Manchester meeting of the British Association by Dr. G. W. Hambleton.

The first trip of the new passenger steamer *Puritan*, of the Fall River line, from New York to Newport, viâ Long Island Sound, was recently made with much success. She attained a speed of 20 miles an hour with 65lb. steam. The *Scientific American* says that when her new machinery is worked down and full power applied, which is 110lb., it is believed she will surpass in velocity any passenger boat afloat.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

"BALL'S" (?) DIVISION IN SATURN'S RING—THE HARVARD "INDEX TO OBSERVATIONS OF VARIABLE STARS"—VENUS—SOME CELESTIAL SPECIMENS OF EQUINE NIDIFICATION—THE MOON'S ALBEDO, &c.—CALCULATING THE MOON'S POSITION—VOLUME OF A SPHERE—FAULTY TELESCOPE: A TILTED OBJECT-GLASS—"HYPOTHESES NON FINGO"—TERRESTRIAL MAGNETISM AND THE SUN—THE SOLAR CORONA: INVISIBILITY OF LIGHT—THE MOON AND THE WEATHER—PRO BONO TIRONIS—ALUM IN BREAD: O LAW!—SUN CROSSING THE LINE.

[29977.]—Re-perusing your article on p. 216, I observe that Professor Hastings speaks of "Ball's division" in Saturn's ring. It seems almost incredible that anyone in Professor H.'s position can be ignorant of the fact that the interval separating the Saturnian rings A and B is no more Ball's division than it is his own, inasmuch as Ball never saw it in his life! All this was conclusively shown in 1882 (English Mechanic, Vol. XXXVI. p. 356), by Mr. W. T. Lynn and Mr. C. Leeson Prince, both Fellows of the Royal Astronomical Society; while Captain Noble traced the error to its origin in the pages of Dr. Kitchener, who had misread Vol. I. of the *Philosophical Transactions* for 1665-66. It was Cassini who, in 1676, first discovered the division now universally known in Europe by his name. Should this meet the eye of Professor Hastings, he will find a quantity of information on this subject in Vol. II. of *Knowledge*.

Yet another valuable contribution to astronomical science reaches this country from Harvard, in the shape of No. 8 of Vol. XVIII. of the "Annals of Harvard College Observatory," which contains an index to observations of variable stars. To all engaged in the study and investigation of the mysterious objects referred to, it is quite needless to point out the value of a detailed index of all previously recorded observations, and equally needless to add that, like all other Harvard work, the present part of the "Annals" is distinguished by the most painstaking accuracy and completeness.

I may now tell Mr. Baird Gemmill (letter 29929, p. 237) that my reason for asking him to make the experiment of hiding the illuminated crescent of Venus was: that some few years since I did so myself, only to find that the quasi-phosphorescent "dark" part of the planet's disc *vanished at once*, thus indicating that it had its origin in some way in the telescope itself. But on every occasion when I have been able to trace the planet in, or close to, inferior conjunction in daylight, I have seen the dark limb unmistakably projected on the very slightly lighter background of the sky; and have shown it to a friend, whose knowledge of, and practice in, observing, was almost nil. I was careful not to prejudice him by telling him what to look for; but he detected the appearance of which I am speaking, *proprio motu*, notwithstanding. My observatory has been dismantled now for some months, and its painting and papering are only just completed. Hence it has come to pass that my dismounted equatoreal has not yet been reinstated, and I have myself missed the recent inferior conjunction altogether.

I heartily sympathise with Mr. Holmes in the wish he expresses (in letter 29932) on p. 238, for some critical authority on the subject of "wonderful discoveries" in the heavens. The amount of nonsense that has been written anent the physical features of Mars is certainly ludicrous, if not even discreditable. A leading Canallite actually witnessed the disappearance of a Continent, bodily! not so very long since. It was conclusively shown that this said Continent was continuously visible in a large and powerful telescope elsewhere: but that is a detail. As for the Canals, I venture to affirm that no one reading the various observations I read them impartially can come to any other conclusion than that they are subjective phenomena. There would seem to have been a severe eruption of them all over the martial disc, simultaneously with the renaming of the familiar features of the planet by Schiaparelli, whose pedantic and cacophonous nomenclature, however, has not yet superseded (at all events in England) the well-known designations borne by the chief Areographical features in all previous maps. I have expressed my views on the subject of the white spot on Saturn's ring on the page preceding that which contains Mr. Holmes's letter. As for any unassisted human eye detecting the *crescent* of Venus, I should feel tempted to quote Colossians iii. 9, to any one who assured me that he had himself seen it.

In reply to Mr. Peal (letter 29933, p. 238), I have no means of access here to Zöllner's work; but as Schröter and Beer and Mädler all used the lunar shadows for the 0 of their scales, it seems extremely unlikely that he departed from so obvious a standard of blackness. What, may I ask, is Mr. Peal's authority for his assertion that "the 'brightest' peak of Aristarchus is sunk thousands of feet *below the general surface level* of the globe"? I put the question because "Neison" (p. 273) says: "The ring-plain is 28·27 miles in diameter, with broad, terraced walls rising at *a* 2,447ft. above the outer surface, and 7,520ft. above the interior, according to Mädler, though Schröter, from two measures, makes this last 5,600ft., and Schmidt, from seven measures, 6,139ft. . . . The brilliant central mountain, according to Schmidt, is only 1,280ft. high," and so on. Is this what Mr. Peal is going upon? If so, he is proving too much—in fact, showing that the nearer we get to the level of the moon's surface the deeper the snow lies! If your correspondent will re-read the passages to which he invites my attention he will find Proctor attributing the lunar brightness *not* to the snow-covering or reflective material of the formations, but specifically to the steep slope of the lunar inequalities. I am sorry to say that I must still regard Mr. Peal's hypothesis of the electrical origin of the ray system as the veriest *deus ex machinâ*. If snow be a non-conductor, surely it should prevent any sublunarean discharge from affecting metallic dust covering its surface. No satisfactory theory has yet been advanced to explain such purely abnormal phenomena as the Tychonic system of rays, nor does Mr. Peal's own help us one iota towards the solution of the problem. Finally, I may say that undoubtedly meteoric dust does fall on the moon, in the same way that it does on the earth, and, I strongly suspect, is just as visible on our satellite as it is on our own globe—neither more nor less so. Mr. Peal has made up his mind that the moon is covered with snow, and no explanation seems permissible in his eyes which does not take this for granted. If the facts are against him, so much the worse for the facts.

"Ruric" (reply 68370, p. 243) must forgive me for saying that he is not quite so intelligible as might be desired. If he wishes to plot on a map the position of the place at which the moon is in the zenith at any given instant, he must take out her right ascension and declination for that instant from the *Nautical Almanac*, and also calculate the sidereal time or right ascension of the meridian at Greenwich. Then taking this sidereal time from the right ascension of the moon, he will have the number of hours, minutes, and seconds the moon is east or west of Greenwich, and this measured on the terrestrial equator, will give the longitude of the place on the earth's surface where the moon is vertical, while her declination will furnish its latitude at once—being obviously identical with that latitude. He may repeat this process for a series of short intervals, and join the places so obtained by a line on his map, or on a terrestrial globe, and so trace the moon's path relatively to the earth's surface.

Mr. Bowie (query 68629, p. 248) can obtain the volume of a sphere by cubing its diameter and multiply the product by one-sixth of 3·1416; i.e., ·5236. For example, suppose that his sphere is 2ft. in diameter, then 2^3 or 2 × 2 × 2 = 8, and 8 × ·5236 = 4·1888, the number of cubic feet in the sphere.

I may answer "Aston" (query 68680, p. 249), by telling him *in limine* that his object-glass is tilted on the tube and not "square" to its axis. To remedy this my querist must carefully loosen the screws which bind the cell of his objective to the tube, and, looking at a bright star, tap the edge of the cell with a wooden, or preferably a hide, mallet on the side on which the rings appear, inwards towards the eyepiece (I am assuming that he is using an Huyghenian or inverting one). This must be done very gently, a few taps at a time, and when the diffraction rings are in this way brought to surround the star disc symmetrically, the screws must be gently tightened up again, each a few turns at a time, going round and round them in sequence, and not "hugging them up" one at a time, or he may throw his glass out of adjustment again. The purple fringe shows that the object-glass is what is called "over-corrected," which is a very venial fault, possessed more or less by some of the finest German glasses I have ever looked through. Had "Astron's" objective given an orange or red edge to stars, I should certainly have condemned it.

Should this meet the eye of Mr. Isaac Roberts, I may perhaps express a hope that he will forgive a hint from one who has the highest admiration for the splendid work he has done and is doing in familiarising us with the physical structure of the visible universe by the aid of photography. It is my appreciation of the service which he is rendering to science which renders me unwilling that he should do anything to lessen his claim upon the astronomical world, and which prompts me to utter what I am about to say. Shortly, then, can he not furnish astronomers with the results of his labours without lugging in the unproved meteoritic theory? Upon the last two or three occasions on which he has addressed the Royal Astronomical Society we have had references to this hypothesis. The Astronomer Royal on May 18th gave a spirituel reproof of this in the shape of an intimation that "we can hardly speculate usefully as to the character of the phenomena we are observing until we know something of the scale of these nebulæ." Ill-natured people, with less suavity, say that Mr. Roberts cannot be making this perpetual reference to the meteoritic theory to please its original propounder, Mr. R. A. Proctor, who developed it in 1870 ("Other Worlds than Ours," pp. 210, *et seq.*), as he, unhappily, is dead and gone. Nor to propitiate Mr. Wright, of Yale College, U.S., who, in 1877, spectroscopically examined the gases evolved from meteoric masses, and compared their spectra with that of Winnecke's comet; but that it must be done to curry favour with the gentleman who is now advertising it as his own. I am far from alleging that this is true: I am only repeating what people say. Surely Mr. Roberts remembers the dictum of the immortal Newton, which I have put as a heading to this paragraph, and can profit by it.

There is a very noteworthy paper in *Ciel et Terre* for May 16th, by M. C. Lagrange, on Terrestrial Magnetism, and on the parts played by the Earth's rotation and the Solar Radiation in the production of its observed phenomena. Whether M. Lagrange proves his hypothesis or not every reader must determine for himself. At any rate, he is no mere paradoxer.

With reference to letter 29949 (p. 257), I may at once say that, were the illumined æther visible, no darkness could possibly exist, and night and day would be practically alike to us. Has Mr. Penny, with his intimate knowledge, practical and theoretical, of Optics, forgotten the familiar experiment to exhibit the invisibility of light? If so, I may remind him that it is performed with a cylinder lined with dead-black paper, black velvet, or the like, with one end closed, and the other left open to be looked into. Two holes are made about the middle of the tube, opposite to each other, to admit strong light *across* the tube only, and a little hole half-way between them, for a purpose to be immediately explained. Let us begin by darkening the room, and admitting a beam of sunlight through a hole in the shutter, and cause such beam to pass in through one side hole of our tube and out at the other. Now let us look into the tube, and we shall see—nothing but the blackness of darkness. If, though, we put a bit of white paper, the tip of the finger, the end of a tooth-brush handle, or some other white object, up through the small hole into the course of the beam of sunlight, instantly will this become illuminated and reveal the existence of the crossing beam. Undoubtedly nothing akin to our atmosphere can exist at the distance from the sun's surface to which coronal radiations have been traced; but, all the same, those phenomena must have their origin in light reflected from particles of some sort. I am afraid that I still fail to perceive the exact drift of Mr. Penny's first question; but I may say that there is a narrow ring of notably brighter light round the moon's limb—in fact, "the inner and outer corona" is a fairly familiar phrase as indicating the distinction in brightness between the narrow ring referred to and the streamers which extend so far in an approximately equatorial direction at the time of sunspot minima. Apart from the fact of the proved invisibility of the mere undulatory æther, and assuming, for argument's sake, that it could be seen, it must be obvious that a homogeneous substance must itself appear homogeneous, instead of exhibiting the very highly complicated structure displayed by the coronal extensions.

Would Mr. Nicolls (letter 29952 p. 258) mind informing us what he considers as a "change" of the moon? I always thought myself that she was "changing" at each instant of the time during which she is describing her orbit, that the instant before new moon she was waning, and the second after it waxing, and so on; but perhaps I am mistaken. Your correspondent ought to have seen a diagram exhibited at the last meeting of the Royal Astronomical Society, by Mr. Ellis, of the Royal Observatory, Greenwich. It might have enabled him the better to appraise the value of such comparisons as those he has instituted. And, assuredly, he ought to buy, beg, or borrow No. 62 of Vol. XIII. of the *Quarterly Journal* of the Royal Meteorological Society (April, 1887), and carefully read Mr. Ellis's masterly presidential address from beginning to end.

In the interest of the incipient astronomer, one would be glad to see a few more letters of the type of Major Markwick's capital one (29956) on p. 258. The sober relation of the personal experience of a man who has travelled and observed in the Southern Hemisphere must be invaluable in counteracting (what the late Captain Marryatt called) the "flapdoodle," with which Messrs. Hampden and Co. (Limited) essay to delude that small section of the British public weak enough to listen to them.

I gravely doubt Mr. Hinton's law (reply 68586, p. 265). In several cases ("Mullins v. Collins," "Fitzpatrick v. Kelly," "Cundy v. Le Cocq," &c.), has it been held by the superior Courts that a man may be convicted criminally without criminal intention under 38 & 39 Vict. c. 63, and 6 & 7 William IV. c. 37, s. 2. For myself, I prefer the judge's decisions in the High Court of Justice to the dicta of any Recorder whatever. In strict confideuce, I have known at least one of these gentry make a perfect fool of himself.

Query 68736 (p. 270) is a very funny one. Does Mr. Pywell imagine that "the Sun crosses the line" at the dates of the lougest and shortest days respectively? He is labouring under some delusion as to the Astronomer Royal having given the dates of greatest and least sunlight as July 1st and January 1st. The Earth was in Perihelion—or at her nearest to the Sun—at 4h. p.m. on the 31st of last December, and will be in Aphelion—or at her farthest from him—at 9h. p.m. on July 1st of the present year; but this has nothing to do with the longest and shortest days. The Sun "crossed the line," or, in other words, was on the Equator about 9h. 50m. 16s. a.m. on March 20th, and will again cross it at 8h. 37m. 54s. p.m. on September 22. These are the theoretical dates of the Equinoxes.

A Fellow of the Royal Astronomical Society.

WHITE SPOT ON SATURN'S RING.

[29978.]—On Wednesday, the 22nd inst., we had in Portland an unusually clear and steady atmosphere, when I was able to use the following powers on my 4·5o.g. with good effect—first, 70, when the luminous spot was clearly seen, and seemed by contrast to stand out as a protuberance on the ring; with 115 it was not quite so bright, and shaded off on the rings, the part nearest the shadow of the ball being clearly the brightest, strongly suggesting that the appearance was the effect of contrast with the black shadow. With 200 the spot was much fainter, though still plainly seen, and glided more easily into the light of the other portions of the ring. With 350 the so-called spot required intense gazing to discern it, and most certainly would escape notice were not special attention being called to that part of the ring at present. With the Barlow lens on the 350 the spot was undiscernable, though the sharp definition of the markings on the planet indicated that the atmosphere would bear the abnormal power, probably not less than 500, 50 more than the theoretic power of the o.g., if Dawes' formula of 100 to the inch be correct.

Without admitting the rotation of the rings which we hold to be a gravitational necessity, and which, of course, is fatal to the objectivity of the spot, the impression left by the foregoing mere observations was that the spot was subjective, and the result of optical contrast. I may add I was careful to avoid any prejudgment from having heard the very logical and fair statements of those who took part in the discussion at the meeting of the R.A.S. on the 10th inst.

One good result of Dr. Terby's supposed discovery will be to call the attention of amateurs to interesting features of the planet Saturn, which may lead to some real discoveries in time to come, for it is clear our knowledge of the planet is initial.

May 25. **W. R. Waugh.**

[29979.]—The proceedings of this spot are remarkable, but not unexampled. What strikes people most is its fixity. In this, however, it agrees with what is told us of all other spots on record. Webb tells us that Schroeter, Harding, Schwabe, Schmidt, Bond, Secchi, and also De Vico, observed bright spots, and were all of them agreed as to their fixity, as is the case with all observers of the present spot. Nor does he mention a single instance to the contrary, except that Herschel I., who deduced from observation a rotation in 10h. 32m. 15s.; but "W." says, "an examination of the original observation shows this to be without foundation."

It seems, then, not too much to say that all observation tends to show fixity. And the conclusion generally drawn from the fixity of a point is to negative a rotation. A little closer examination, however, shows that the inference ought to be different. It really is, that *the ring performs its rotation in the same time that the planet does its revolution.* Take our present case. The shadow of the planet on the ring holds a fixed position with respect to the spot, and this can only happen if the periods of the ring's rotation and of the planet in its orbit are the same. Thus, supposing the ring to have no rotation, and the planet to have a period of 30 years, we should find that the relative position of the spot and the shadow would vary by one degree in a month, measured on the ring.

This variation might not perhaps be sensible in the case of our spot, which has only been observed for a few weeks. But the same cannot be said of the spot observed by De Vico on several consecutive nights in 1840, and which was seen again in the same place in 1842. It ought to have varied by some 24°, which it hardly can have done.

It is therefore quite certain that if the spots have remained fixed there must be a small rotation of the ring, such as has been described; and this is of the utmost importance with regard to the stability of the ring, for whereas without any rotation the ring would be in unstable equilibrium, a very slow rotation, observing that the ring is not quite concentric with the planet, would be sufficient to preserve the stability, whether the ring was of uniform density all round or not, provided that the disturbing forces were but small.

Such a slow rotation however, it must be admitted, would entirely contradict more than one favourite theory as to the *composition* of the rings. Thus it is much too slow to admit of the idea proposed by Cassini that they consist of a multitude of satellites, for they would revolve much more rapidly; and it equally contradicts the idea that the ring either is or *ever was* with such a rotation—fluid. But I may repeat that all I would maintain is that the fixity which all observations ascribe to observed points indisputably requires that the time of rotation is equal to that of Saturn's revolution.

W. G. P.

ASTRONOMICAL—VENUS.

[29980.]—With regard to letter 29954, p. 258, I may say that while spending my holidays at St. Bees, Cumberland, on April 27th, I certainly saw the crescent with the naked eye, and called two friends to verify it, and they also could see it quite distinctly. The time I think was about ten minutes after sunset. The air at the time (although the planet was, of course, very near the horizon) was exceptionally clear, but a little unsteady. I next brought an ordinary opera glass which showed the crescent more distinctly. I may add that I saw it best with my left eye (my right being rather defective), and by looking not directly at the planet, but a little to one side of it.

With reference to the valuable data given by "Tria" in letter 29860, p. 176, I may say that on April 29th, at about 11.55, I set up my excellent 3in. achromatic (Dollond) on altazimuth mounting, with a power of 40, and adjusted it as directed. After waiting the appointed time, Venus was in the field, looking like a very thin hair-like crescent. The air was very clear and still, and I used a very light neutral-tint screen glass. Afterwards I inserted a pin-hole diaphragm in the eyepiece, and then I could distinctly see the dark body of the planet.

G. Dixon.

Bradfield College, Berks, May 26.

VISIBILITY OF CRESCENT OF VENUS TO THE NAKED EYE.

[29981.]—I gather from the concluding paragraph of Mr. Holmes's letter (29932, p. 238) that he is of the opinion that the crescent form of Venus cannot be discerned without telescopic aid. Though it may be true that the crescent is not visible to the unaided vision of the majority of observers, I do not see that we should on that account doubt that, under favourable conditions, it may not be so seen by those possessing extra-good eyesight.

In connection with this subject, the following extract from a letter, sent to Sir John Herschel by Mr. Stoddart, an American missionary at Oroomiah, in Persia, may be of interest to your astronomical readers: "After examining Saturn, I turned to Venus. The most I could determine with my naked eye was that it shot out rays unequally, and appeared not to be round; but, on taking a dark glass of just the right opacity, I saw the planet on a very minute but beautifully-defined crescent. To guard against deception, I turned the glass different ways, and used different glasses, and always with the same pleasing result."

Forest Gate, E., May 21. **B. J. Hopkins.**

VULCAN?

[29982.]—Upon my return from California at a recent date I was greatly surprised, in looking over the accumulated numbers of the English Mechanic, to find in the issue of Feb. 8th, in the bi-monthly letter of "F.R.A.S.," the following absurd paragraph:—"When I read that 'Prof. Swift fails to observe' the intra-Mercurial planets, I am irresistibly reminded of the reason given by the Governor of Tilbury Fort (in Sheridan's play of 'The Critic') why his daughter was unable to perceive the

Spanish fleet. Surely the *Vulcan* nonsense does not survive in America?"

I trust "F.R.A.S." does not need to be informed that Vulcan is the name of the mythical planet seen (?) transiting the sun by Lescarbault, in whose existence not a dozen astronomers in the world believe. I certainly do not, nor of any large enough to be seen in transit by the most powerful telescope. The evidence against such a theory, though negative, is almost as strong as against the hypothetical satellite of Venus. In both cases it approaches as near the positive as would be the denial that Jupiter had been seen by someone to revolve around the Dog Star. Now, the intra-Mercurial planet question is as far removed from the Vulcan problem as is the zenith from the nadir, and I am immeasurably surprised that any man of astronomical ability should confound the one with the other.

The sun's face has been too long and too closely studied for any body in transit to elude observation, and as only Mercury and Venus have been seen, we are led to the conclusion that if intra-Mercurial planets have real being, they are much too small to be visible on the sun, and can be seen only on the rare occurrence of a total eclipse, and, even then, only for two or three minutes. An entire century affords but about an hour of time for searching for these planets, and it is a difficult task for the astronomer to break away from the absorbing grandeur and fascination of the scene before him to seek for what has unproven existence. But the quest is a worthy one, and should be fostered rather than derided. What ridicule would have attached to Prof. Hall had he announced beforehand his determination to find satellites to the planet Mars! Is it more strange that there should lie undiscovered matter near the sun, than that 284 planets should have been found between Mars and Jupiter? Or that a photographic camera should reveal the presence of 16,000 stars and of several nebulæ in the Pleiades? Is "F.R.A.S." assured of, and prepared to deny the existence of intra-Mercurial planets, and, if so, will he convey to us the source of his information, and the reasons for his infidelity in the matter? Either this or modest silence is to be commended. To his remark that I "failed to observe," &c., I answer simply, that though that was the main—I might almost say sole—object of my journey, yet, very unfortunately, clouds interfered, so that I did not *look* for any. Has "F.R.A.S." read the testimony of Sam Weller in the trial of "Bardell against Pickwick," and realised that there are obstacles to vision? And clouds, as well as flights of stairs and deal doors, prevent seeing.

As to the two objects which I saw at the Denver eclipse of 1878, I know that they are not charted in that region of the heavens, and that they are unknown to astronomers. No two known bodies in that vicinity answer in any particular to those observed. With good reason they have been supposed to be circumsolar planetoids nearer the sun than Mercury, and hence have been denominated intra-Mercurial planets—not Vulcan nor Vulcans.

This confounding of the supposed intra-Mercurial planets, whose existence has never been disproved, with an easily-seen and hastily-named object on the sun (Vulcan), which was undoubtedly a sunspot, has too long disfigured the pages of scientific journals. **Lewis Swift.**

Warner Observatory, May 10.

POWER OF APERTURES.

[29983.]—I have read very carefully, and with the deepest interest, the correspondence which has occupied your columns for the last two months in regard to the power of various apertures in the telescope. It is singular that "our" authorities are so far from agreeing about the capacity of a certain aperture; but no doubt much may be accounted for when we remember that the power of ordinary vision varies strikingly in different persons. This fact, taken in consideration with other well-known difficulties due tc atmospheric conditions, &c, may really be at the root of the matter. But, however this may be, it is extremely interesting and instructive to those of your subscribers who, like myself, intend to obtain a larger instrument than the one they have, to learn what they may fairly expect to gain by the outlay: and even more so to those who, knowing practically next to nothing of the telescope as applied to astronomy, are about to make their first venture by purchasing one. To those the appearance of such a letter as that of Mr. W. H. Maw's (29864) proves a great boon, as it shows (providing the "stopping-down" is a really fair test), what is the comparative power of different apertures *upon the same object*.

I should like to know, through the kindness of some of our astronomical friends, what is the *smallest aperture* with which one could satisfactorily observe the phenomena of "ingress" and "egress" of Jupiter's satellites and their shadows; and to get some idea of the same in regard to Saturn. I mean for a *refracting* instrument, as I understand a *refractor* will do more, inch for inch of aperture, than will a *reflector*. **Omicron.**

REMINISCENCES OF SOUTHERN SKIES.—II.

[29984.]—On 13th July, 1884, I recorded a frosty night with an exquisitely transparent sky—not a sign of a cloud, and yet there was a species of lightning playing about. It appeared in rather faint flashes at a few minutes interval, and gave me the idea of being far removed on the horizon.

Query: Is this of the same nature as lightning which appears in conjunction with storm, cloud, and rain?

It may have been due to a storm in the distance; but as the weather at that time of the year was pretty uniform over a large area, I am more inclined to think it was a different form of lightning from the vivid strings of light seen in thunderstorms.

Amongst other naked-eye phenomena were radiating pink and gold streamers seen after sunset. I have alluded to these before in this journal. At times they were so brilliant, it was difficult to believe they were not of a cloudlike nature, so as to obscure stars; but a glance at Venus or a bright star showed them to be perfectly transparent. On one occasion at sea, after sunset (24 Nov., 1885), I observed the sky, which was perfectly clear at the time, divided into two parts—the right or northern part of a beautiful turquoise blue, the left or southern rose-pink. I have not come across a perfectly satisfactory explanation of this phenomenon. No doubt it is caused by irregular masses of clouds partly obstructing and partly transmitting the sun's rays. By why this should be in a country like the Transvaal, where at one season of the year a perfectly clear sky must exist over an enormous area, I cannot clearly see. At what distance, and at what altitude from the earth's surface, are the clouds in question situated which cause the streamers?

I devoted a deal of attention to the sun, and was much interested in the great groups of spots which appeared in 1883, that year of tremendous solar activity. I constantly found that the detail visible in my little 2¾in. was far more than I could satisfactorily represent with the pencil. Having no observatory, however, the glare of sunlight in the air was found to be very oppressive, even at 9 a.m., and careful observations of sun-spots made in the open air had, after a time, to be discontinued, the surrounding conditions being incompatible with any comfort whatever.

Notes of observations of Mercury with the naked eye were recorded on twelve different dates; but that is no criterion of the total number of days on which it might have been so seen. On 3rd Sept., 1883, it was not far from the moon, looked the shape of a bean, but very small in the telescope. It was to be occulted by the moon when below the horizon. On the 8th Nov., 1881, Mercury might have been seen completing its transit over the sun for some ten or twelve minutes after sunrise in Natal, but a layer of clouds effectually prevented any observations. On 19th Oct., 1880, I saw Mercury and Venus, and one or two stars set, or disappear quite sharply on the horizon with a suddenness unlike anything seen in England. In Nov., 1880, Antares, Venus, and Mercury formed a triangle, Mercury being brighter than Antares. Later on, Mercury and Antares were close together, and it was noted that the apparent magnitude of Mercury was decreasing as compared with Antares. Antares twinkled rapidly, while Mercury did so only faintly, and much less rapidly and shone with a steadier light. In Sept., 1882, it made a combination with Spica and Mars. On Sept. 17th, 1883, it was a golden cream colour in telescope. In July, 1885, there was a configuration of Mercury, Venus, Regulus, and Jupiter. Generally speaking, Mercury was of a somewhat ruddy tint, and varied from 1st to 2nd mag. in brightness.

Venus was always an interesting object. In the clear air of the Transvaal it could easily be caught in bright sunshine long before the sun had set. I once watched it with the 2¾in. refractor disappear behind a hill, which must have been nearly ten miles distant. It looked like a flaming and smoking torch swaying hither and thither, and then it was suddenly extinguished. Perhaps the light was one second in disappearing, not more. On October 16, 1882, Venus and Antares were in the telescope together, a very pretty sight, the ruddy hue of the star, and the whiteness of the planet forming a fine contrast.

December 6th, 1882, was a red-letter day in my *Astronomical Calendar*, for I obtained a splendid view of the Transit of Venus. Some time previously I had determined to observe the transit on my own account with the the 2¾in. refractor, borrowing a chronometer from a local watchmaker for the purpose of getting accurate time. On the 29th November, however, I was somewhat astonished by the appearance of Mr. Neison (now Nevill) who had just come out from England to take up the post of Astronomer to the Natal Government. He had hastened his departure from home in order to arrive in Natal in time to observe the transit. Everything being new to him in the place, and the condition of the 8in. refractor in the Durban Observatory anything but satisfactory, he asked, and at once obtained, any assistance that I could give him in connection with the transit. It was decided I should go to Durban and note the times of his observation. Shortly after, however, he obtained the services of someone else in the matter. I was accordingly free to observe with my own telescope, which I took to Durban, and set up in the Observatory grounds on the morning of the 6th. There was much speculation as to how the weather would turn out, for clear weather at that time of the year at Durban was by no means to be depended upon. As it happened, however, the day was brilliantly clear from morn till eve, and the observations were most successful. I observed, with a solar diagonal on the 2¾in., which was mounted on a somewhat rough equatorial stand. The lens of eyepiece next the eye was taken out, and a Barlow lens added between the diagonal and object-glass. A neutral-tinted wedge served to reduce the light slightly, as required. The magnifying power of this arrangement was about 90.

As the time for external contact drew near, it was, perhaps, difficult to maintain that placidity of temperament with which astronomical observations are usually made. Each minute seemed to lengthen out to an hour, and I recall how that, failing to see any sign of external contact, when I considered I should have done so, I hastily ran the telescope round the sun's limb, in case I had been looking for it at the wrong point; almost immediately after a small, dark nick in the limb, at the very point I had been looking at, was seen. Following are the notes recorded:—

Cape Mean Time.

3h.	5m.	56s.	External contact. Perhaps 2 or 3 secs. late.
3	11	2	Planet intensely black.
3	15	12	Planet half on sun's disc.
3	17	22	Sun's edge boiling. Planet intensely black.
3	18	47	Smoky coloured grey line round the planet outside sun.
3	25	10	I fancied the black ligament had broken; but found, after giving the time, that it had not.
3	25	34	*Internal contact.* Planet entirely within the sun's disc. Perhaps this may be a very little late.

General Observations.—Venus an intensely purple black. No sunspots of any size to speak of with which to compare the planet, and they were not at all near. Granulations well seen. No satellite: although I looked carefully for a minute dot near the planet, could see nothing. There were no faculæ near Venus either. I almost imagined a softening of the blackness towards the planet's limb. No white spot. Just before internal contact a great boiling of the sun's limb commenced.

The time of internal contact was 6·6sec. later than Mr. Neison's time. The three amateur observers (say A, B, and C), in addition to myself, whose times were recorded, all observed external contact later, and all observed internal contact sooner, thus:—

	Ext. Contact.	Int. Contact.
	h. m. s.	h. m. s.
A..........	3 6 8	3 25 24
B..........	3 7 13	3 25 5
C..........	3 5 7	3 24 57

It was noted at the time that the three sets of observations probably represented the relative experience of the three observers in descending order, as an inexperienced person would be likely to see external contact later than an experienced one, and vice versâ in the case of internal contact.

After internal contact, which, of course, was the critical part of the business, the observatory was thrown open, and visitors were free to inspect the dark purple ball projected against the bright background of the sun. Many were the curious comments made thereon by the uninitiated. One elderly lady was very anxious to see it, and, after painfully climbing up the observatory steps, whereon she was supported by a companion, and peeping through the big telescope, came down with the air of a person who had nothing left in life to wish for.

At the inferior conjunction of Venus in July 1884, there was much interest in watching the planet with the 2¾in. Although possessing no such refinements as graduated circles, I constructed temporary ones of paper, and by this means was often able to catch the planet in broad daylight. Venus was observed 31 hours after inferior conjunction at 10.45 a.m. July 13, 1884. It was a delicate, pearly-looking crescent, and was all the more interesting from the trouble required in searching for it.

In 1883-4 the polar snow cap on Mars was several times distinctly seen in the 2¾in. On 24 Aug., 1884, Mars was seen close to the moon, about 4' or 5' S. of it. The contrast between the ruddy planet and the golden yellow moon was very interesting.

Several comets came under our ken while in the S. hemisphere; brief notes of them follow.

Comet *b*, 1881. I first noticed this comet (without any previous knowledge of its existence) on the evening of 30th May, 1881, at Pretoria. It looked to the naked eye as a nebulous star, with a faint tail. Thinking this might have been the first observation of it, a message was despatched to H.M. Astronomer at the Cape notifying the observation. Owing to the telegraph line between Pretoria and Newcastle having been cut by the Boers, this message (like many others) had to be sent for a long distance by heliograph, the clear, sunshiny air being eminently favourable to despatch of messages by this instrument. As it turned out, however, the comet in question had been observed several days previously, on May 22, by Tebbutt in N.S. Wales. Mr. Eddie observed it, for the first time, at Grahamstown, Cape Colony, on May 27.

Comet *a*, 1882—otherwise "Wells." First seen June 17, 1882, close to the new moon. Tail 5° long. Brightness = 3rd mag. star. But few observations of this comet were made.

Comet *b*, 1882. The celebrated one. I had the pleasure of watching this magnificent comet from shortly before perihelion, through its lovely phases, till it at last disappeared in the depths of space, prior to which it looked a mere speck of misty light. The observations extended over six months. The gauze-like envelope surrounding this comet was one of the most etherial, delicate sights I have ever seen. Are we to suppose this envelope as consisting of meteorites sparsely distributed round the more dense agglomeration of the comet proper? I very much regret that I had at the time no apparatus for determining approximately the position of two wisps or pieces of nebulous light seen a little south, preceding the comet's head, on the 5th October.

Pons comet, 1884. First seen on 14th January, 1884. Looked to the naked eye like a dull star about = ϒ Pegasi in brightness. Had the good luck to observe this comet through the Durban 8in. equatorial (21st Jan.). With low power, it was very beautiful, the head consisting of diffused nebulosity condensing to a stellar nucleus. No trace of any envelopes, jets, or such like. There were two rather bright stars lying across the tail, one within, one just outside. The line joining these two stars was nearly perpendicular to the comet's axis. It subsequently became a tolerably conspicuous naked-eye object. Watched it on many occasions till it became a dim little ball. Observed during a period of 100 days.

Barnard's comet (*b* 1884). This was also seen in the Durban 8in. It was on 18th August very faint and dim; no visible condensation, perhaps a suspicion of elongation towards the lower part of the field.

I find I have omitted from its proper place the great comet of 1880. This was a most mysterious object; only seen twice, as a very faint streak of light stretching upwards about 80° from the horizon.

I once amused myself by showing the moon through the telescope to some Natal Kaffirs; one of them was much delighted at the sight, and their resounding exclamations of astonishment, after breathlessly gazing through the magic tube were most humorous. I understand that the Zulu Kaffirs think they see an old woman with sticks in the moon—just the same fancy as we have at home, only with the gender reversed. I also learnt that they were guided as to the planting of their "mealies" (or Indian corn) by the apparition of the Pleiades in the East.

One of the most original apparatus I ever saw was a sundial made out of a commissariat packing-case—the gnomon made of a piece of the tin which once formed the lining! This had been designed by a colonel of artillery.

I once looked at *α* Centauri in the Durban 8in. The big glass brought out beautifully the thousands of stars with which it is sprinkled. Noted a little dark gap in the cluster, which was pointed out by Mr. Ballot at the time. It was not at all conspicuous. This same gap is referred to by Sir J. Herschel in his Cape Observations. Mr. Gore, in his "Planetary and Stellar Studies," finds that the distance separating the component stars in a cluster like this is probably so large as to give plenty of room for the stars to revolve round their common centre of gravity without fear of frequent collisions, and if the gap referred to has remained unchanged for 50 years, this tends to show what an enormous interval of time must be occupied by the component stars in completing their revolutions, and also strengthens the argument that there is plenty of empty space round each star, although to the sight they are so crowded together. If their motions were rapid, and the distances separating the stars small, the relative change of positions in 50 years would surely have altered the appearance of this gap.

On 21st Nov., 1880, I noticed the Pleiades to contain nine stars visible to the naked eye—the six ordinarily seen and three others. On 23rd Nov. I observed ten stars altogether.

Regarding the "pink glows," the first record I have is 1st Sept., 1883, when I noticed a magnificent display of this curious phenomenon. In the east the sky was a most peculiar turquoise blue, overhead a ruddy brown, and in the west a deep orange. Later on a very vivid band or arch of orange was situated above where the sun went down. Displays were seen off and on for years afterwards, but never equalling in brilliancy that of 1st Sept. On 4th May, 1884, the western sky after sunset appeared of a rich bronze red hue. At 6.30 p.m., when the moon was shining quite brightly, this lovely glow was still plainly apparent in the west, so that by fixing the attention on that, the idea was produced that the sun had only just set, and that there was no moon. It was a most curious optical illusion.

Many pleasant memories of S. skies still remain, and I am not without hope of once again making their acquaintance. As regards the amateur, the S. hemisphere probably contains more fresh work for the observer than the northern; and yet, as regards its stars, it has been stated that, through the labours of several astronomers, the S. heavens have now been better surveyed than the northern.

E. E. Markwick.

AN OLD AMERICAN LOCOMOTIVE.

[29985.]—I am much obliged by the reply of Mr. Stretton (letter 29964) on this subject, more particularly for that part relating to the second form of valve gear which was fitted to this locomotive; for although I had long since concluded by simple reasoning that some such form of gear must at one time have been contrived, no proof was found in the works within my reach.

I do not mind, however, confessing that the first gear of "Old Ironsides" is, from the description, still hazy to my view, for the reason that in all the descriptions of reversing gear that I have met with in which the eccentrics were loose and independent of each other, there was no reversing lever otherwise than the *starting handles* on the foot-plate. No doubt there was some arrangement unknown to myself, but it is not clear how the eccentrics were "changed from the foot-plate" in the first gear fitted to "Ironsides," as these were loose on the axle, apparently only connected to the latter by drivers.

Assuming I may have encroached on delicate ground, involving considerations of priority of invention, in raising the query regarding the credit of the introduction of fixing the two eccentrics on a sleeve with the accompanying *reversing lever*, shall I be presuming too much in asking if it is known in what locomotive this construction was first adopted?

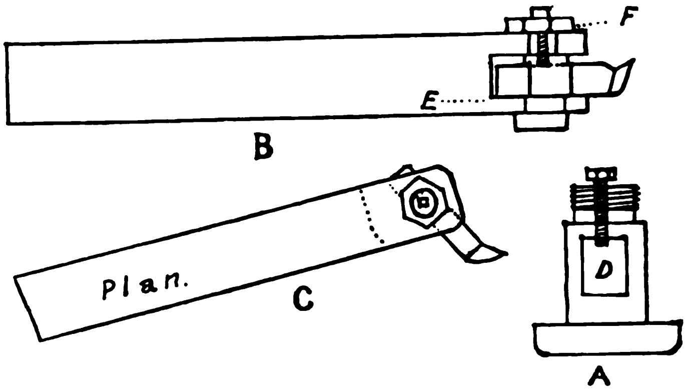
In putting forward these queries I console myself that I am not gratifying my own satisfaction alone, for, considering the great part which the locomotive has already played, and continues to play, in Great Britain and the world, it is with great reluctance that one would imagine there were not many who are equally interested as myself in the detail of its early history. For this reason I trust Mr. Stretton will be good enough to excuse my inquisitiveness in desiring to realise the precise mode of operation of the ancient arrangement. **A. Marson.**

LOCOMOTIVES.

[29986.]—I wish to point out that the Northumbrian is sketched by Mr. Stretton in letter 29963 as an outside cylinder loco. with the driving wheels leading, the cylinders being placed at the back; trailing wheels 2ft. 8in. diam., boiler 6ft. 6in. long, wheel base 7ft. 6in., whereas, in Mr. West's "Sheets on the Loco. Engine," the Northumbrian is shown as an inside cylinder loco., having horizontal cylinders in front, and the piston rod passing above the leading axle, driving wheels are trailing; leading wheels 3ft. diam., length of boiler 7ft. 3in., wheel base 5ft. 3in., and reversing gear handles are represented on the foot-plate. Surely there must be a mistake somewhere. All the other locos. agree with those drawn in the sheets. **J. A.**

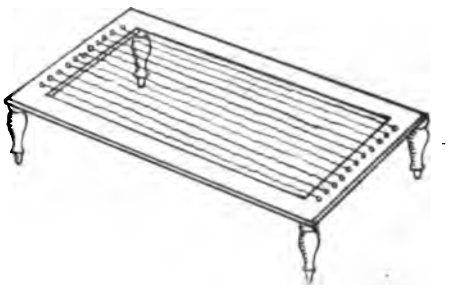
A GOOD TOOL-BAR.

[29987.]—I was just wondering if this tool has ever found favour with amateurs as a universal tool-bar. I have seen it in use in one particular shop for heavy work, and I see no reason for its non-use among amateurs. Sketch at A shows the screw and tool-box; the principal part of the bar is screwed with a fine thread, to carry a thin nut. Through the axis of the screwed part there is a small tapping hole. The bottom of the square hole at D is made slightly lower than the face at E, so that, on getting the box into right angular position, the nut at F is screwed-up, and the tool is then screwed-up against face at E by the small set-screw. **H. D. Robinson.**



SPRING BED.

[29988.]—I send you a sketch of a spring bed, which is the most effective and comfortable I know; is very simple and easy to construct, does not sag from wear, yields only where the weight rests, and then in a longitudinal direction only, the wires being independent. It is the invention of Mr. B. W. Blood, the Engineer-in-Chief of the Rajputana Mulwa Railway in India.



In its simplest form it consists only of a frame with legs and the spring wires, and this form I have shown in the sketch, where the wires are shown as thick wavy lines. The springs are made of steel wire, about 14 B.W.G., wound on a mandrel about ⅜in. diameter, then pulled out until they attain a permanent set of about 1¼in. pitch. Loops are formed at both ends of the wires to fit on to pegs in the head and foot rails (round-headed screws for wooden frames). The lengths of the wires are so much less than the distances between the pegs on the head and foot rails that they can just be strained *by hand* over the pegs. It is not necessary to make them tighter. The pegs and wires are about 1¼in. apart. A thin mattress is all that is necessary over these wires. It would be difficult to design a simpler or cheaper form of a good bedstead, or to meet a more comfortable one, and I would recommend it to anyone to whom these qualities are considerations. **Phos. Bron.**

EXPLOSIVES.

[29989.]—The public are so frequently hearing of new discoveries under this heading that it may be beneficial to explain that there are, after all, only two kinds—viz., that which propels and the other that blasts, rends, or splits material. The first applies to gunnery, and the second to engineering.

As we all know more or less of gunpowder, I cannot do better than offer an explanation of its action, since it was in use for both purposes till recent years when new blasts have been introduced. First, then, as to gunpowder. On ignition, its solid constituents—viz., saltpetre, charcoal, and sulphur, which are in the relative proportions to each other of 17, 15, 10, take fire but *slowly, so to speak*, when they change their form into gases occupying about 400 times the space they did as powder. This law so far applies alike to both propelling and blasting.

Now, we all know that in gunnery the gases are confined laterally in the barrel; but few are aware that those gases get a second heating from the effects of the ignition by which they were generated, which increases their volume about three-fold; thus the 400 times becomes 1,200 volumes along the barrel which form the powerful propellant, gunpowder, having a muzzle velocity of, say, 1,350ft., with a pressure of about 20 tons on the square inch. As to blasting force, the gases, after the rending or splitting, become diffused, and the 400 volumes pass away without second heating. This letter being general in its purpose, I will merely add a broad principle, thus:—A powerful propellant ignites but slowly, and its gases get a second heating, whereas a blast ignites on the instant, and its gases pass off with air and get no second heating.

Years ago, when I was an assistant superintendant at a Government gunpowder mills at Waltham Abbey, I noted in my mem. book as follows—i.e., gunpowder:—"A low maximum pressure long sustained develops greatest power."

John Shakespear.

Colonel, late R. Artillery, A.M.Inst.C.E.
25, Great George-street, S.W.

ORGAN MATTERS.

[29990.]—It will afford me much pleasure to help, to the utmost of my poor ability, Mr. G. Landell in the matter he so courteously writes about; but before giving the advice he asks for, I should require to know what are the proposed dimensions of both the swell-boxes, the wind pressure or pressures he intends to use, and for what chief purpose the organ is to be designed. With reference to the last, I mean such questions as these: Is the organ intended for the performance of strict organ compositions of a solo character only, or is it to be used for all classes of music alone, and with other instruments, such as the piano, violin, violoncello, flute, horn, &c.? Perhaps it would be more satisfactory to Mr. Landell, before he proceeds with so important an instrument as he is contemplating, if he would come here and see what I have done in the latter direction. Should he be unable to this, I shall be pleased to hear from him on the subject at issue, and to help him in a manner impossible through a public correspondence.

G. A. Audsley.

Devon Nook, Chiswick, W. May 25.

CHEMICAL SUGAR.

[29991.]—May I be permitted to observe that the writer of the article bearing the above title in your issue of 10th inst. starts with the object of showing that cane-sugar, or a sugar identical with it, has been produced artificially? He even says that the synthesis of cane-sugar is "un fait accompli"; but his subsequent statements do not justify this assertion. Cane-sugar has, in reality, not yet been synthesised. The chemical properties of acrose, the new sugar in question, prove it to be a very different sugar to saccharose or cane-sugar; it is more closely allied to the glucoses, since it reduces Fehling's solution, whilst cane-sugar does not.

Hitherto sugars had only been obtained artificially from a certain class of bodies, including starch, cellulose, and dextrine, all of which are represented by the formula $C_{12}H_{20}O_{10}$, or a multiple of it $(C_{12}H_{20}O_{10})_x$ differing only from sugar by one or more molecules of water—

$$\underset{\text{starch.}}{(C_{12}H_{20}O_{10})_x} + \underset{\text{water.}}{2x\,H_2O} = \underset{\text{glucose.}}{2xC_6H_{12}O_6}.$$

This is a simple change when compared with the complex series of metamorphoses effected by the German chemists in converting acrolein into a sugar, and every credit is due to them for their great achievement; but they do not claim to have produced cane-sugar.

There are also the following little inaccuracies (of smaller import) in your correspondent's article. Cane-sugar is converted by the action of dilute acids not into lævulose alone, but a mixture of lævulose and dextrose. All dextro-rotatory sugars are not called dextroses (cane-sugar is dextrorotatory); but only to one of the glucoses this name has been given. Alpha-acrosazon is not a sugar, but one of the intermediate products prepared by Fischer and Tafel. Coal-tar "saccharin" is not exactly orthosulphamido benzoic acid anhydride, but the *inside* compound—the most convenient name is, I think, benzoyl sulphimide (that is to say, it expresses its composition in as short a way as its structure will allow).

Charles E. Sohn.

25, Beverley-road, Anerley.

A PIANO FOR EVERYBODY.

[29992.]—Mr. Nettleton's idea (29974) of a piano for everybody is indeed a happy one, and no one would more rejoice to find a genuine *musical* instrument in every cottage than the person whose *nom de plume* appears at the end of this letter. But (and a *but* as big as a *water-butt* comes in here) how is it to be done? The size suggested precludes all chance of turning out a piano with a respectable tone. Mr. Nettleton's explanation that the makers do not think it worth while to cater for the multitude will not hold water. It is just what they are trying their best to do; but a maker who is worthy of the name knows his business too well to sacrifice his reputation by turning out a piano which, when finished, could never give forth a note of real music.

Firstly, the soundboard would have to be so tight-laced that the process would for ever spoil the voice of the piano. The bars at the back would have to be made of sufficient strength to resist the down-pressure, and this, coupled with the smallness and consequent stiffness of the belly itself, would produce a tone more worthy of a beer-barrel than a piano.

Secondly, if Mr. Nettleton has any knowledge of scales for the string lengths, he will know that in an ideal scale for the modern piano the lengths of the C's, from pitch C downwards, would be 14, 28, 56, 112in., &c.; but the space at the maker's disposal enforces him to curtail the bass and tenor strings. What, then, would the result be if he were obliged to make a 7in. pitch C, and this with a stiff and small soundboard behind? Then the action should be a modern one. The Acme, or other repetition check action, I imagine would suit. But where is it to be put? The keys of the instrument must be about the usual height; therefore, if the piano is to stand on the floor, the action must be underneath, if not turned upside down, a position in which the modern actions would, to put it mildly, be unsatisfactory.

There are many other technical difficulties; but our Editor will cry "Enough!" if I were to take up any more valuable space. Personally, I should not advise any attempt to curtail the 4ft. by 4½ft. of the modern cottage piano. If a piano worthy the name is wanted, go to a respectable and trustworthy maker (not always the most advertised) and pay a fair price, and you will get an article which will always repay you in soothing harmony what you have paid extra in £ s. d. Cheap and nasty are twin-brothers, and are inseparable in the pianoforte factory.

Vandal.

A SIMPLE GAS ECONOMISER.

[29993.]—From an ordinary tin can cut a piece of tin 2in. long by ¾in. broad, and bend as in Fig. I., the circular part to fit the gas-burner. Then get another piece, ⅝in. broad by ¾in. long, and cut, as in Fig. II., and slide into the grooves of Fig. I.

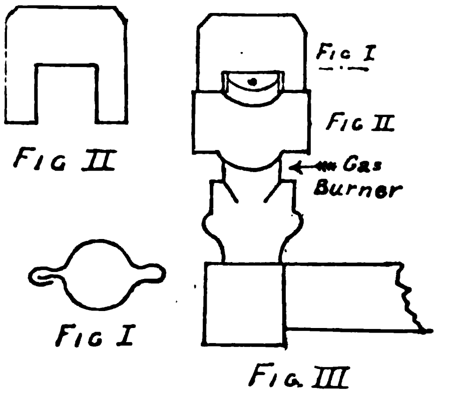


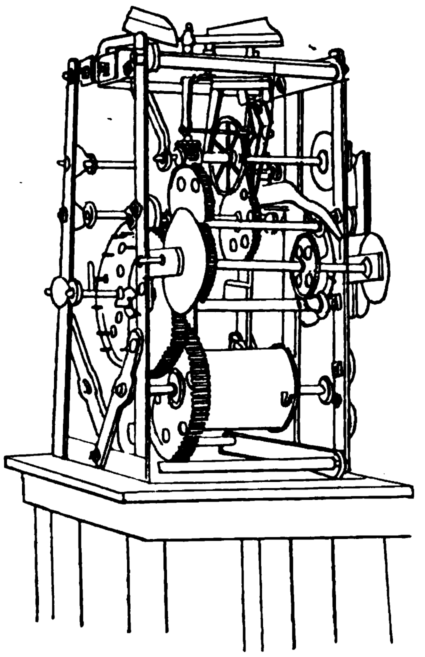
Fig. III. shows the burner complete. This contrivance is, of course, only suitable for the two-holed burners, and will not do for those with a saw-cut across.

Chas. H. G.

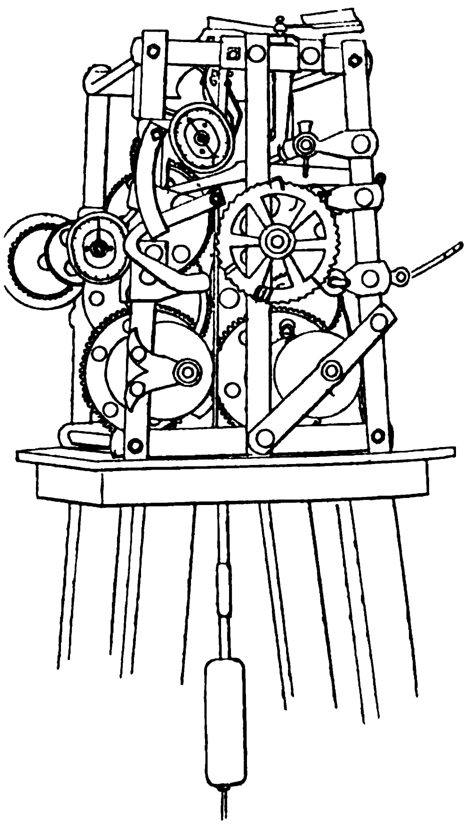
A SMALL CHURCH CLOCK.

[29994.]—I inclose two photos. of a small church clock I have just completed. If you think them worth engraving, some of your readers may be glad to be told how the thing is done. It is difficult to show all the wheels; but, taking the front view, the one showing the pendulum, the great wheel has 100 teeth No. 12 pitch, gearing into a pinion with 20 teeth on the second spindle. This carries a wheel with 120 teeth No. 14 pitch, working a lantern pinion of 10 pins, keyed on the third spindle. The wheel with 120 teeth rides loose on the second spindle, and is driven by a ratchet wheel acting through a pawl on the wheel. The barrel, which is 5in. diam., is wound by turning the second spindle. There was a special reason for making it do so, as a handle long enough to turn the barrel direct could not be used. Of course, the time required to wind is five times as long, so that has to be met by long maintaining power.

The second wheel, with 120 teeth, works one with 60 teeth, riding loose on its spindle, and pressed by a spring against a plate, so that the hands can be set round independent of the train of wheels. The spindle turns once in the hour, and a pin on it raises the lifting-piece at the hour. The hands outside connect with it. The wheel on third spindle has 100 teeth No. 14 pitch. It gears into a lantern pinion keyed on fourth spindle, having 10 pins. The fourth spindle has a brass wheel No. 20 pitch, the only brass wheel in the clock; it works a lantern pinion of 10 pins on the 'scape wheel spindle. Therefore we have, beginning at the second spindle, a wheel with 120 teeth, turning once in two hours, driving a pinion 12 times quicker.



Then a wheel on the third spindle, with 100 teeth, driving a pinion 120 times quicker. Then a wheel on the fourth spindle with 100 teeth, driving a pinion 1,200 times quicker than the second spindle, or 600 times in the hour, which is right for the 'scape wheel of a seconds pendulum. The



number of teeth for great wheel depends upon what is convenient as regards fall for weights, &c.

The photo. showing the back of clock will give the best idea of the going train. The striking part will be more difficult to describe, as it scarcely shows at all in the photo.

The great wheel has 110 teeth, No. 12 pitch, driving a pinion of 20 teeth, barrel about the same size as going. The second spindle carries a wheel loose, 130 teeth, No. 14 pitch. It has 13 pins for lifting the hammer lever. It drives a lantern pinion of 10 pins, keyed on third spindle, which has on it the cam-wheel for raising the lifting piece, and also a wheel with 80 teeth No. 14 pitch, which drives a lantern pinion of 10 pins keyed on the fly spindle. That again has a mitre wheel of 30 teeth keyed on it, driving a pinion of 20 teeth on a vertical spindle, carrying the horizontal fly. Such a fly was used to keep the clock more compact. The floor I had to work on was about the size of a large washing-tub, and the wall had to be cut out before the handle could be turned in winding. The cam wheel spindle makes one turn for each stroke of the hammer. At the end of its pivot there is a gathering pallet, which drives the locking plate. This has 78 ratchet teeth, and is moved one tooth for each stroke of the hammer. Being loose on its stud, but sprung tight, the hour can be made to agree with the outside hands without striking round. The lifting piece has a stop on it which catches the arm on the fourth spindle, when the slit in the locking-plate, coinciding with the notch in the cam wheel, allows the lifting piece to fall and stops the striking train. There is also another stop on the lifting piece, which keeps the train back until the lifting piece is off the pin on the minute hand spindle. The maintaining power is kept up for about two minutes. It pivots on the outside of the third spindle. On lifting it up a light pawl engages in a ratchet wheel and works itself out.

I fear my description has been rather tedious; but it is so difficult to make things of this sort clearly understood by people who are not acquainted with the construction of turret clocks, and it is for those we write. For an amateur I have had some little experience by this time, and I am quite willing others should have the benefit of it. I think the arrangement of this last clock as regards all its parts, does not admit of much improvement, except that I should have had the minute-hand spindle in the centre; but I was compelled to have it at the side to get the dial in the middle of the tower wall. The bell is between 2 and 3 cwt., so no great strength was required in the works. The brasses are fastened to the frame with bolt and nut. Having guide pins, they go back in the same place if removed to take out a wheel. The escapement may be called duplex gravity, having separate locking and impulse pallets, very similar to a duplex watch.

S. Maddison.

WATER MOTORS.

[29995.]—WITH reference to letter 29966, p. 261, I remember seeing a description of Hastie's patent automatic water-motor in an engineering paper some years back. It had two single-acting cylinders which oscillated on trunnions at one end, working on to one crankpin on a disc crank, the shaft and two trunnions forming the apices of an equilateral triangle. As the power required was greater or less, the crankpin was moved by an automatic device (the particulars of which I do not remember) further from or nearer to the shaft in a diametral groove on the face of the crankpin. This, of course, increased or lessened the stroke of the rams, and used a proportionate quantity of water. I hope this rough outline may be of some service to "F. A. M." **C. White.**

MICROSCOPICAL.

[29996.]—I WOULD expect that in the case of the 2in. objective of the second series there is another and more important difference than that of merely a few degrees of less angle. It is this: the 2in. lens of the second series is probably a single combination lens, whereas that of the best series is a double combination. If this is the case (I speak from conjecture, not having a second series 2in.), not only would you lose the resolving power by the reduction of the angle in the second series, but you would also lose defining power due to the superior aplanatism of the double combination lens.

Compensating eyepieces can be used with ordinary achromatic objectives with great advantage. I greatly prefer those of the positive kind, and my favourite of these is that of 12 power. I would certainly not advise the use of any higher power than this with an achromatic ⅛ objective.

The term "N.A." means "numerical aperture," and not "natural angle." The term "natural angle" is not used in microscopy, and if it means anything, must be equivalent to angular aperture.

A full explanation of the difference between "angular aperture" and "numerical aperture" would take up too much space; but briefly it may be stated that the resolving power of a lens is proportional to its "numerical aperture," and it is not proportional to its "angular aperture." Example: a lens of 60° of angular aperture will resolve (theoretically) 48,000 lines per inch, and a lens of 120° of angular aperture will resolve (theoretically) 83,000 lines per inch. We see, therefore, that a lens of double the angle will not resolve double the number of lines per inch. Now, the N.A. "numerical aperture" of a lens of 60° of angular aperture is ·5. Now double this, or 1·0 N.A., will give you the N.A. of the lens, which will (theoretically) resolve double the number of lines per inch that the lens of 60° of angular aperture can—viz., 96,000. Now, the angular aperture of a lens whose N.A. is 1·0 is 180°. So we see that it requires three times the angular aperture to resolve double the number of lines which can be resolved by a lens of 60° angular aperture.

But when the aperture of lenses is expressed in terms of "numerical aperture" instead of in terms of "angular aperture," then lenses having twice the N.A. can resolve twice the number of lines, and so on. The method of converting "angular aperture" into "numerical aperture" is very simple:—

1. Halve the angular aperture.
2. Find the sine of this. (This must be found from a table.)
3. Multiply the sine by the refractive index of the medium. (That is, 1 for a dry lens, 1·33 for a water immersion, 1·52 for an oil immersion).

The product is the N.A.

Example: 120° angular aperture; find N.A. 120 ÷ 2 = 60°. Opposite 60° in table of sines is ·866. The lens being a dry one, ·866 has to be multiplied by 1, which gives ·866 for the N.A. If the lens was a water immersion, then ·866 would have to be multiplied by 1·33, which would give 1·15 for the N.A. But if it were an oil immersion, then ·866 would have to be multiplied by 1·52, which would give 1·32 for the N.A. **Edward M. Nelson.**

FRESH EGGS.

[29997.]—I THINK it a pity that the statement of "D. B. L." (letter 29948) concerning *his* experience of the failure of pickled lime eggs should go forth without some evidence of an opposite tendency, as it might hinder housekeepers from availing themselves of a most useful plan of preserving eggs at a time when their hens are supplying more than necessary for household purposes. We put down into crocks filled with lime and water some 30 to 50 dozen of eggs every year, and it is rarely that we meet with *one* bad egg. They do crack in boiling if they are not first pricked; but for all cooking purposes they are excellent, and come in most serviceably in the winter time, when eggs get rather scarce, and keep perfectly good for the time we require—some ten months, more or less. The special point to be attained is to keep eggs good in *summer* months when they are plentiful; we do not get many in winter. I do not say they are to be recommended for the table; fresh eggs are certainly preferable for this purpose. **Amateur.**

REPLIES TO QUERIES.

⁎ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67995.]—**Ivory.**—By the courtesy of the Editor I have had an opportunity of examining the slip of celluloid sent by Dr. Frank L. James, of St. Louis, Mo., and I readily acknowledge that I was "quite behind the times" when I said that celluloid "has not the grain of ivory," for in this slip the grain is, as Dr. James puts it, "marvellously well imitated." I do not think much celluloid of the kind has been seen over here, and I would venture to ask Dr. James to explain, if possible, how the grain is imparted to the celluloid. The methods of making the substance itself have been fully described in back volumes; but such specimens as I have seen previously have been dead-white, without grain at all. NUN. DOR.

[68088.]—**Preserving Vegetable Colourings (U.Q.)**—The subjoined formula, which I happened to come across in *Cosmos*, will no doubt be of some use to you:—COLORATION DE L'HUILE D'OLIVE.—Voici un genre de falsification qui est absolument innocent et que nous indiquerons à ce titre, parce qu'il permet de donner à certains aliments conservés la belle teinte verte exigée par les amateurs, il est surtout employé pour colorer l'huile d'olive en vert. On y emploie les feuilles vertes d'épinard que l'on fait bouillir jusqu'à ce que l'eau de végetation soit vaporisée; on y ajoute un pour cent de bicarbonate de soude qui annihile en partie l'action de la lumière sur la chlorophylle. Possibly dyeing first with the preparation, and then bottling in clear water, would prevent the colour from running. LUX.

[68104.]—**Catering.**—Some of my men, who are members of the Blue Ribbon Army, have a portable tea-kettle, as shown in Fig. 1, capable of brewing 700 cups of tea at a time. After the kettle has been filled with water, fire is lighted in the firebox and fed, if necessary, from the top of the chimney, or through a side aperture. The water boils in about 20 minutes, or sooner, if an extra length of chimney be added. The grate and fire is then dropped, and the tea in gauze-wire baskets introduced. These baskets should be moved about to create currents of water through them, and should be kept in the water about 7 minutes only. The proportions of tea, sugar, and milk depend so greatly on their qualities and the tastes of the drinkers, that they can only properly be ascertained by trial. There are many cocks for measuring quantities, one of the simplest being shown in Fig. 2. With the plug as shown, the passage from the discharging vessel to the measuring vessel is open, and the liquid would flow into and fill the latter. On turning the plug quarter revolution contra clockwise, the former passage would be closed, and that from the measure to the spout opened, and the quantity of fluid in the measure would be discharged. PHOS. BRON.

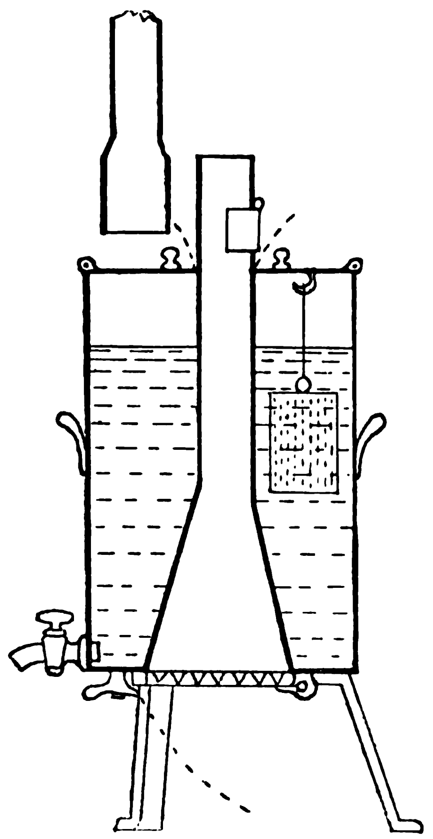


FIG. 1.

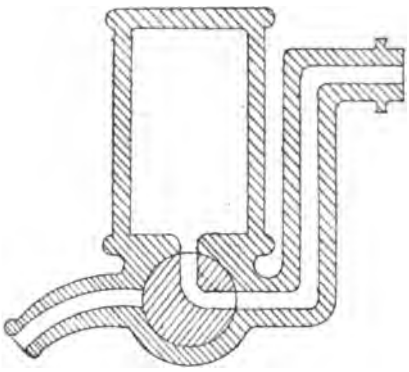


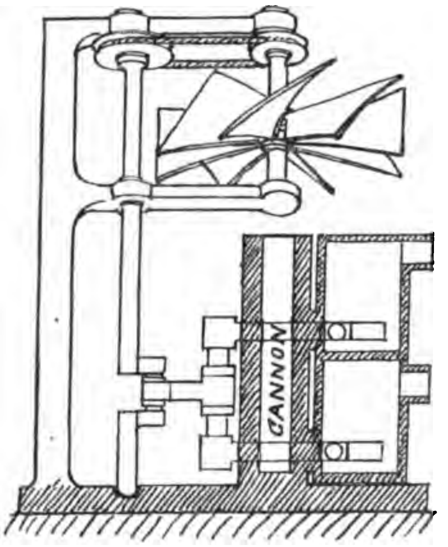
FIG. 2.

[68193.]—**Punkhas—Machine to Drive.**—I don't think anyone replied to above. I am just making an engine to heat with paraffin oil. Hitherto gas has been the heat used, and that is not obtainable in country districts in hot climates. The man who pulls the punkha often "drops off" to sleep at the hottest moment of the night.

Britannia Works, Colchester. T. M. BEAR.

[68230.]—**G.W.R. Automatic Vacuum.**—I am quite as well aware as "Nun. Dor." what a brake is supposed to do and not to do. My point is this, that the brake has to be applied harder to skid the wheels than it has to pull the train up properly, and if a brake has such power it has more than enough to stop the train properly; so that, given two trains under precisely similar conditions, and both having more brake power than they actually require, if the brakes are applied properly both trains will be pulled up in exactly the same distance. B. R. W

[68243.]—**Explosives.**—To "J. T. M."—I send herewith sketch of explosive engine, lower part section; see former description.



DONALD MCDONALD.

[68339.]—**Paraffining Carbons.**—Thanks to "Nun. Dor." for answering this; but he does not grasp the difficulty. What I want to do is this: keep the portion of carbon rod that is to go into the porous cell, and the top where the copper is to be deposited, in water whilst the intervening portion is heated and saturated with paraffin wax. If he will tell me how to do this, I shall feel obliged.

F.R.MET.SOC.

[68360.]—**Prof. Lodge and the Leyden Jar. (U.Q.)**—Dr. Lodge has made several and exhaustive experiments of late with the view of investigating the character and action of a lightning discharge. Doubtless this is what "St. Augustine" means. Will he kindly indicate more clearly the experiment to which he refers?

W. PERREN MAYCOCK.

[68360.]—**Prof. Lodge and the Leyden Jar. (U.Q.)**—I should advise "St. Augustine" to obtain the back numbers of the *Electrician*. I fancy he will find in them all the particulars he wants regarding these experiments. The jar can be charged by the induction coil by taking advantage of the fact that the current induced at the break is stronger or more intense than that induced at the make. The consequence of this is that the break current is able to spark across a greater distance than the make, so all that is needful is to provide a gap in the secondary circuit, so that the current will just spark. The consequence of this will be that the direct current will only be able to pass, in consequence of its being able to spark across a greater distance than the inverse current.

F. W. MASON.

[68382.]—**Banjo.**—The querist must get a prepared parchment and stretch it over the drum. The query is rather an extraordinary one; but "Ne Plus Ultra" will find all he can want to know in back volumes. G.

[68383.]—**Telephone.**—"An Old Subscriber" is rather a persistent fellow at asking questions; but the singular thing is he does not seem to know that his questions have all been answered while he has been growing "old." He can make a mechanical telephone out of two toy tambourines, providing a metal washer (or something as hard) where the line wire is screwed tight up on the drum-heads. If he can keep the line taut, a piece of string and two chip pillboxes can be made to answer. NUN. DOR.

[68384.]—**Mean and Apparent Time.**—I see I made a slip in my reply. I said that we know from Kepler's laws that the earth travels faster when near the end of the ellipse than when in the middle. This should have been that the earth has greater angular velocity when at the perihelion end of the ellipse than when at the other or aphelion end. The real earth and the imaginary "mean earth" start together at perihelion; the former, going faster than the latter, will be ahead; but they will come together again at aphelion, after which the mean earth is ahead of the real earth until they come together again at perihelion. The difference of time caused by the inclination of the axis of the earth can be calculated exactly by analytical geometry, assisted by the diagram. The result is given in the "E.M." of Feb. 8th, p. 485.

Bath. M.I.C.E.

[68387.]—**Black Pepper.**—Presumably the querist wants to make white pepper, and therefore heads his query "black." Any dealer in grocers' machinery will supply him with the information he requires, and the machines, too—at a price. There cannot be many readers who want such information. The finest grains are selected for white pepper; they are soaked in water, rubbed together, and winnowed to separate the black corticle from the white kernel. I suspect the querist wants to find out some easy method of making white pepper out of the inferior and low-priced berries, and I submit that is not the purpose to which this column is devoted. NUN. DOR.

[68398.]—**Oil-Lamp for Optical Lantern.**—A three-wick lamp is generally sufficient; but if preferred, a four-wick can be had, and the wicks can be so set as to last through a "lecture" of any ordinary (not wearisome) length. No circular-wick lamp better than the Doty for illuminating power.

R.

[68400.]—**Leaden Caps on Carbon Plate.**—If "C. A. A." cannot think of any other means, let him carve out of Bath brick a hole of sufficient size, and cast the caps on the carbons in that. There are other suggestions in back volumes.

M. T. J.

[68403.]—**Chromic-Acid Batteries.**—For economy nothing beats the Bunsen arrangement; but the cells must be kept outside or in some well-ventilated place. Hence the chromic-acid or Fuller arrangement of battery is preferred, as described many times. "A New Subscriber" should look up back volumes. NUN. DOR.

[68411.]—**Threads of Common Paraffin Lamp-tops.**—These threads are rolled up or squeezed up between dies or rollers. See indices for particulars. D.

[68413.]—**Melting Metal.**—The molten metal must be stirred with a piece of iron previously made red-hot, and the moulds should be made warm. Pay a visit to the Mint, and take note of the way bars of gold are cast there. The mould must not be hot, but just warm enough for touching. In the crucible the gold is covered with fine charcoal to prevent oxidation. NUN. DOR.

[68414.]—**Blowpipe for Brazing.**—Should not this querist refer to back volumes? or he might consult Fletcher's catalogue. A "Novice," however, if that correctly represents his abilities, will not do much good brazing with a blowpipe. It requires skill and experience. S. M.

[68467.]—**Coach Painting.**—There is no gauge used except the second and third fingers of the right hand. Coach-painting, or, rather, picking-out, is rather difficult to acquire, and allow me to inform you that it cannot be learnt at one lesson. Before you can run a "straight" line you will require a deal of practice. If you have to pick out, say, the panels of a cart or van, you may set it out with compasses. WALTER J. PARKER.

[68483.]—**German Yeast.**—In this (Lydney) locality a most excellent yeast, in a semi-dry portable form, is used, made from potatoes; in fact, it looks not unlike mashed potatoes; 4d. worth being sufficient for 28lb. of flour. That the quality of bread made with it by my cook is beyond criticism, our Editor shall receive a sample loaf in proof, provided this mem. has a footnote of his consent. When "Sm." made his sensational statement concerning the, to him, hitherto unequalled quality of certain Welsh bread, described to him as being made with milk, I put the matter to the test, using six quarts of one-meal milk to the half-bushel (28lb.) of flour. The flavour of the bread was so peculiar, its colour and its crust so singular, its texture so tough, so different from the household or shop bread, that had the bread described by "Sm." been made with milk, the latter would have been perceptible to his sense of taste, and of his vision with a lens, while as a chemical nothing would have been more easy to him for analytical detection than the curd, the casein, the milk sugar and the milk salts, and (in my instance) its cream. My nursery governess, however, used to lull me to sleep by her ditty, "Taffy was a Welshman, a liar, and a thief, Taffy came to my house and stole a joint of beef," &c. Now, nearly 50 years afterwards, it occurs that "Taffy" is but the Welsh brogue for David, a prevalent name in Cambria, to

THE LYDNEY DISPENSER.

[Better send it to Dr. Allinson, the medical editor of the *Weekly Times and Echo*, who is always interested in good yeast and good bread. Send the doctor a whole meal loaf, however. He regards a white loaf as poison, and so do we.—ED.]

[68530.]—**Great-Western Broad-Gauge Engines.**—"W. E. C. B.'s" reply in last number being somewhat incomplete and misleading, I now send a complete list of broad-gauge engines now running:—Great Britain, Great Western, Iron Duke, Alma, Crimea, Courier, Sultan, Hirondelle, Warlock, Bulkeley, Prometheus, Rover, Eupatoria, Tartar (passenger)—shed, Westbourne Park; Swallow, Balaclava, Inkermann, Sebastopol, Dragon, Amazon, Lightning, Timour, Emperor, Tornado (passenger), Sir Watkin, 6-c. tank—shed, Bristol; Hawk, Fenton, Gooch, Hackworth, Blenkinsop, Murdoch (passenger), Miles, 6-c. tank—shed, Taunton; Avonside (passenger), Bulkeley, Whetham, Buffalo, 6-c. tanks, Exeter; Zebra, Sol, Gorgon, 4-c. tanks; Elephant, Camel, goods tanks, Newton Abbott; Cerberus, Hedley, Kingswear; Penn, Mortonhampstead; Pollux, Ashburton; Taurus, Brixham; Hecla, Hector, 4-c. tank; Argo, Emperor, 6-c. tanks; Crow, Rook, Jay, Owl, Raven, Goat, 4-wheel tanks; Europa, 6-c. goods tender; Wood, Dewrance, 4-c. coupled passenger tender; Plymouth, Melling, Ostrich, 4-c. tanks; Launceston, Stewart, 4-c.; Stromboli, Romulus, 6-c. goods tanks; Truro, Magpie, Heron, Stag, Leopard, Lance, Osiris, 4-c. tanks; Dromedary, Vulcan, Achilles, Python, Hercules, 6-c. goods tanks—Penzance. These are all the B.G. engines with names now running. There are several others with numbers only. The Weymouth, Salisbury, Wells, Bathampton and Trolbridge, and Reading and Holt lines were converted to narrow-gauge in June, 1874. I believe this latter branch was worked by the "Waverley" class of engines. GORGON.

[68523.]—**Railway Mileage.**—The following is the mileage between Bath and Bournemouth:—

Stations.	M.	Ch.	Stations.	M.	Ch.
Bath	—		Templecombe Jun.	3	37
Midford	4	19	Hensbridge	1	75
Wellow	2	31	Stalbridge	1	40
Radstock	3	70	Sturminster Newton	3	73
Midsomer Norton	1	67			
Chilcompton	1	78	Shillingstone	3	3
Binegar	2	49	Blandford	5	37
Masbury	1	44	Spetisbury	3	25
Shepton Mallett	3	14	Bailey Gate	2	64
Evercreech	3	8	Broadstone	4	58
Evercreech Junc.	1	41	Poole	3	38
Cole	2	60	Parkstone	1	62
Wincanton	4	20	Bournemouth W.	2	40

GORGON.

[68547.]—**Clock Gong.**—In reply to "Nemo," I would advise, in the case of a drum marble timepiece, to use a support for the gong, springing from the base of the clock, the train in this case being unavailable. Your correspondent Chas. A. Jones has the same idea as myself, when he suggests metal as a block instead of wood.

Birmingham. HALL.

[68552.]—**Maxima and Minima.**—"W. J. A." is quite right; the curve represented by the equation for the area has a point of contrary flexure, and its tangent is horizontal when the variable angle is that found by calculation; but there is no maximum. There is this, however, to be said—that supposing the sides of the base to remain constant, but the height to vary, the revolving axis being always at half the varying height, then so long as the height is less than the proper height of the cube, the area of the revolving plane will have both a maximum and minimum value, and as the varying height tends towards that of the cube, the two will coalesce at the point of contrary flexure. It has been a great treat to me (for one) to read the various replies, all so correct and so correctly printed.

Bath. M.I.C.E.

[68582.]—**Medical Electricity.**—There is probably no subject under the sun of which both quasi-professionals and the general public are more intensely ignorant, than that of the medical applications of electricity. You have been recommended many books, and though I have not seen any of them, I think that there are doubts as to the information contained in some of them being very very reliable—e.g., "Lindsay v. Blackiston on Paralysis, Neuralgia, &c., *treated by Galvanisation and Faradisation.*" The very use of such terms as these denotes ignorance of modern electrical science. Under the auspices of such men of eminence as Lubbock, Hunter, and Mackenzie on the medical side: and Ayrton, Silvanus Thompson, and Preece, on the electrical side, an "Institute of Medical Electricity" has been founded, situate in Jermyn-street, W. You can apply to that institution for either advice or treatment with every confidence. I would refer you to *Elec. Review*, Jan. 6, 1888: *Electrician*, Jan. 13, 1888: *Health*, Jan. 6th, 1888—*et seq.*, setting forth its objects and scheme of work. I think the "Lydney Dispenser's" tirade against medical electricity is certain proof that he knows no more about it than most people.

W. PERREN MAYCOCK, A.I.E.E.

[68618.]—**Fixing Corrugated Roofing.**—Let the sheets lap two grooves on the edge, and 5in. or 6in. at the ends. Nail through the crown of the corrugation, not in the hollows, punching with a sharp blow on a diamond-pointed punch. Put a lead washer and a dab of white lead under each nail head, and do not drive the nail tighter [illegible] just to squash the white lead (that is, don't [illegible] the corrugation in the least). Three nail [illegible] top, bottom, and middle of each sheet [illegible] sufficient. Cut the sheets with a hand-[illegible] with a quick stroke, at right angles with th[illegible]

T. F. [illegible]

[68629.]—**Bulk of Sphere.**—Multiply [illegible] of the diameter by ·5236, and the produ[illegible] the solid content. [illegible]

[68629.]—**Bulk of Sphere.**—A rough rule for calculating content of a sphere is this:—Multiply the diameter by 3·1415927, which gives the circumference. Reduce the circumference to feet, and multiply by itself and then by ·0353678. This product gives the content in yards. Lux.

[68636.]—**Cycles Up-Hill.**—I have often been puzzled with this question; but I think the following explanation will make things clear. When a man is on a bicycle he (in effect) adds to the length of his legs in the proportion of the throw of the crank to the diameter of the wheel. He, as it were, is walking on stilts, but with this proviso, that he must always make his steps of equal length, whether on the level or going up-hill, the length of step being half the circumference of the wheel. Now, suppose there is a hill of a steepness of one vertical to five horizontal; if he were walking with his own legs, and taking steps of 2ft. 6in. long, each leg would alternately raise his body 6in., so that the exertion would be only that of going up an ordinary staircase; but if he had to take steps, say, four times as long, each leg would have to raise his body 2ft. at each step, as in going up a very steep staircase: hence the fatigue.

Bath. M.I.C.E.

[68637.]—**Dipping Rod.**—The ordinary dip-rod will show "Barrel" the quantity of ale in his cask to within, say, a gallon, if his casks are the usual sizes, well made; but to use his dip-rod he must take the bung out and put the rod in diagonally, letting the bevelled end fit into the chimb of the cask, when the mark left by the liquor will indicate the number of gallons there; but if "Barrel" wishes to be more exact and to gauge casks of intermediate and outside sizes to those marked on the rod, he will require an ullaging rule, the use of which takes rather a lot of explaining; but if "Barrel" cares to advertise his address, I would explain the way to use it more fully than I can here. It would not hurt the ale to take the bungs out, if they were put in tight afterwards.

Tren.

[68638.]—**Clock Train.**—Your 96 might drive trundle of 7 in one hour. On the former axis also one of 8 to drive trundle of 7 in 12 hours. You may double or triple these latter numbers, but the smallest number of well-shaped teeth is better. Then, on the hour arbor, a wheel of 48 to drive trundle of 7, and on this latter, 35 to drive one of 4 in one minute. On this arbor a wheel of 25 to drive trundle of 6, and on this last one of 18 driving trundle of 5 in four seconds. Thus every driver and follower can be prime to each other. The trundles of 4 and 5, with their drivers, must be double-faced; the remainder not necessarily, but better so. Fourteen turns of your 96 wheel will be just 8 days.

E. L. G.

[68652.]—**Wood Labels.**—Fill up the pores with size, or rub the wood with pure unvulcanised rubber. Lux.

[68652.]—**Wood Labels.**—I advised on this in *Gardening Illustrated* some few weeks ago, as follows:—Take the label, smear it with white paint with a brush or piece of flannel, let it dry, sandpaper it, then use a Woolf's garden pencil, blue. Result: No rain or damp will make it run or blear or blur. The only bad feature is that the pencils are made of bad cedar, and the leads are not well glued in, so be careful not to cut to too fine a point. It is a great pity that these pencils are not made to fit the cases sold in which the leads can be put out far enough to write (without the whole lead falling out), and yet can be pushed back after using. These cases, to my mind, beat all others, and the leads are perfect for all purposes but damp. For gardening, such a case with the Woolf lead would prevent my having to carry about two pencils daily.

The Cotswolds. B. P. A.

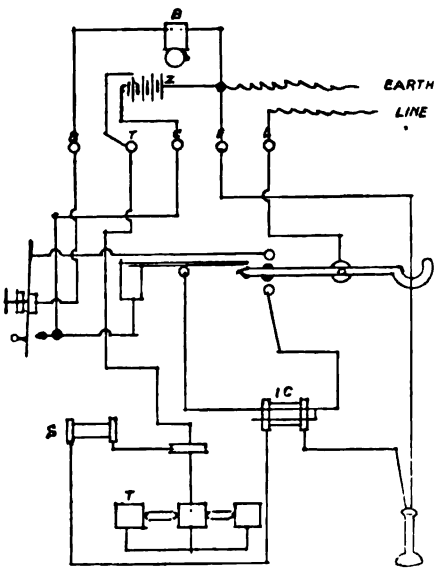
[68654.]—**Harmonium.**—Without endorsing the dictum that the shape and capacity of the channels produce tone colour, I give a scale for 16ft. reeds, which has been found good:—1st C, 4⅝in. long, 1⅝in. deep; 2nd C, 4¼in. long, 1⅝in. deep; 3rd C, 3¾in. long, 1¼in. deep; 4th C, 3¼in. long, 1in. deep; 5th C, 2⅝in. long, ¾in. deep; 6th C, 1in. long, ½in. deep. These measurements may be used for corresponding F's without any detriment. The scale may be shorter than that above given, and certainly the channels may be varied in depth, as Mustel makes his—that is, the channel is deeper at the free end of the reed than it is at the pallet aperture. Channels differ in shape in the really good instruments; but for common work pans are made by the dozen, like cheap violins. Organon.

[68660.]—**Electrical Repairs.**—Would F. W. Mason be kind enough to explain how permanganate of potash sol. regenerates Gassner cells, and also how it is "run through"?

W. Perren Maycock.

[68671.]—**Micro-photo.**—To Mr. Bottone.—The process I require information on is "microscopic photography," or the art of reducing any subject or view to so small a size as to require the aid of a microscope to view it. Should be pleased to have complete process from camera and focussing to finished picture on glass slide. F. T. B.

[68662.]—**Telephone.**—I send you sketch of Johnson's transmitter; you will be able to follow the connections—I C being induction coil, S a shunt, T carbon microphone or transmitter, B bell, with the five terminals required. Sketch as drawn shows conversation going on.



An Ex-Watchmaker.

[68670.]—**A Proportion Sum.**—As the Editor observes, it is really astonishing how many have fallen foul of this. Below is shown the working, step by step, which should be quite clear to all:—

If 1½ hens in 1½ days lay 1½ eggs,

$\therefore\ 1$,, $1\frac{1}{2}$,, ,, $\frac{3}{2} \times \frac{2}{3} = 1.$

$\therefore\ 1$,, 1 ,, ,, $1 \times \frac{2}{3}.$

$\therefore\ 6$,, 1 ,, ,, $\frac{2 \times 6}{3}.$

$\therefore\ 6$,, 7 ,, ,, $\frac{2 \times 6 \times 7}{3} = 28$ eggs.

W. Perren Maycock.

[68671.]—**Micro.-photo.**—The following may suit "F. T. B." Place the microscope in a horizontal position, remove the eyepiece, place the negative or picture to be enlarged behind the tube of the microscope from 1 to 4ft. The negative must be lighted by a camphine lamp or Argand gas-burner, whose rays must be rendered as parallel as possible by placing a large plano-convex lens between the light and the negative. The great object is to get the negative evenly illuminated. To focus, the best thing is an ordinary bit of sensitised plate, as ground glass would give much too rough a surface. Having fixed an inch object-glass to the microscope, and placed the plate on the stage, proceed to focus, using a powerful lens to examine the small image, which will be scarcely visible to the naked eye. When the exact focus has been obtained, remove the object-glass slightly from the plate so as to get the chemical rays into focus. Now shade the light, and place a slide covered with collodion, and treated with the silver bath in the usual way, on the stage, and expose from 30 to 40 seconds. Then develop in pyro and mount in Canada balsam. I have found in practice that a plate of ground glass between the negative and light does instead of a lens, but lengthens the exposure. E. G.

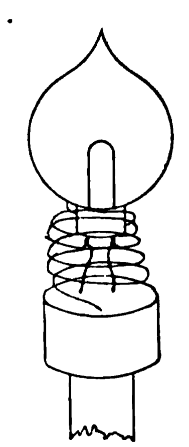
[68672.]—**Electrical.**—You could use the method given in No. 1239, reply to query 67323. The series wire is the same size. F. W. Mason.

[68674.]—**Link Motion in Centre.**—When the link is dead centre, if your cams or eccentrics are true on the shaft, no steam should enter the cylinder. Have you looked if the eccentrics have moved on the shaft, or if the eccentric rods are equal in length? If you do not find these wrong, look at your valve, and set it equal with port-holes of cylinder. Nimrod.

[68691.]—**Grease, to Remove from Granite Paving.**—Take 1lb. of commercial potash and ½lb. of quicklime and stir together in a large bucket of boiling water; scrub your floor with this, avoiding contact with the skin, as it will take it off. If this does not take the grease off, nothing else will.

Principia.

[68685.]—**Holder for Small Incandescent Lamp.**—Take a piece of rattan cane, about ½in. diameter and ½in. long; put two small pieces of No. 20 steel wire through it, at such a distance apart as to reach just under the loops of the lamp; bend the upper extremities of these wires into hooks. Now make a coil of 5 or 6 turns of the same gauge wire, and push one end into the hooked end of the cane. Your lamp-holder is complete, and should present the appearance shown in the above cut, where the lamp is given in position.



S. Bottone.

[68692.]—**To Clean and Protect Gunmetal Fittings to Hydrants Exposed to all Weathers.**—Perhaps the best way is to clean with a mixture of fine brickdust and oxalic acid or lemon juice, and polish with a wash leather. To preserve them from the damp, &c., slightly coat them with good machine oil—very little: an oily rag will do.

Principia.

[68693.]—**Mandrel.**—It is according to whether you require this for "amateur" or practical work. The following is what I have on a powerful 5in. screw-cutting lathe, and of course treads rather heavy; if you require a light lathe, reduce proportionally in all parts. Of Bessemer steel and left soft—nose, 1⅛in.; front cone, 2⅛in. long, tapering from 1⅝in. to 1¼in.; body of mandrel, 1in. and 1⅛in. where main gear-wheel is fixed; tail end, ¹⁵⁄₁₆in. and ⅝in. where back cone is, which is 1⅛in. long, tapering from 1¾in. to 1¼in.

Bristol. T. C.

[68699.]—**Copper Sulphate Deposition.**—"Sauros" could effect a deposit in the mine with a dynamo; but it is hard to state whether it would be a practical and paying success without first seeing the mine and knowing the specific gravity of the water in the mine. Suitable dynamos would be two of Siemens' shunt-wound electro-deposition dynamos. One (HC_{10}) giving 500 ampères, 60 volt, at 700 rev., H.P. 47, and one (HC_9), giving 300 amp., 50 volt, at 700 rev., H.P. 24. This gives a total horse-power of 71 required. On knowing further particulars, shall be pleased to advise.

F. W. Mason.

[68699.]—**Copper Sulphate Deposition.**—It could be done, though the mains for carrying your current from dynamo to pit's mouth, having to be necessarily heavy, will be expensive. Roughly, you could go to work thus: From — pole of dynamo (shunt-wound, low potential, large quantity) run lead to mine, and let it down as far as possible—without, of course, touching sides or bottom. The reason for this is that the solution is densest at the bottom. The lead terminates in sheets of copper as broad as possible + pole of dynamo connected to E. by E. plate in river bed.

W. Perren Maycock.

[68699.]—**Copper Deposition.**—Having cheap water-power at command but half a mile distant, then by means of a dynamo at source of power and an electro-motor at pit's mouth, the cupreous liquor might be pumped from the mine into pools or tanks on the surface, in which have been placed a quantity of scrap iron. This precipitates the copper in an impure metallic state, which, collected at intervals, may be sold to the smelters. It is a well-known process, which I have seen in operation, and is used in many mining districts both in this country and abroad. Further details can be obtained from metallurgical books. I do not think that reduction by electrolysis (hinted at in query) would be feasible, the solution being probably much too dilute.

F. G. Ll.

[68702.]—**Fitting up Dynamo Castings.**—To Mr. Bottone.—An armature 3½in. long by 2in. in diameter would be very difficult to wind if of the Gramme or Pacinotti shape. I should advise a Siemens H form; but you will not find 2in. punchings in the trade. The nearest size is 1¾in. diameter, and if these have wide holes through them, as they ought to have, a spindle about ³⁄₁₆in. diameter will allow you to string the punchings alternately on each side a little eccentrically, so that you can make the armature to run within $\frac{1}{16}$in. of the fields; and this will give a good result. The price of the punchings is 4s. 6d. per gross—25 go to the inch. But if you do not want your dynamo for continuous work, but only for experiments not exceeding twenty minutes or half an hour at a stretch, you will find a casting in "malleable" iron for the armature quite, if not more, effective. You will be able to get on about 5oz. No. 18 on the armature, and about 3lb. No. 22 on the fields. Connect up as a shunt machine. Drive at 3,000 revs. per minute, and you will get 25 to 30 volts, with a current of 1 or 2 ampéres. S. Bottone.

[68704.]—**Electro-Motor for Circular Saw.**—A motor of the type last described by me in "Electromotors: how Made," with an armature of 4⅜in. diameter, and 2in. deep, would give all the power you need; but I warn you that after you have fitted it up and seen it once or twice with batteries you will give the batteries up in disgust, and wish you had bought even the cheapest hot-air or gas-engine. S. Bottone.

[68703.]—**Data for Winding Dynamo.**—To Mr. Bottone.—I have given in "Electrical Instrument Making for Amateurs" (see adverts.) a few simple rules for calculating the amount of wire, the size of armature and fields, &c., which, at a given speed, will give a certain result. The first thing to be considered is the speed. It is found that, with fairly soft iron, and at an angular velocity of 1,250ft. per minute, each yard of active wire on the armature will give an E.M.F. of 1 volt. Now, since to get the best results economically from any dynamo the resistance of the external circuit (the outer resistance) should be about 20 times that of the armature, it follows that we can easily calculate what diameter of wire we must use in order to get a given current in the outer circuit. In order to make this quite clear I will give an example worked out, neglecting for the moment the amount of current required to magnetise the F.M.'s. Let us suppose we desire to get a current of 2 ampères, through an outer resistance of 40 ohms. Since the armature resistance should be $\frac{1}{20}$ of this, or 2 ohms, we must select a wire of such a diameter that the 84 yards of wire required to furnish the 84 volts shall not have a greater resistance than 2 ohms. (Here it must be observed that the resistance of the wire on the armature, when running, will depend on the mode of winding, and also upon the number of brushes used to pick up the current. In armatures of the Siemens H type, and all those in which there is only one section, the resistance of the armature, while running, is the resistance of the entire length of wire used; but in armatures of the Gramme, the Pacinotti, and other allied types, where the current divides itself equally along the upper half and the lower half of the ring, the resistance is only a quarter of that of the entire length of the wire used.) I repeat, then, the 84 yards of wire needed to give an E.M.F. of 84 volts, and therefore a current of 2 ampères, through a total resistance (armature and outer circuit together) of 42 ohms, must not itself exceed in resistance 2 ohms. Casting our eyes along a table of copper-wire resistances, we find that No. 20 B.W.G., equal to 0·03in. in diameter, most closely fulfils the conditions, since it runs about 80 yards to the pound, and has a resistance of about 2 ohms to the pound (I here refer to the ordinary No. 20 d.c.c. of commerce). There is another point which must be attended to, and that is the carrying power of the wire. By this I mean the capacity which the wire has of carrying a current, without injurious heating. No. 20 will be found, on reference to a table of carrying power, "safe current," to be able to carry 2 ampères safely. N.B.—If the armature be of the ring type, since the resistance is a quarter, the carrying power is increased in like proportion. From the above example we see that 84 yards of No. 20 d.c.c. would give an E.M.F. of 84 volts, if driven at an angular velocity of 1,250ft. per minute, and that this E.M.F. of 84 volts will give us a current of 2 ampères, through the combined outer resistance of 40 ohms, and the armature resistance of 2 ohms. Since the E.M.F. in a constant field is proportionate to the velocity, it follows that at half the velocity we should need twice the amount of wire, and that at twice the speed half the amount of wire (provided it could carry the current) would suffice. Now comes the question, What size armature will contain the 84 yards of wire? This, of course, will depend to a considerable extent on the form we give to the armature, and to the number of coils we desire to wind in each section. In armatures of the Siemens H type the number of layers of wire is practically immaterial; in ring armatures, on the contrary, the fewer the layers in each section the better. One is theoretically the best. Practically, from three to five work well. If an armature of the H form be selected, one of about 2¼in. diameter, 7in. long, having a channel 1¼ wide, and 1in. deep, will hold the 84 yards of wire easily, since No. 20 d.c.c. runs about 22 coils to the inch. If a ring armature be chosen, one having a diameter of about 3½in., and a depth of 2¼in., will be found to hold the required amount of wire. Since we require to use a portion of the current (say 5 per cent.) to magnetise the F.M.'s, we must allow for this in our calculations, so that it will be well to increase the length of the wire on the armature by at least one-twentieth to allow for this. Now we come to the field-magnets. Whether we decide to shunt-wind or to series-wind the field-magnets, we must take care to have them massive—so massive, in fact, that the limit of magnetic saturation should never be even approached. The wire space should be such as to allow the diameter of the core to be at least doubled when wound. Say, for example, the diameter (or thickness, if a flat core) be 1½in. when unwound, the wire space must extend to 3in. in diameter at least. For a series-wound machine, the wire, which should fill the wire space indicated above, should have rather less resistance than the running resistance of the wire on the armature. Thompson recommends ⅔ the armature resistance. In practice it is found that a series-wound machine will work even when the F.M. resistance is as high as five or six times that of the armature; but the best effects are certainly obtained when the F.M. and the A. resistance are about equal—at least, this is my experience. Hence, for the series-wound machine the proportions for resistances are:—Outer circuit, 20; armature, 1; field-magnets, ⅔ to 1. Still continuing with our H armature, 7in. long, 2¼in. diameter, as our example, and using F.M.'s 7in. wide, ¾in. thick, and 3in. high, we see that the wire space around the magnets will extend ¾in. at least, and be 3in. in height. We must, therefore, choose a wire of such a gauge that the length required to fill this wire space shall not exceed in resistance from 1½ to 2 ohms. On reference to a wire table, we should find that 10lb. No. 16 would most nearly fulfil the required conditions, since its length would be 240 yards, its resistance about two ohms; and as 14 coils of this wire can be got in the linear inch there will be no difficulty in getting the required amount on in the wire space provided. (I am not advocating here flat electro-magnets, or Siemens H armatures; but only calculating the amount of wire required to give a certain current.) In the case of shunt-winding, experience teaches us that the most economical results are obtained when from 2 to 5 per cent. of the total current produced is sent round the field-magnets to magnetise them. Since we have it in our power to increase the magnetising power by increasing the number of turns, it follows that if we lay on a sufficient number of coils round the F.M.'s, we can get the same magnetisation from the twentieth part of the whole current, as we could have done had we used only a few coils with the entire current, and this without adding useless resistance. The proportions for shunt-winding a machine, so as to work economically, are:—Outer circuit resistance, 20; armature resistance, 1; field magnets' resistance, 400. Hence, in a dynamo of the dimensions given above, about 12lb. No. 28, would give sufficient resistance, would admit of a sufficient number of turns being laid on to magnetise duly the F.M.'s, and, lastly, could be got in the wire space at disposal. To facilitate these calculations, it is well to have at hand a wire-table, so as to see at a glance at once the weight, diameter, resistance, safe-carrying capacity, &c., of any given gauge of wire. Provided the carcase of the dynamo has been fairly proportioned, the calculations as to the amounts and gauges of wire to be used are then easily obtained from the above data. The data for calculating the best proportions to be given to the relative masses of iron in the armature and F.M.'s is another and most important matter, which I will go into in a future letter, if "R. H. H." desires. I append a condensed table of copper-wire properties, which may prove useful to others:—

B.W.G.	Dia. in inches.	No. of coils to the linear inch.	Yards to the lb.	Ohms to the lb.	Safe current in amperès.
No. 8	0·165	5	4	0·004	40
10	0·134	6	6	0·011	28
12	0·109	8	9	0·025	18
14	0·083	10	15	0·080	10
16	0·065	14	24	0·200	6
18	0·048	17	45	0·676	3
20	0·040	23	80	2·100	2
22	0·029	27	120	5·08	1·5
24	0·025	30	162	9·198	1·
26	0·019	37		27·57	0·5

S. Bottone.

[68707.]—**Screwing to Wedges in Walls.**—Drill a hole considerably smaller than the screw, and dip the screw in the glue-pot before insertion; but perhaps the wood used is too soft for the purpose. Principia.

[68707.]—**Screwing to Wedges in Walls.**—In a newly-built house there is no such difficulty. Before the walls are plastered the ultimate position of the pushes is determined on. Round or square blocks of ½in. stuff (preferably teak) with bevelled edges are fastened to the wall with two or three brads, a slot and centre-hole being cut for the [illegible] wire-tube. When the wall is plastered the block is "keyed in" by virtue of its bevel. There you have the grain the right way. In the other case, where plugs have to be used, let them be of teak or other hard wood. If you use fairly long screws—say 1½in.—you should have no trouble.

W. Perren Maycock.

[68710.] — **Legal.** — Looking at your query broadly, I should say that A. (B.'s solicitor) by depositing B.'s title deeds with C., and obtaining money thereon, had created an equitable mortgage on B.'s property, and that B. had no remedy but to rank as a creditor on A.'s estate for the amount he pocketed; but I would advise B. to go to a respectable solicitor, give him full details, produce all the papers, accounts, and letters relative to the property in question, and to the object for which A. held the deeds, and possibly he may find a method of neutralising the fraud of B.'s solicitor.

Plymouth. B.Sc.

[68711.]—**G.W.R. Locomotives.**—The peculiar hissing sound that you hear on the G.W.R. locos is from the air-pump for the vacuum brakes, and continues all the time, only the noise is drowned when the engine is under steam. M. H. N.

[68712.]—**German Yeast.**—(A.) The precise reason of bread fermented with yeast being sometimes bitter to the taste I cannot fully explain: but the change which yeast brings about when added to dough is that the sugar which the flour contains is converted into alcohol, and carbonic acid-gas is set free, which, of course, makes the dough rise, the alcohol being dissipated—i.e., in the form of vapour when the fermented dough is placed in the oven. (B.) Hydrochloric acid and bicarbonate of soda may be used in the following manner. To every 6lb. of flour add 2oz. 2dr. (apothecaries') of bicarbonate of soda; this must be thoroughly mixed, for upon this depends the evenness of the porosity of the bread. Now take the HCl, just a sufficiency to balance the $NaHCO_3$, and add it to the water with which you are going to make the dough: add this quickly to the flour and $NaHCO_3$, mix thoroughly, and bake in a quick oven. The quantity of HCl which will be sufficient to counterbalance the quantity of $NaHCO_3$ mentioned is, if the acid has a specific gravity of 1·16, 2oz. 7½dr. in fluid measure. You will understand the HCl is to be added to the water, and the $NaHCO_3$ to the flour. It is advisable to mix the dough with a wooden spoon, or porcelain will do; metal should not be used. (C.) When the dough has risen to its full height—i.e., just before it begins to sink—fermentation is complete; the dough should then be immediately baked. (D.) The logwood test consists shortly of this. Two solutions are necessary, one an alcoholic tincture of logwood, the other a solution of carbonate of ammonia. A little of the flour to be tested is taken and made into a stiff paste with water, then add separately a quantity of the tinct. hæmat., well mix in; then add immediately a quantity of the $N_4H_{16}C_3O_8$ solution, when, if alum is present, the paste becomes a dark blue or lavender; if alum is not present, the paste strikes a pink colour, which eventually becomes a brown. Another test is to shake a little of the suspected flour with chloroform; if alum is present, it sinks to the bottom, the flour floats on the top; the supernatant portion may then be decanted, and the supposed alum tested chemically by other means. In applying the test to bread, merely take the crumb, and dissolve out the alum by water, and test the solution as before described. (E.) I know of no book detailing the processes, the little I have said being gleanings from bakers, farmhouses, and the laboratory. Any further information I can I shall be pleased to give. From practical experience, I know the HCl, &c. process to be a good one, making a nice-eating, sweet bread. Frederick Davis.

[68713.]—**Electric Lamp for Lantern.**—To Mr. Bottone.—Unless you connect up your dynamo *pro tem.* as a shunt machine, you will not be able to charge your accumulators with it, as it will surely reverse. The least number of cells you can use to light a 100-volt. lamp is 50. The weight per cell, without acid, 20lb.; with acid, 30lb., so the total weight would be about 1,500lb.

S. Bottone.

[68713.]—**Electric Lamp for Lantern.**—A series dynamo should never be used for secondary cell charging, as it is liable to reverse its polarity if the engine "slows up" for a moment. General result: ruin of cells and burning up of dynamo. This can be got over by using an automatic "cut-out," which breaks circuit if current reverses its direction. I should recommend you 42 or 50 (according as lamp is 80v. or 100v.) E.P.S. cells, T. 11 type, weighing 38lb. each (including acid), having a capacity of 66 ampère-hours, and costing 30s. each. This type (T.) is made specially for tram-cars and such work, and would thus suit you very well if they were not so costly. In charging, your cells must be so arranged as to suit the [illegible] and output of your dynamo.

W. Perren Maycock, A.I.E.E.

[68714.]—**Electric Light.**—Are "Amateur's" zinc plates thoroughly amalgamated, and also what are the proportions he uses in the manufacture of his solutions? F. W. MASON.

[68714.]—**Electric Light.**—There is no remedy. You can obtain a longer duration by using a two-fluid battery, that is to say, by placing the carbon in a porous cell along with a strong solution of chromic and sulphuric acid, and the zinc on the outside, with dilute sulphuric acid; but you will need double the number of cells to get the same effect, as the internal resistance is higher. S. BOTTONE.

[68724.—**Thermo-Electric Pile.**—To MR. BOTTONE.—As a matter of fact, a thermo-electric pile will light incandescent lamps. As a matter of fact, it is only possible to utilise about $\frac{1}{100}$th of the energy put into them as heat. A thermo-electric pile, on the Clamond principle (see my book "Electrical Instruments for Amateurs"), consisting of at least 120 jars, would have an E.M.F. of about 24 volts, and sufficient current to light such a lamp. But with the fuel consumed to keep this going, you could work an engine and dynamo to give a 300 c.p. S. BOTTONE.

[68726.]—**Alcohol.**—Proof spirit contains 49·24 of alcohol by weight. Practically every addition or subtraction of 0·5 per cent. of absolute alcohol to proof spirit is one degree above or below proof. Thus spirit of 17° u.p. will contain 58·5 of water, and 41·5 per cent. of alcohol (C_2H_5HO).

PRINCIPIA.

[68726.]—**Alcohol.**—In spirit 17° under-proof there is 47·36 per cent. of absolute alcohol and 52·64 per cent. of water; or 83 per cent. of proof spirit, and 17 per cent. of water. Absolute alcohol is 75·25 per cent. over-proof, and proof spirit is 100 parts by measure of alcohol, and 81·82 of water at 60° Fahr.; sp.gr. of the mixture is ·9196.

TREN.

[68728.]—**Diehl's Electro-Motor.**—To MR. BOTTONE.—I should wind it with No. 24 silk-covered, and use six or eight quart Bunsens, or chromic-acid cells. S. BOTTONE.

[68729.]—**Electric-Bell Fixing.**—Join up bells in series, using one ordinary bell and twenty-three shunt bells. You do not say if your stations are far apart or not. If there is any outdoor work involved, you must use iron in place of copper wire. The bells should be wound with comparatively fine wire—say No. 30 B.W.G. Cells required, about Leclanché 40, Gassner 35, Fuller 25.

W. PERREN MAYCOCK.

[68729.]—**Electric-Bell Fixing.**—To connect up 24 stations "R. C." had better use single-stroke bells, joined up in series with one trembling bell. I was once in a similar difficulty myself, but overcame it in the way described. As to the number of cells required, I had to use 18 No. 2 Leclanchés for 10 bells which were very large ones (9in. gongs). If "R. C.'s" bells are only ordinary size, I should think he will require at least 30 No. 2 cells connected in series. The bells and battery should be so connected that the current flowing from the positive (carbon) pole of the battery passes first through the trembling bell, which, being properly adjusted, will break and make the current, and so cause the single-stroke bells to ring as trembling bells. F. W. A.

Bradford.

[68731.]—**Engine.**—In the absence of proper diagrams, a theoretical calculation may be anywhere but the actual truth. However, the simplest way in this case, and making some allowance for losses, is to reckon on the l.p. cylinder alone, which is 2·47 times the capacity of the h.p., so that the ratio of expansion is 2·47 × 4 = 9·88 times—or, say 10. 60lb. absolute expanding 10 times gives 19·8lb. average (and deducting back pressure) say 16lb. or 17lb. actual. Take 16—then $40^2 \times \cdot7854 = 1256\cdot6$

$$\frac{1256\cdot6] \times 16 \times 14 \times 2 \times 22}{33{,}000} = 373\text{H.P.}$$

Bristol. T. C.

[68735.]—**Reversing Gear.**—Strike the curve of link from centre of crank-shaft to centre of block, when valve is in mid-position, or a radius of 9¼in., as I understand you. Let the block travel, say, four times the travel of valve (three to four times). It will be easier for you to look at a loco. somewhere than engraving a block for you. Give the valves a bare $\frac{1}{32}$in. lead. I do not understand the latter part of the query; the link must be slung from centre or end.

Bristol. T. C.

[68737.]—**Kitten and Parasites.**—If you happen to have numbers 1,226 and 1,227 by you, and will turn to pp. 83 and 101, you will find what you require. PRINCIPIA.

[68737.]—**Kitten and Parasites.**—Hard to state what, unless seen underneath a microscope or good magnifying-glass. You could use any powder that contains white precipitate (prepared by pouring solution of corrosive sublimate (or mercuric chloride) into a solution of ammonia). A solution of the corrosive sublimate in water is also very effective in getting rid of vermin.

F. W. MASON.

[68737.]—**Kitten and Parasites.**—The white nits in Persian kitten can soon be removed by a daily application of camphorated oil, the coat being parted and the oil rubbed in with a small piece of flannel. "Tabby" can obtain camphorated oil from any chemist, and at a trifling cost. The nits would probably hatch in carpets.

EDWARD M. WRIGHT.

[68737.]—**Kitten and Parasites.**—The eggs are most likely those of the flea; they will hatch, but most probably the larvæ will die from want of nourishment if in the carpets, &c. Wash the coat of the kitten with spirit; this will dissolve the gummy substance with which the eggs are attached to the hairs. The eggs will then be freed; you can brush them out and destroy them.

FREDERICK DAVIS.

[68741.]—**Tarnished Steel Mirrors.**—To "I. H. B."—I conclude the sulphur fumes arising from the combustion of coal have tarnished the polished steel. I have had no experience of these articles, but venture to suggest that "jeweller's crocus powder," with a new wash-leather rubber, might be tried on a minute portion to test its efficacy, being a mere film of obscuration. Eos.

[68744.]—**Regenerative Gas Lamps.**—Mr. D'Evlyn's experiments have not deceived him. Under all circumstances, or with any form of regenerative lamp, there is no advantage in heating the gas supply; but, on the contrary, there is a loss in doing so, as highly carburetted gas deposits a portion of carbon in passing through red-hot tubes. The gas should be kept as cool as possible, so as to issue from the burner orifices in the smallest bulk, and then be subjected to the highest practicable temperature at the point of escape, so that the particles of carbon set free in the right place may, by their increased incandescence, at once contribute to the light-giving power of the flame. So little is known about this fact by some inventors of lamps that several worthless patents have been taken out for heating gas in coils and pipes before it reaches the burner. F. H. WENHAM.

[68745.]—**Tempering Watch Drills.**—I have found that a good way of tempering drills under ⅛in. diameter is to twist a bit of thin wire round the shank, light a candle, and, holding the drill (pointing in the direction of the flame) about 1¼in. from the candle-flame, heat the drill-point to a bright red with a blowpipe. Then plunge it into a bottle of sperm oil (any oil would do, I expect, but there must be plenty of it) and shake it about in the oil for a few seconds. Try the temper with a fine file; if it does not bite at all it is all right, if it does retemper drill. I have made many drills in this way (not smaller than $\frac{1}{16}$) and they have always worked very well and have drilled cast-iron easily. I made the drills out of knitting needles.

E. J.

[68745.]—**Tempering Watch Drills.**—Do you use a blowpipe in tempering? At least you would require to do so. It all depends on heating the drill to the proper degree—neither too much nor too little—and on the suddenness with which it is quenched. When you happen to temper one rightly, try to preserve it for as much use as you can, and particularly avoid forcing it to one side, as the least lateral pressure will be apt to break it. Have a slip of Arkansas stone for cutting the drill-head to an edge, though an emery pencil used for opening the holes in watch dials, will answer the purpose in an inferior manner. Those who make their own emery files should use the blue emery, sometimes known by the name of corundum, corundum stone being in fact crystallised emery. The red or brown kind is altogether inferior. The cutting power of emery powder may be tested by putting some, mixed with oil, on the teeth of a fret-saw, sawing metal, and observing how much it increases the cutting power of the saw. SCHLOSS SCHWERIN.

[68746.]—**Transformers, &c.**—To "ENGINEER, GOVAN," AND OTHERS.—The only "special precautions" to be observed when wiring for high-tension currents, is to use only the highest class of insulation, to keep the leads well apart, and to protect each lead with a separate fuse or safety-catch, not "double-pole fittings," but quite separate, and on each pole. The reason for this is that supposing only the + lead had a fuse on it where it entered the building, and that the + lead became earthed, say at the dynamo, through frame and holding-down bolts (as has happened before now), then, the negative being by some mischance put to earth, by touching a gas or water-pipe, for instance, there is nothing to prevent the place being set on fire by overheating. There is no novelty in the making of the joints, except that they must be very well made. To make a joint in indiarubber-cored cable: With a sharp knife pare down the indiarubber core for 2 or 3in. on each side of the joint, and be very careful not to touch these surfaces with your hands or fingers, else the grease left on them will prevent you making a good joint. A good plan is to wash them with methylated spirit or naphtha. Next, over the conductor lap spirally a ribbon of pure indiarubber strip about ½in. wide (the best is cheapest); warm this layer so as to soften, and with perfectly dry, clean hands work it so as to become a solid layer (hence the reason for keeping all grease away); then lay on a coat of indiarubber varnish, allow it to dry, and proceed with the next layer of the strip, laid on in a reverse direction to the first, and proceed in the same way, until the core has reached its full size; then lap over it several layers of the protecting tape, &c., and the job is done; but before laying on the tape give the core several coats of indiarubber varnish—this makes all secure. As to attachment to insulators, I do not see what you mean. If you mean for overhead lines, the cable is usually shackled off at each derrick, as the great weight of the cable would cause a disaster if it broke, and ran back several hundred yards. To attach to shackle insulator, simply double the end of cable on itself, leaving a loop, through which pass the insulator as if you were splicing a thimble in a rope loop, only instead of splicing the free end to the body of cable, bind it alongside for several inches tightly with iron binding wire; but you should protect this part of cable, and also that which passes round the insulator, with extra insulation, either with a piece of pure rubber tube or a lapping of indiarubber. As to your questions on transformers, I cannot pretend to give a satisfactory reply, and you must apply to someone more scientific than I. When the secondary circuit of a transformer is open, the primary induces on itself a back E.M.F. = that in supply mains; on closing secondary circuit and taking off more or less current, this counter E.M.F. is more or less reduced and more current flows. To calculate size of mains and branches you are all right generally if you wire on the basis of 1,000 ampères per square inch; for long leads you may check this as you say, and if fall of potential is too large, take a larger wire. Is this what you want?

Govan. ENGINEER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Lux" has replied to 68088; W. Perren Maycock, F. W. Mason, 68300.

68136. Turbine for Lathe, p. 79.
68142. Permanent Way, 79.
68152. L. and S. W. R. Old Passenger Locos., 79.
68164. Lever Bicycle, 80.
68178. Coefficient of H, 80.
68180. Fret-saw, 80.
68182. Stamps on Pewter, 80.
68187. Model, 80.

68365. Prices of Ironwork, p. 161.
68377. L. and S.W. Bogie Engines, 162.
68381. Fire Extinguishing, 162.
68388. Best Quality Crucible Making, 162.
68396. Electro-Magnet, 162.
68402. Incandescent Lamp Stands, 162.
68406. Battery—Bunsens, 162.
68417. Detective Camera, 163.

USEFUL AND SCIENTIFIC NOTES.

THE French Ministry of Marine has just decreed that on and after January 1, 1890, wine furnished to the naval service must not contain more than 2 grammes, or 30 grains, of sulphate of potash per litre.

A COMPETITION in carving and artistic woodwork, instituted by the Worshipful Company of Carpenters, will take place on June 18, and all articles intended for competition must be delivered at the hall before June 17.

THE annual exhibition of work done in the classes of the Home Arts and Industries Association, including wood-carving, metal-work, embroidery, lace, &c., will be held at the studios, Royal Albert Hall, from the 3rd to the 8th of June.

AMONG the North American Indians the hair grows to a remarkable length. One Crow chief is said to have had hair 10ft. 7in. long. He wore it rolled up with a leather strap, which made the coiffure weigh several pounds; but on occasions of ceremony, he let it hang over him like a mantle.

OLIVES are now largely cultivated in California. There are several orchards of 15,000 trees, and more are planted every year. As it takes ten years for the trees to come to maturity, it is usual to plant grape-vines between them. The crop is gathered in December and January, and keeps very well.

QUERIES.

[68748.]—**Anemometers.**—Will some reader of the "E.M." kindly state the different anemometers in use in mines; stating the allowance for friction: and how such allowance is calculated?—Miner.

[68749.]—**Underground Surveying.**—How must I proceed to test the accuracy of the dial for underground surveying (fast and loose needle)?—Miner.

[68750.]—**Pearl Brooches.**—I want to make mother-of-pearl brooches in the shape of a shield with words perforated on them. I can cut out the shields, but cannot cut the words out. Any information how to do this—what tools to use—would be much valued by—Legitimo.

[68751.]—**Spiral Spring.**—I want to get a spiral spring that will stand a tensile strain of 15 to 20 tons dead load. Will any one kindly inform me what size rod, number of turns or revolutions, diameter and length of spring is required, or give instructions how to get at the strain a certain size spring will take without having a permanent set?—Pryce.

[68752.]—**Differential Calculus.**—In the book I read on the differential calculus, such problems as the following frequently occur:—"Make a cylindrical vessel, to hold a given quantity, so that its surface shall be the least possible." Now, C being the capacity of the cylinder, X the radius of the base, and Y the height of the cylinder, we find $x = h$. "Divide a line into two such parts that the rectangle contained by the parts shall be a maximum." Here I have the equation

$$d\,(a - x)\,x = o,$$

or

$$a\,d\,x - 2\,x\,d\,x = o$$

$$x = \tfrac{1}{2}a.$$

Will any of our readers kindly point out how I am to determine when in such cases I am to be sure that I have a maximum instead of a minimum, or vice-versa? Suppose, for example, a minimum instead of a maximum were required, how should I proceed?

$$x\,(a - x) = a \text{ max.}$$

also

$$x\,(a - x) = a \text{ min.}$$

—A Very Old Reader.

[68753.—**Silicic Acid and Alumina.**—Can any of "ours" give me particulars of the volumetric estimation of silicic acid; also of alumina in the presence of iron? I wish to determine the above in clay by a quicker process than the usual gravimetric method.—Silical.

[68754.]—**Aneroid.**—Can any fellow-reader of the "E.M." inform me what metal or what two metals the horse-shoe shaped metallic part of my aneroid barometer is composed of? It seems hollow. Is the top half of the horse-shoe one metal and the underneath part another metal; or if the two metals are mixed and then rolled thin, and the horse-shoe made out of the alloyed metals?—Henri.

[68755.]—**Slower Striking of Gong.**—Will Mr. Bottone or other electric bell-fitter tell me how to alter coil or armature, so as to make it work slower, and give a more decided blow on bell? I purpose making hammer a little heavier, as I think this will make it ring louder and more distinct than the chatter it makes at present. The coil and armature is fixed under gong.—Ignor.

[68756.]—**Gas-Engine.**—Will "Yarg" or any other readers give me a little advice respecting a gas-engine I have been making, and cannot get it to work? It is a compression type, and explodes once in two strokes, and exhausts one in two. It has no slide-valve; it has one small chamber, with a valve at top of chamber, through which gas and air enters, and a tappet valve for the exhaust. Dia. cylinders 3½in., length of stroke 8½in. The charge is fired by being forced up a tube made red hot. What I want to know is, what amount of compressive force is required to force the gas and air up the tube to fire it; and also whether the cylinders must be air-tight; because my cylinder blows a little, and does not seem to have any great force like other compression engines? I tested the compression by putting a gauge on to engine, and then pulling flywheel round very sharp; and the very best compression I got was 12lb. square inch. Did not it ought to be a great deal more than that? My valves are all air-tight, and I seem to get a good charge in cylinder; but the moment I compress it, it all seems to get away, and leaves only enough for a faint explosion. Any information or hints will greatly oblige—One in a Fix.

[68757.—**Pumping.**—My well is 24ft. deep; the water has to be raised 60ft. above the top of well, making 84ft. from surface of water to the tank at top of house. The ground slopes considerably from the house to the well, the distance being about 150ft. I want, if possible, to use one of the Otto domestic gas-engines, approx. indicated H.P.½. Can I do it? Will some correspondent oblige by saying what size suction and delivery pipes I must use, and what diameter the bore of pumps must be? Amount of water required about 250 gallons a day.—Iffery.

[68758.]—**Prime Cost.**—What is the usual method employed for ascertaining cost of any machinery used on any certain job in an engineer's shops? Are machines numbered, and the time they are used booked to the order they are engaged on? If not, is the prime cost made up, so as to include the necessary expense incurred by using any lathe or other large tool on any certain work?—Prime Cost.

[68759.]—**Oculist's Formula.**—Will some kind reader inform me as to the meaning of the following formula, which I had recently placed in my hands coming from an oculist for a pair of ordinary spectacles. Right eye + ·50 D., left eye + ·50 D. What is the meaning of + ·50 D.?—Helm.

[68760.]—**Hydrostatics.**—In an idle hour I was glancing over the column of Answers to Correspondents in the "E. M." of last week (May 17), and I found a reply concerning the pressure of liquids addressed to "Mercury," which set me thinking, the result being the following problem, which I should like to see solved by one or two of the mathematical correspondents, either with or without the calculus. A hollow cone, fitted with a bottom, is filled with water, through a hole at the apex, and then suspended by the apex to one end of the beam of a weighing machine, the other end being weighted so as to exactly balance. Now, suppose the water to become solid (without expanding, however, as ice is known to do), then if the radius of the bottom of the cone is r feet and the height h feet, the pressure on the bottom of the cone is the weight of the conical-shaped ice, that is $\frac{\pi r^2 h}{3}$, the weight of a cubic foot of water being unity; but before the water was frozen, the fluid pressure on the bottom was the area of the bottom multiplied by the height or $\pi r^2 h$—that is, three times more than when it became ice. As it is absurd to suppose that the mere thawing of the ice would alter the balance of the weighing machine, how is the extra pressure on the base to be accounted for? If we substitute the hemispherical bowl for the cone, convex side up, show by means of integral calculus, why it is that the balance will not be disturbed when the ice thaws, in spite of of the extra pressure on the base.—M.I.C.E., Bath.

[68761.]—**Camping Out.**—Would like to communicate with a fellow-reader who has pitched a tent on Exmoor or such place and get a few hints, &c.—W. H. Lovell.

[68762.]—**Ivory Comb.**—Could some one kindly inform me of a cement to mend ivory? The end tooth, a fairly thick one, of an ivory comb has broken off at the root. I have screwed a brass pin into the tooth, which projects 3-16in., and is filed rough. What I want is a cement to fix the ivory to the ivory, and also fix the brass pin into hole made for it in back?—X. Y. Z.

[68763.]—**Feed Pump.**—Would any reader kindly assist me? I have a pump to feed my steam boiler worked with an eccentric on the engine, which I cannot get to work properly. Sometimes it will work a few hours and then stop, and it keeps forcing out the packing. If it lifts more water than it can deliver, will it be liable to make the clacks stick? What should I do to stop it from lifting so much water? When it is working properly it fills the boilers in two or three hours, and then I have to stop it, and then it is very difficult to start again.—One in a Fix.

[68764.]—**Centrifugal Force as Exercised on the Moon.**—I should feel obliged to "F.R.A.S." or other reader who will inform me where I can find the latest writing on the above subject. Dr. Dick, Herschel, Proctor, Guillemin, and others I have read, say little or nothing about the results of centrifugal force, especially on the more ductile material of which our satellite may be composed.—Wm. Hosken.

[68765.]—**Spectacles.**—Would any optician kindly state how to distinguish pebble from crystal lens? Also how to tell focus when numbered ticket has come off.—Jeweller's Shopkeeper.

[68766.]—**Persian Cat.**—Does any reader know of an ointment or medicine that will make the fur of Persian cats grow? I have one that has lost a deal of fur round the neck, and thus it has lost its beauties. It is not the mange, for its back and tail are all right?—Feline.

[68767.]—**Walking Sticks.**—Will any reader kindly inform me how I can prepare walking sticks? Those which I obtained are nearly two years old, and are very dry, the wood having cracked and warped in some places. Nothing has been done to them since they were cut.—Fee.

[68768.]—**Cleaning Battery.**—Will any kind friend tell me how I can dissolve the old salammoniac in a battery so as to be able to take out the zincs, &c., to clean the battery?—R. Carter.

[68769.]—**Electric Bell.**—I have put up an electric bell, but cannot get it to work properly. There are only 36yds. of wire (indiarubber and cotton-covered), a flat door contact, a small switch, and three No. 2 Leclanché batteries. Sometimes when door is open end bell rings well, other times won't ring at all, or will go all right for a day and then play larks all the next day, or not ring at all. Will some one kindly help me in this? I fancy it may be the fault of bell. What is the best kind of bell?—Back Parlour Showman.

[68770.]—**Steam Ports.**—Would "T. C., Bristol," or others kindly answer the following? If piston travels at the rate of 100ft. per min., and I make the area of each port 1-60 the area of piston, would they be large enough? If not, what would be the correct size? Engine is 2in. bore, 4in. stroke.—Colonel.

[68771.]—**"Woolly" Lamb.**—Can any of your readers explain why mutton and lamb at this time of the year should have the very unpleasant taste known as "woolly" or "muttony"?—A. M. S.

[68772.]—**Ventilation.**—Will some of your scientific contributors state how to measure or otherwise find the movement of the air at low velocities? Could the draught in a room be ascertained by the angle assumed by the flame of a candle, say, at every 5° from 95° to 180°—e.g., in an open window is placed a lighted candle, the flame makes an angle of 95° or 100° with the horizon, what is the velocity at which the air is coming into the room?—Ventilator.

[68773.]—**Purification of Zinc.**—Can anyone tell me a way of purifying commercial zinc by putting something into it when in a melted state in the crucible, or some other cheap method?—O'M.

[68774.]—**Battery.**—Can any reader give me the description of an electric battery for making an intense heat by connecting its poles with platinum wire or carbon rods? The price of a small one, how often it wants recharging, and what kind of fluid it is recharged with.—Son of Vulcan.

[68775.]—**Piebald Snails.**—Whilst staying at Pen-y-gwyrd, in N. Wales, a short time ago, I noticed, amongst great numbers of black snails (the shell-less kind), one which differed from the uniform colour in having the entire of the foot a creamy white, and only the dorsal region the usual black. I have seen snails entirely white (although I did not notice any at Pen-y-gwyrd), and I presume this "piebald" variety is the result of the union of two snails, one of each colour. I should be glad to know if this black and white variety is commonly found.—R.

[68776.]—**Bromide Paper.**—Can any reader tell me the cause of the following:—Wishing to make some bromide paper for photographic enlarging, I coated some paper with solution of potassium bromide, dried it, and floated it on solution of silver nitrate in dark room. Instead of acting like bromide paper, this immediately blackened with ferrous oxalate developer without being exposed to white light at all. Cannot a workable bromide paper be made this way?—Andrew.

[68777.]—**Frigoline or Frigiline.**—This is an article sold in this town (Cardiff) as a preserver of all meats, fish, fowl, made-up stuffs, such as sausages, saveloys, brawn, &c.; and is used extensively by makers and sellers of such goods. Now, what is this "frigoline"? Will it do what it is stated it will? Is it in any way hurtful to the partaker of food treated with it? Chemists' please give opinions as to its merits, good, bad, or indifferent?—Gwent.

[68778.]—**Vulcanite Cells, Repair of**—Would Mr. Bottone or any one interested in such matters tell me how to close up fine cracks which take place in the bottom of old vulcanite cells, and render them watertight again? I was told it was impossible, and must get a new set, which I did, and having put one of the cells to dry on the top of the plunge box it tipped over and cracked the cell at the corner three parts down to the bottom. Can this be remedied?—J. D. H.

[68779.]—**Facile Bicycle.**—Can any of "Ours" give me a rule for finding the sized Facile that I should ride?—Principia.

[68780.]—**Easter in 1827.**—Will some kind reader who has the time to spare, and knows how to do it, tell me in what month, and what day of the month, Easter Sunday fell in 1827?—Easter.

[68781.]—**Cupola.**—I have built a small cupola, 3ft. high, 1ft. diam. (internal measurement), blast entering cupola by 2in. pipe, 1ft. from the tapping hole in the bottom, which has a layer of sand. Upon feeding with coke and iron in the usual manner, the iron is rapidly melted; but upon attempting to tap what should be melted iron, I find it set into a dull red mass, removed only when cold by destroying the firebrick lining. I have varied the depth of sand, but always with same result. A 14in. fan is used, 1H.P. engine driving it at 3,010. Is the whole concern wrong or too small? If so, would some reader give the dimensions and construction of furnace, which could be worked with 1½H.P.? I want to cast no larger than 56lb. each casting.—Failure.

[68782.]—**Battery for Motor.**—Will Mr. Bottone or other electrician inform me the cheapest kind of battery to drive a large motor? I have thought of using the double-carbon single-fluid type of chromic-acid battery; but I read a few weeks ago that these would only run three hours, or thereabouts. What I want to find out is, the best battery to run for about eight to ten hours. Is the double fluid chromic-acid battery a good one for this purpose, or is the Fuller better?—G. A. B.

[68783.]—**Harmonium.**—I am making a pan for an harmonium of one set of reeds, 8ft. pitch, or from 16ft. *f* to upper *f*, five octaves, broad reeds. I shall experiment until I obtain in tone-colouring all that is possible from the said reeds. And, as Mr. G. Fryer has expressed his willingness to give me a scale for the channels of an harmonium pan—a good scale, will he do so?—James Day

[68784.]—**Spirit Compasses.**—Can any reader oblige me with information as to what kind of paint is employed by opticians for painting the cards of compasses that float in spirits of wine? Some compass cards remain white for years, whilst others peel, or get powdery in a short time.—Ignoramus.

[68785.]—**The Nail-less Horseshoe.**—Will any of your contributors kindly give particulars of this horseshoe, which was recently discussed at the Society of Arts?—Ireland.

[68786.]—**Schohlein's Transposing Pianos.**—Should be glad if any of your musical contributors would kindly explain the principles and construction of above? It is a German make.—Music.

[68787.]—**Horizontal Engine.**—Would "T. C., Bristol," kindly give me a sketch of a horizontal model engine, showing scale of all parts, including rods, slide bars, crosshead, crank and shaft, weight and size of flywheel, bearings, &c.?—only two slide-bars is intended? The cylinder is 1in. bore, and 2in. stroke. It is only required to drive a flywheel.—Young Mechanic.

[68788.]—**Water Beds.**—I have undertaken to store two water beds when not in use. How can I keep them in good condition?—W. H. S.

[68789.]—**Raising Water.**—Is there any way of constructing a siphon, or any other apparatus besides a pump or ram that would raise water from a river to a height of 6ft. at a distance of 18ft. away?—A. J. S.

[68790.]—**Cycling.**—Could any of your readers tell me what the driving bands of an Otto Safety bicycle are made of? I have been told that the bands are only iron; but they must be made of good stuff to bear the strain they are subject to.—M. W. Burrows.

[68791.]—**Street Galvanic Battery.**—Kindly give information for constructing a galvanic battery, with indicator, to be worked from three or four Bunsen cells, with apparatus for controlling strength of current, intended for public use.—Amateur Electrician.

[68792].—**Compounding.**—Will "T. C., Bristol," or "Glatton" please tell me how far from the end of the stroke should the exhaust open and close in the h. and l.p. cylinders, which are 6ft. stroke? Also if the h.p. cuts off at ½-stroke, where should the l.p. cut off at?—Engineman.

[68793.]—**Dynamo for Tricycle.**—To Mr. Bottone.—Would one of your 5c.p. dynamos be sufficiently powerful to drive a tricycle at the speed of eight miles an hour? If so, how many of the pocket accumulators, described in your book "Electrical Instrument Making," will be required to drive it for four hours, and how long would it take to charge the accumulators with the same dynamo, if driven at the speed of 3,000 revs. per min.?—L. Andrews.

[68794.]—**Gramme.**—To S. Bottone.—I want to make a 5c.p. Gramme dynamo, A type. Would you kindly give me size of castings for same, diam. and width of armature, number of cogs, diam. and length of iron cores? What thickness should I make the standards to which pole-pieces are bolted? Will you tell me size and weight of wires for pole-pieces and armature, shunt? What voltage lamp should I use and number of revolutions per minute? Is this the best type of dynamo for so small a machine? Would it work as a motor? Could I magnetise the field-magnets with two No. 3 Leclanché cells? What would be the difference in size and weight of wires, if wound for direct lighting? Should I get more power? —A Beginner.

[68795.]—**Gravity Problem.**—At what rate would a body of certain specific gravity have to travel along a level track, so that its tendency to travel in a straight line balances the effective force of gravity, and, therefore, when the pressure on track is nil?—A. W. Lambert.

[68796.]—**Mensuration Problem.**—What is the mathematical solution of the following, without use of scale? A rectangular field, 100ft. by 60ft., a road 10in. wide crosses from corner to corner in such a way that the diagonals of rectangle and road are coincident. Areas of road and remaining portions required?—A. W. Lambert.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 29, and unacknowledged elsewhere:—

Perken, Son, and Rayment—Al Fard—G. E. H.—T. R. —C. May—The Lydney Dispenser—G. M. S.—Major—Bellhanger—R. X.—Old Hand—Edward Hines—G. H. Evans—Nitrate—R. N.—A. M.—A Young Turner—Harpist—Diarmid—F. W. Mason—Young Mechanic—C. E. Stretton.

W. James. (No charge is made for inserting in the body of the paper a description of an invention or a patent. Send on the specification of your patent coupling pole, but send a plain pen-and-ink sketch, not the "coloured drawing." If we think it likely to interest our readers we will insert a description and sketch.)—Vox Mavi. (We do not know the name of the Leeds firm who are putting down plant "for the manufacture of steel boats in one piece." As such boats must be something of curiosities, perhaps you will give the information a more definite form. Where does it come from? 2. We cannot take the responsibility of answering questions relating to the law of limited liability companies. When the shares are allotted and accepted it is difficult to get rid of them, or people would simply hand over bad bargains to men of straw; but if you decline the allotment at the time and forfeit the deposit, we presume you would be free; but really you should consult a solicitor, and put the documents before him. 3. You may send anything on post-cards. For mere queries or replies they are preferable.)—C. S. Percival. (The method of making rubber stamps has been described many times. The prepared indiarubber is, as a rule, bought from the mill, where it has been masticated and mixed with sulphur. The type, &c., is set up in the form required, and a plaster cast taken of it, which, when dry, is dusted with French chalk. Into that mould a piece of the prepared rubber is forced by gently screwing up between iron plates, which at the time are being heated—the heat being necessary to cure the rubber. The best work is done in a vulcaniser—a vessel in which steam can be obtained at considerable pressure; then the mould and the rubber are placed in a flask, and the pressure and heat of the steam effect all that is necessary. Rubber stamps are now sold so cheaply, that it is not worth while to attempt to make them, except as a matter of business.)—Penalty. (The directions for making the soap are supplied by the manufacturers of the caustic alkali, as described some years ago. As they supply their patent alkali and invite people to make soap, it is scarcely likely they would consider it an infringement of their patent to buy their goods. What is it you mean?)—De Stacey. (We will answer definitely. To prepare the floor: plane it, using an old plane; failing that, go over it with glasspaper until it is smooth. Then float on the stain, according to the colour desired, and allow it to dry. Permanganate of potash (Condy's fluid) makes a pleasing stain in deal, pine, and other white woods. Then, when dry, size, using it rather thin and floating it over all parts with a broad brush. Give two coats, allowing the first to dry. If it froths use it hotter, and brush the bubbles out. Oak varnish is good enough; but if the best is wanted use copal. You must not expect to succeed the first time of trying; but there is nothing very remarkable about the skill required.)—Clock. (No necessity to ask our correspondent to find up the references. Luminous paint was fully explained in No. 774. There is some further information in No. 776, and the specification of the patent is available to all; but all necessary details were given in No. 774. Balmain's later patent was granted in 1877, but see p. 256 Vol. XXIX., and the volumes since then for further information.)—Will o' the Wisp. (In Edinburgh you can see the volumes of the English Mechanic and the patent specifications. Holmes's self-flaming signals for use at sea are much older than the date you specify. 2. Such a gun would, we should think, withstand the recoil. 3. Good red rubber would do; but why not use corks?)—Ledom. (See numerous replies in back volumes. There are no rules for model boilers.)—Statim. (See Vol. XXXV. for several illustrations of hot air and vapour baths.)—A Reader. (For dulcimers see pp. 97, 168, Vol. XXXVI.)—Geo. Topping. (How could we misunderstand when you did not state which process you wanted? However, all have been frequently described in back volumes; but if you want to work the process by battery, better procure Watt's "Electro-Metallurgy," Crosby Lockwood and Son. The solution will vary with the metal on which the copper is to be deposited; but a good recipe is 8oz. of sulphate of copper dissolved in one quart of hot water; when cold add strong liquor of ammonia until the precipitate first formed is redissolved; then add a strong solution of cyanide of potassium until the blue colour disappears, and then a little more, so as to leave the cyanide in excess. Work at a temperature of 130° Fahr., there or thereabouts.)—A. B. B. (It is a case for medical examination of the individual. You should be "careful about food and drink," and get all the fresh air you can, taking pains to inflate the lungs fully.)—An Old Keepsake. (We answered you on p. 250. You must have the china riveted.)—H. B. (Why not apply to the author direct—W. T. Wilkinson, North Parade, Otley, Yorkshire?)—Perseverance. (Certainly; they make excellent manure, but they require grinding to a fine powder.)—H. S. Arnold. (We do not know how to make an aquarium out of a biscuit tin, and think it a most unsuitable vessel for such a purpose.)—Catford. (Not that we know of; but why not try? There are a good many metals, you know.)—E. M. N. P. (We cannot spare space for sketches of individual locomotives. They are of very little interest to the mass of readers, and take up space.) —W. G. (The hairy ball you mention had nothing to do with "chewing the cud," which is merely an expression for the digestive function performed by all ruminating animals. We have seen the ball spoken of, which was simply an accumulation of hairs and other matter in a hard lump in the animal's stomach).—M. A. (We know nothing of them. Write once more, and threaten them that you will communicate with the police if they do not send your goods, and if they do not respond, ask the superintendent of the police of the district if they are known to the police or not. If they are sharpers, it is of no use wasting money; if they are respectable tradesmen, serve them with a county-court summons for the return of the £5 deposit).—Olim Socius (Much too general and diffuse for our columns).

Men who feel Weak and Nervous should wear HARNESS' ELECTROPATHIC BELT. It generates a mild, invigorating, galvanic current, which effectually restores impaired vitality, strengthens the nerves and muscles, and speedily promotes the health of the entire frame. For particulars, book of testimonials, or advice, apply at once to the MEDICAL BATTERY COMPANY, Limited, 52, OXFORD-STREET, LONDON, W. (the largest Curative Electrical Institute in the world.) Pamphlet and advice free.

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Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

Vols. XXVI., XXX., XXXII., XXXIV., XXXVI., XXXIX., XL. XLII., XLIII., XLIV., XLV., XLVI., XLVII., and XLVIII., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

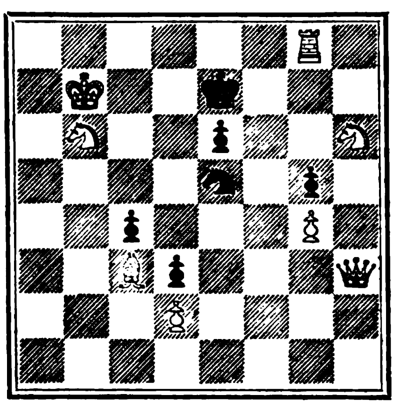
Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLII.—By B. G. Laws.

Black.



White. [8 + 6

White to play and mate in three moves.

Solution to 1,149.

White.	*Black.*
1. Kt takes Q P.	1. K takes Kt (*a*).
2. Q takes P.	2. K-B 4.
3. Q-Q 4 mate.	
	(*a*) 1. K-Q 2 (*b*).
2. Q-B 7 (ch), &c.	
	(*b*) 1. K-K 3.
2. Q-B, 5 &c.	

Also 1. Kt (K 7)-B 8 (ch) and 1. Kt takes P (ch).

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,149 by J. E. Price, T. Wright, J. Bryden [(3), also if 1. KQ 2 a triple], Janus (ditto), W. Gleave (ditto and quadruple), Mendelssohn, E. Retchford, (3), A. Dean (3), Fr. Fernando, Muzio (2), W. L. Martin (3) and quadruple; to 1,148 by E. Retchford, H. G. Walsh, Othello, Bernard Green, and J. E. T. Smith.

Muzio.—Neither.

F. C. Cook.—The variation in question was not sent with the problem—it is unimportant.

W. L. Martin.—In 1,147, if 1. P-K 3. 2. Q-B 3 or K-Kt 3 is the dual.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

Holloway's Pills.—The Chief Wonder of Modern Times.—This incomparable medicine increases the appetite, strengthens the stomach, cleanses the liver, corrects biliousness, prevents flatulency, purifies the system, invigorates the nerves, and reinstates sound health. They are a blessing to the afflicted, and a boon to all that labour under internal or external disease.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Small upright copper **Steam Boiler**, with Gas Furnaces, completely fitted. Offers.—Singleton, Lune-street, Preston, Lancs.

Otto Bicycle, 54in., in good condition; must get it off hands. Offers.—Box 5, Post Office, Stirling.

"**Nicholson's Carpenter's and Joiner's** Guide," cost 30s. What offers?—Carter, Ullesthorpe, Leicestershire.

Excellent **Book** on the Orders of architecture, numerous steel engravings. What offers?—Carter, Ullesthorpe.

54in. **Bicycle**, excellent condition, Brook's saddle, and all accessories, plain and cone bearings, a well-made and easy-running machine, worth £3. Exchange for books or tools to value.—Brown, 30, Temple-street, Southwark.

Induction Coil, with regulator, &c., 12s.; Gentleman's Electric Belt, 10s. Exchange for Field Glass, Rook Rifle, or offers.—George Peers, Little Hulton, Bolton, Lancs.

Vol. I. "**Knowledge**," bound, cloth, leather back (six first numbers missing), and numbers 79 to 87. Offers.—West, 4, Estelle-road, Mansfield-road, N.W.

Two **Electric Motors**, suitable for clocks, cost 21s. each. Exchange one for Model Locomotive, or offers.—1, Chesterfield-terrace, Silvester-road, East Dulwich.

Wanted, a small Iron **Printing Press** for printing cards, &c. Exchange good-toned Dulcimer and accessories.—G. Eyers, 7, Harriet-street, Fulham, London.

Dynamo, 100c.p., value £8. Will exchange same for Lathe, with slide-rest.—Dynamo, 13, Newcastle-street, Strand.

Lathe, 8in. back-gear, gap bed, chucks and tools, nearly new, Britannia Co.'s make. Exchange for good Silver Lever. Letters only.—E. A., 9, Myddleton-street, Clerkenwell.

Three-quarter size **Violin**, splendid tone, with bow. Will exchange for Electric Wire to value ..s., or offers, electrical.—John Collinge, 37, John-street, Middleton, near Manchester.

To Amateurs.—Useful **Parts of Organ.**—280 Pipes, wood and metal, wind-chest, keyboard, framework and bellows. Useful exchange. Room wanted.—H., 95, Lower Park-road, Peckham.

Dallmeyer's No. 1 Half-plate **Triplet Lens,** new, £2 10s. Also thorough good ½-plate Portrait Lens, £1 10s., both stops. Offers.—H. Cooke, 3, Weekday Cross, Nottingham.

A Centennial Zither, 16 strings, wire, American make, grand tone, good as new, cost 12s. 6d. Exchange offers.—Jones, Hairdresser, King-street West, Plymouth.

British Molluscs.—Wanted animals of Paludina, Ancylus, Velletia, Assiminia, Helicella. Will exchange living Testacella, Shells, or Mounted Tongues.—May, 14, Mincing-lane, London.

Exchange **Organ Accordian,** 3 octaves, 1 stop, beautiful tone, cost £4; for Stocks, Dies (Whitworth thread) and Gas Tongs.—Barnett, 84, Bridge-street, Macclesfield.

Model Loco. Boiler, 5 tubes. Set Model Vertical Engine Castings. Cash or anything useful.—Swain, 18, Torriano-avenue.

Induction Coil, ½ spark; also Quantity Galvanometer. Exchange Vacuum Tubes or Quantity and Intensity Galvanometer.—Ernest, 1, Ferncliff-road, Dalston.

Exchange Henley's **Needle Telegraph Instrument,** Medical Coil (10 powers), 30 1s. "Industries of the World," Batteries for 10-volt lamp. No reasonable exchange offer refused.—Harcourt, "Butchers' Arms," Abingdon, Berks.

Model Engine and Boiler, Volume "Boy's Own Paper," 470 Foreign Stamps. Offers accepted.—A. Hyde, 20, High-street, Yeovil.

"**Scientific and Mechanical Industries** Explained," by Watt, both perfect, published at 2s. 6d. each; and "Ventriloquism," by Maccabe. Offers to value of 3s. 6d.—4, Collison-street, Nottingham.

Exchange good ½-plate **Camera Set,** cost £7, for Tricycle, Safety, or Kneehole Table and part cash. Also Lantern for exchange.—Goaman, Bridgeland, Bideford.

Soda-Water Plant, complete, one of Hayward Tyler's, London. Exchange wanted. Gas Engine.—Wicks, 17, Pitlake Bridge, Croydon.

Locomotive, high-class model, 16in. long, fitted with quadrant link motion, brazed tubular boiler, tested to 45lb., spring buffers, pump, &c. Exchange for Safety Bicycle, Drilling Machine, or Gas Engine to the value of £8. No rubbish.—102, Teviot-street, Bromley, E.

Back-geared **Lathe,** centres 5½in., bed 5ft., slide-rest, tools, &c., weight 5cwt. Will exchange for Rover Safety Bicycle to the value of £10.—A. J. Powell, Dudley-road, Tipton, Staffs.

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Lancewood Trout Rod, 2 tops; about 26 doz. salmon and trout flies, and reel. Exchange for good treadle Fret Saw, or offers.—Shannon, Thornby, Rugby.

Are you Fitting up Circular Saw? If so, you will want driving-wheel. I have one 29in. diameter, 100lb. weight, shaft and crank complete. Offers.—Above.

Wanted Safety Bicycle. Exchange two **Induction Coils,** sparks 2¼in. and 1in.—C., Mrs. Palmer, 25, Albion-street, Brierley-hill.

A.B.C. Copying Apparatus, complete, 5s. size, new, exchange. Best offers to—F. J. Mills, 14, Bostock-street, London, E.

Wanted, 10 by 8 Bellows **Camera,** with swing and reversing back preferred, 100 dark slides. Exchange offers.—Edmund, 89, Lenox-street, Lozells, Birmingham.

One-horse **Boiler,** with fire-door and bars, steam and water gauge, valve, &c., 150lb. pressure. Offers.—Hardwick, Siddals-road, Derby.

Wanted, Lancaster's quarter-plate **Camera and Lens** only, in exchange for two 3in. Electric Bells and three Leclanché Batteries, both new; also four sets of Maundy money, comprising silver penny, two-penny, three-penny, four-penny, 1887 date.—Write first to—C. Rogers, City News Rooms, Ludgate-circus, London.

Will give a high-class large-size 18-carat **gold English Lever Watch,** with gold dial, full jewelled, the best watch money can buy, cost £16, warranted, in exchange for Model Beam Engine, 2½in. bore cylinder with governors, or a Semi-fixed Model and Boiler complete, same size as above.—Apply, 279, St. Philip's-road, Sheffield. Postcards not answered.

Bright copper riveted loco. type **Boiler,** ¾in. thick, with chimney and safety valve, water gauge, cocks, will work at 100lb. pressure; also Model Beam Engine, 2½in. bore cylinder, complete, all bright. Exchange to value of £10.—279, St. Philip's-road, Sheffield.

Bessemer Steel, round, 3-16in. to 1in., short bars. What exchange offers for 10cwt.?—Gilbert, Steel Merchant, Oxford-road, Sheffield.

Water-Motor, drives any light machinery, Sewing machine, small lathe, &c. What offers in exchange?—Walton, 9, Queen Anne-street, Shelton, Stoke-on-Trent.

I have a lot of **Books on Engineering,** Mechanics, Carpentry, and Architecture.—N. Massey, Clifton, Cork.

Inverted Engine Castings and Patterns, partly finished, cost 50s., Revolver and Holster, cost 63s., 58 Periodicals, cost 10s. Offers wanted.—Gale, Seend, Melksham.

Cabinet **Lens wanted,** rapid, F. 3 or F. 4, focus about 8. Exchange R.R. Lens. Cash to difference either side.—Walker, Watchmaker, Minster, Thanet.

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½-ton of the new depolariser, **Electronite,** 5 miles of cable, quantity of Bell and Telephone Wire. Offers wanted.—Huddleston, High-street, Woolwich.

Genuine £20 **Rover Safety,** Humber Tricycle, "Popular Educator," complete; Billiard Balls, Miscellaneous Literature. Wanted, Wanzer Cooker, Gentleman's Clothing, light Safety.—80, Netherwood-road, Kensington.

Important.—All kinds of **Scientific Properties,** Apparatus, Instruments received for others or cash by A. Caplatzi, Chenies-street, Tottenham Court-road.

Wood-turner's **Lathe-Head and Poppet,** 5½in. centre, T-rest. Exchange 1b silk-covered wire, or large binding-screws.—R. Newell, Cheapside, Todmorden.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

New Illustrated Price List of **Screws, Bolts and Nuts** for Model Work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

Billiards or Bagatelle, or Requisites for ditto, or Billiard Work.—Hennig Bros., High-street, London W.C.

Manchester Electrical Stores.—Medical Coils, Magnetos, Bells, Cells, Wires, Fittings, Chemicals. Best terms.—J. Bentley, 7, Newton-street.

Turning Woods.—Box, Ebony, Lignumvitæ, Redwood, &c. Parcels, 5s. and 10s., cut squares.—Harger Bros., Settle.

Lathes. Lathes Cheap, good. List 2 stamps.—Robinson, Catherine-street, Sheffield.

Electric Depot, 14, Deansgate, Manchester.—Handiest shop in the trade. Largest stock. Greatest variety. Lowest price.

Brass **Door Plate,** 9in. by 4½in., free, 4s. 6d. See specimens.—Gilkes' Engraving Works, Reading.

Stencils for sack, box, and ticket marking. Price and quality unsurpassed.—Gilkes' Engraving Works, Reading.

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Taps (Engineers'), Whitworth, plug or taper, ¼, 5-16, ⅜, 8d.; 7-16, 10d.; ½, 1s.; ⅝, 1s. 3d.; ¾, 1s. 6d.; ⅞, 2s. 3d.; 1in., 3s. each, postage extra.—Lunt, Tool Merchant, 297, Hackney-road, London.

Hat Bearer. A great luxury. Fits all hats, 6 stamps.—T. Rawson, Heaton-lane, Stockport.

Microscopic Mounting Materials.—All kinds of requisites supplied at Norman's, 178, City-road, on the lowest terms.

Wheel-cutting and Dividing to 12 inches diameter, in brass only.—Clegg, Belinda-street, Hunslet, Leeds.

Write for **King, Mendham and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

100 Packets of genuine, freshly-saved, hardy **Flower Seeds** for 1s., post free, 1s. 2d.; all named and every packet different. Probably the most extraordinary shillingsworth ever offered in any advertisement. If not considered worth four times the amount they can be returned, and the sum paid will be at once refunded in full, or the parcel can be sent without prepayment if satisfactory references are given. Fresh genuine vegetable seeds also for disposal. Respectable men wanted, to add to their income by selling above on commission.—T. Richards, 5, Cranham-terrace, Oxford.

Smokers, don't buy pipes before seeing the "**Medical Patent,**" illustrated particulars, post free.—Address, Patentee, 52 Cotham Hill, Bristol.

Microscopy.—Instructive list of really high-class botanical preparations, with sample, 2d.—Walter White, Litcham, Swaffham.

Boats, 14 by 4½ft., Hardwood Frames, carvel or clinker, £6; cash with order.—Harrison, Devoran, Cornwall.

Fluid Malt is the best aid to digestion known.

Fluid Malt is invaluable in all cases of debility, exhaustion, consumption, convalescence, and weakness.

Fluid Malt is a powerful fattening agent, containing all the best principles of the choicest English Barley Malt.

Fluid Malt is the best and cheapest preparation of malt sold. Post free for 1s. 9d. and 3s. 6d. of Reffell Bros., Bexley, Kent.

Duplicate **Micro-Slides,** 3s. 6d. per dozen. Conditional approval. List (returnable) for stamp.—Microscopist, Mottram, Manchester.

Cheap **Rubber Stamps.**—Name, 1s. 3d.; address, 1s. 9d. Warranted best make. Lists free. Agents wanted. White and Co., New Wimbledon.

Boilers, all kinds and sizes.—Vertical, Portable, Cornish.—The Grantham Crank and Iron Company, Limited, Grantham.

Capital 4H.P. second-hand **Engine,** nearly equal to new, low price taken.—Crank Co., Grantham.

Vertical Engines, newest designs, with or without boilers.—The Grantham Crank and Iron Company, Limited, Grantham.

Fretwork.—Tools, Materials. New catalogue, containing 400 illustrations, free, 4 stamps.—J. Howard and Co., East Dereham.

Cyclists.—Use "Graphine" on your chains; no grease, will not hold dust, 8 stamps, free.—Wolff and Son, Falcon Pencil Works, Battersea, S.W.

Recipe for **Raspberry Sherbert,** refreshing beverage, very fruity flavour, 7 stamps.—Robinson, Chemist, 93, Trafalgar-street, Brighton.

Model Engines.—Lucas and Davies' Enlarged and Illustrated Catalogue, castings, finished parts, &c., post free, 4d.

The **Above** contains all information, and is illustrated from photographs of the finished engines.

Two **New Features** introduced.—Triple-expansion Engines and Bent Steel Crankshafts are entirely original novelties.

Photos. of these Triple Expansion Engines can be had, price 6d., post free 7 stamps.

The **Designs** are all new, and are not copies of the stereotyped models of other firms.

We Court Comparison for novelty of design, finish of engines, and quality of castings.

Models of every description repaired and put in working order.

Lucas and Davies, Mechanical and Scientific Model Makers, 21, Charles-street, Hatton-garden, London, E.C.

Fossils, duplicates, Greens and others, named and localised. List on application.—C. Franklands, West End-lane, N.W.

Astronomical Telescope.—Apparatus and parts made to order.—A. Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

Astronomical Eyepieces, any power, fitted to any telescope, 15s. each.—Clarkson.

Transit Instrument, by Ross, on iron stand, perfect adjustment, new condition; also others.—Clarkson.

Equatorial, by Cooke, of York, slow motions, will carry up to 4½in. telescope, £15.—Clarkson.

Universal Equatorial, with circles on tripod stand, will suit any telescope to 4in., £5.—Clarkson.

4in. **Telescope,** Cooke and Sons, York, new condition, on tripod stand, diagonal and five eyepieces.—Clarkson.

Astronomical Telescopes, some in stock, good condition, by leading makers.—Clarkson.

Astronomical silver-on-glass **Telescopes,** Mountings made for these; also flats, finders, rack, eyepieces, mounts.—Clarkson.

Astronomical Telescopes (good) sold for private owners if reasonable prices.—Clarkson, 28, Bartlett's-buildings, Holborn Circus.

"**The Amateur.**" A paper for Fretworkers, Carvers, Inlayers, Painters. Sixpence monthly. Lists of latest designs free on application.—Henry Zilles and Co., 24 and 26, Wilson-street, Finsbury, London, E.C.

24 sets of **Carving Tools,** separately or together, the whole for £10, cost £20.—Apply to Cobling Hunter, Esq., Bascombe, Bournemouth.

Smoke British Herb Tobacco.—Splendid flavour, delightful perfume. Neither injurious, like ordinary tobacco, nor expensive.—Below.

Smoke British Herb Tobacco.—Quarter pound (nearly), 7d.; half-pound, 1s., post free.—Knight, Druggist, Portsmouth.

85 New Trade Recipes for 6 stamps. A fortune worth £50 if used.—Jackson, Linenhall-street, Ballymena.

Lathe Heads, 3in. back-geared, bored, planed, 12s. 6d.; 3½in., 15s. Particulars, stamp.—Jarratt, Queen-street, eicester.

Ideas Worked Out.—Models, &c., designed, terms moderate. Address—A. Kerr, 232, Vauxhall Bridge-road.

Mica or Talc cut for all purposes by—C. Johnson, 87, New Oxford-street, W.C.

Recipe for Summer Beverage, invigorating tonic. Recommended by Mr. Booth. 13 stamps.—Robinson, Chemist, 93, Trafalgar-street, Brighton.

Negatives Retouching, Plates Developed, and Printing for amateurs. Prices moderate.—Saunders, The Stairs, Durham-road, Spennymoor.

Armature, punching, cog, rings, 3¾, 5, and 6in., pure charcoal iron.—165, George-street West, Birmingham.

Machinery for sale.—Engines, Boilers, Wheels. List on application.—Apply, Superintendent, Millard Engineering Laboratory, Oxford.

Indiarubber Stamps and five other assorted profitable Trade Secrets, 1s. 1d., post free.—Taylor, Woodbine-street, Dewsbury.

Launch Engines, 6in. 4½ and 3in. bore. Boilers, Lathes, all kinds of Machinery at reduced prices.—S. Smith.

Propellers, improved pattern, 12in. to 30in., in stock. Stuffing Boxes and Shafts.—S. Smith, 11, West-street, Soho, W.C.

Diamond Drills, from 1s. Spring Drill Stock and postage, 1s. 3d.; Upright, do., 4s. 1½d.—Below.

Diamond Points for all kinds of engraving, writing, and ruling, from 2s. 6d.—Below.

Diamond Turning Tools, for truing Emery wheels and turning hard steel, from 5s.—Below.

Glaziers' **Diamonds,** from 6s. 6d.; Circular and Tube Cutting Diamonds, Diamonds for Lapidaries.—Below.

Diamond Sparks, for China riveters, from 6d.—Woods and Toussaint, 54, Spencer-street, Clerkenwell, London.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 7, 1889.

SPEED REGULATORS FOR PRIME MOVERS.

As soon as prime movers began to be generally adopted for driving machinery under conditions of variable load, the necessity of providing some automatic means of controlling their velocity became apparent. In steam-engines this was especially evident; in water-wheels the extreme velocity, when the load is removed, is limited by that of the water supply, and therefore would not become excessive; but with steam as the motive force the case is widely different, and upon the sudden removal of the load an engine would attain a destructive velocity before the attendant could check it, were no self-acting provision made for such an emergency.

The irregularities to be met by such apparatus as that to which we refer are external to the engine, inasmuch as they are intended to deal with variations of load in comparison with the mean effort of the engine, the cyclical variations due to expansion being met by the inertia of the fly-wheel, or in some cases by other equalising appliances which during one part of the stroke store up excess work to be given off at a subsequent period during the cycle of action, which may extend over one or two revolutions, according to the kind of prime mover used. In a steam-engine the cycle will be completed in one revolution, but in some (petroleum for instance) motors only one stroke in four is effective, in which case the cycle will extend over two revolutions.

The regulation of the speed of an engine must be effected through the supply of steam to it; hence, if the load is diminished, the steam-valve must be proportionately closed, and opened if the load is increased. To effect these movements automatically the tendency of the engine to quicken or slow down on a variation of load is taken advantage of; but for perfect working the actual variation of velocity should only be momentary, and the machinery, although running under an altered load, should resume, without delay, its normal speed, and in the endeavour to attain such a result much study and experiment have been devoted.

The fundamental and earliest form is the conical pendulum, known as Watt's governor. The principle of its action is very simple, but, as will be seen, the desired result is only approximated, and the speed of the engine regulated by it is therefore not kept absolute ough it prevents the poss rous increase therein. Fi his simple form of gove s carried at the lower e

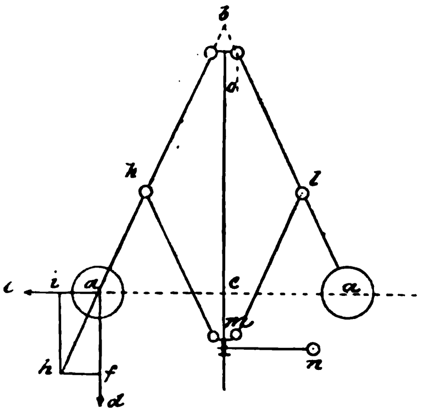


FIG. 1.

jointed at *b* to a vertical spindle *b c*, about and with which they revolve. *k m* and *l m* are links jointed to these arms and to a sleeve *m* on the spindle, which, rising and falling with the greater or less divergence of the balls *a a*, actuates a lever *m n* fixed on the spindle *n* of the steam valve. If the balls are revolving at a uniform velocity their divergence will be determined by the two forces, gravity and centrifugal force, the former acting vertically in the direction *a d* and the latter horizontally in the direction *a e*. Let *a f* = the intensity of the gravitative and *a i* = that of the centrifugal force, and complete the parallelogram *a i h d*. Then there will be three forces in equilibrium acting at the point *a*, these three being the vertical gravitative force *a f*, the horizontal centrifugal force *a i*, and the tensile resistance of the arm *a b*, which latter will equal the resultant *a h* of the two other forces and act in the same straight line with it. *h f* = *a i*, being opposite sides of a parallelogram. By similar triangles $b c : a c :: a f : h f$ . . (1)

Let W = the weight of the ball at *a*, v = its velocity in feet per second, $g = 32·19$ (the measure of gravity), C = the centrifugal force of the ball, and H = the height of the point of suspension above the plane of revolution of the ball in inches.

a c is the radius of the circle in which the ball *a* revolves; therefore its centrifugal force $C = \frac{W \cdot v^2}{g \cdot (a c)} = a i = h f$; and $W = a f$; hence in the proportion (1) becomes $b c : a c :: W : \frac{W \cdot v^2}{g \cdot (a c)}$; whence $b c = \frac{g \cdot (a c)^2}{v^2}$. If N = the number of revolutions of the ball per minute, $v = \frac{2 \times 3·1416 \times N \cdot (a c)}{60}$, and $v^2 = 0·010966 \cdot N^2 \cdot (a c)^2$. Replacing v^2 by its value in the previous expression, $b c = \frac{g \cdot (a c)^2}{v^2} = \frac{2935·55}{N^2}$ and $H = 12 \cdot b c = \frac{35226}{N^2}$.

From this it is evident that in altering the supply of steam to the engine the velocity must also alter, because the movement of the valve spindle *n* is accompanied by alteration of the height *b c*, and to maintain this altered position the new velocity must remain, so that, in point of fact, all that is effected by the governor as described above is the regulation of the supply of steam in accordance with the amount of work being done at any time, and with as slight a variation from the normal velocity of the prime mover as is practical. Prompt and constant control of the steam-valve is absolutely necessary for a governor to be of any real utility; but excessive sensitiveness is an evil, as if the apparatus starts into action on every *momentary* variation, the velocity will be kept in an altogether unstable condition. Some very sensitive governors have been used to which it was found necessary to attach appendages to steady their movements, pistons in partially-closed air-cylinders and other equivalent appliances having been used for this purpose. This mode of procedure is obviously opposed to all common sense, for it is ridiculous to give a machine a special property simply to counteract such property by a further complication of the arrangement.

In order to obtain an absolutely even speed, it is evident that the number of revolutions of the governor should be the same at all heights of the plane of revolution of the balls, and therefore the collapsing effort upon the balls, instead of being only their constant weight, must be variable; in what ratio we shall subsequently show.

At first thought it might appear that if the number of revolutions is kept constant for all heights, that the position of the balls would be indifferent to the work being done by th ine; but it will be seen that this ca ase, as an unvarying speed oly of steam to be accommo- rking resistance, and the amount of such supply depends on the position of the plane of revolution of the balls, and therefore the normal speed can only be maintained while the effort of the steam is in equilibrium with the resistance opposed to it.

In a form of governor much in use small balls are used, and the collapsing effort of gravitation is enhanced by a load shown in Fig. 2, resting upon the sleeve *m*, and exerting its weight through the links *k m*, *l m*. If the rods carrying the balls are equal in length to those by which the central weight is suspended, the latter will rise through twice the space (vertically measured) that is traversed by the balls; hence, *w* being the weight of one ball, and W that of the central load, the height *b c* in the loaded governor will be to that in the simple governor as $w + W$ is to w, and the sensitiveness will increase in the same ratio. In this case the weight in which the centrifugal force is generated is w, and that acting gravitatively is $w + W$ *for each ball.* Let $w + W = P$; then, proceeding as before, $b c = \frac{P \cdot g \cdot (a c)^2}{w \cdot v^2}$ and thence, by similar steps, $b c = \frac{P}{w} \cdot \frac{2935 \cdot 555}{N^2}$, and $N^2 = \frac{P}{w} \cdot \frac{2935 \cdot 555}{bc}$.

$$\text{Therefore } P = \frac{N^2 \cdot w \cdot (b c)}{2935 \cdot 655} \quad \ldots\ldots\ldots \quad (2)$$

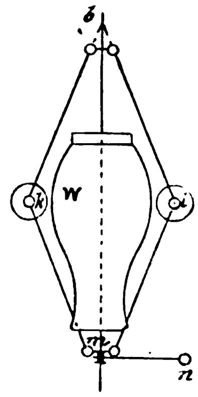


FIG. 2.

As it may be assumed that the governor can be run at any required velocity in relation to that of the motor it is intended to control, it is evident that when the loaded governor is used the central weight can be arranged to give the requisite sensitiveness without involving the use of moderating appendages.

If constant velocity is required, N will be constant, and then it is seen from the last equation that the sum of the vertical components P must vary as *b c*; when the balls with increasing velocity fly out, P must be reduced in the same ratio as *b c* in order to maintain the normal speed.

In Higginson's governor the variation of the vertical components is effected by using in connection with a loaded governor a rocking shaft, on the ends of which are vessels containing mercury, the said vessels communicating with each other by tubes top and bottom, as shown in the diagram, Fig. 3; *a* is the sleeve below the permanent load from which the arm *a b* passes to the spindle shaft *b*; upon this shaft is an arm having at its extremities the vessels *c* and *d* containing mercury, and communicating with each other by the tubes *e e* and *f f*. When the balls are in their normal position the vessels *c* and *d* contain equal quantities of mercury; but when the sleeve *a* rises, *d* is elevated and *c* depressed, causing a flow of mercury from the former into the latter, and causing a corresponding partial counteraction of the load W; when the sleeve descends, the contrary effect is produced, and the descent assisted by the flow of mercury from *c* to *d*.

Let the weight of each ball, with an allowance for the arms attached, be 6lb., the permanent load on the sleeve 80lb., and the number of revolutions per minute 200. The normal height will then be $H = \frac{P}{w} \cdot \frac{35226}{N^2} = \frac{86}{6} \cdot \frac{35226}{40000} = 12{\cdot}62$in.

The amount of pressure, upwards or downwards as the case may be, to be put upon the sleeve for one inch alteration in H will be $86 \div 12{\cdot}62 = 6{\cdot}814$lb. The difference of weight in the two vessels *c* and *d*, due to the passage of mercury from one to the other, will be twice that of the mercury passed; therefore, if W_m is the weight required to pass from one vessel to the other, and P_m the pressure in pounds required to be put upon the sleeve, L and *l* being the distances between the centres of the vessels *c d*, and the length of the arm *a b* respectively in inches, $W_m = P_m \times \frac{l}{L}$.

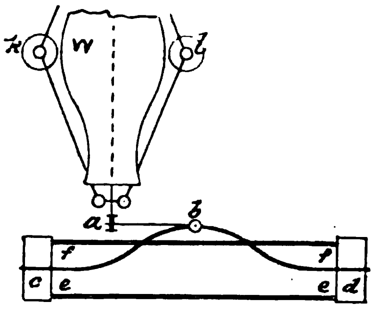


Fig. 3.

In the example, let L = 18in. and *l*=7in.; then, for a variation of 1in, $W_m = 6{\cdot}814 \times 7\text{-}18 = 2{\cdot}649$lb., which is equal to about 5c.in.

When calculating the centrifugal force of the governor, allowance must be made for the arms as well as the balls; we will now show how the complete expression for the whole apparatus is found. If r = the radius of the path in which any body is revolving, its centrifugal force is $\frac{W \cdot v^2}{g \cdot r} = C$. Let a = the velocity of any small element at a distance of unity from the centre of revolution, this is called the angular velocity of the whole mass. Now, for any given angular velocity it is evident that the velocity of any small element of the body will vary directly as its distance from the centre of rotation. Let w = the weight of the small element, and r equal its distance from centre of rotation; then its velocity $v = a \cdot r$, and its centrifugal force $= \frac{w \cdot (a \cdot r)^2}{g \cdot r} = \frac{w \cdot a^2 \cdot r}{g}$, from which it is evident that the centrifugal force varies as the radius simply, and as the weight; therefore, if r equals the distance of the centre of gravity of the whole mass from the centre of rotation, the above formula $\left(\frac{w \cdot v^2}{g \cdot r}\right)$ will apply, whatever may be its form, the velocity being also taken at its centre of gravity.

We will illustrate this by taking an example. Let each ball weigh 8lb., its diameter, if of wrought iron, will be 3·8in. Let the length of the arms and links to sleeve be 12in. from the centre of ball to centre of joint-pin, and the distance (*o*, Fig. 1) of point of suspension from centre of vertical spindle 2in. If the arms and links are of uniform section throughout, say, 1in. by ¾in., their centres of gravity will be in their centres of length, and will consequently, if D = the distance of the centres of the balls from the centre of rotation, have a radius of rotation $= \frac{D-2}{2} + 2 = \frac{D}{2} + 1$. The ratio of the centrifugal force of the arms to that of the balls will, therefore, not be constant. Assume the normal plane of rotation of the balls to be 10in. below the point of suspension, the highest being 9 and the lowest 10in. The radii of rotation of the balls at their highest and lowest positions will be 0·827ft. and 0·566ft. respectively, and those of the centres of gravity of the arms and links for the same positions in feet $- \frac{0{\cdot}827}{2} + 0{\cdot}08\dot{3} = 0{\cdot}497$, and $\frac{0{\cdot}566}{2} + 0{\cdot}083 = 0{\cdot}366$ft. At 200 revolutions per minute the respective centrifugal forces of the balls will be for each ball at the highest position $C = \frac{W \cdot N^2 r}{2935{\cdot}555} = \frac{8 \times (200)^2 \times 0{\cdot}827}{2935{\cdot}555} = 90{\cdot}49$lb., and at the lowest position $C = \frac{8 \times (200)^2 \times 0{\cdot}566}{2935{\cdot}555} = 61{\cdot}94$lb.

The section of arm and link to sleeve being 1in. by ¾in. = 0·75 sq.in., and the the length of each 1ft., the weight will be $2 \times 0{\cdot}75 \times 3{\cdot}3\dot{3} = 5$lb., because a bar 1in. square and 1ft. long weighs $3{\cdot}3\dot{3}$lb. The centrifugal force of the link-work belonging to one ball will, therefore, be—

$$C = \frac{5 \times (200)^2 \times 0{\cdot}497}{2935{\cdot}555} = 33{\cdot}86\text{lb.}$$

and in the lowest position—

$$C = \frac{5 \times (200)^2 \times 0{\cdot}366}{2935{\cdot}555} = 24{\cdot}93\text{lb.}$$

In the first position the centrifugal force of the arm and link is 37·41 per cent. of that of the ball, and in the second 40·24 per cent., a difference of 1·37 per cent. on the centrifugal force of the whole system, which is not of any serious practical consequence. In this case, in making allowance for the link-work, we should add the mean 38·82 per cent. to the weight of the balls, making an effective weight of 11·1lb. for each ball and links. The permanent load on the sleeve to correspond to a velocity of 200 revolutions per minute, and a height *b c* corresponding to a mean height from plane of revolution to point of suspension will be found as follows. The point *b* will be above the point of suspension falling at the intersection of the centre line of the arm produced with that of the spindle of the governor. In the mean position of the plane of rotation it will be 10in. below the point of suspension, and the radius of rotation of the ball will be 8·632in. and the distance horizontally of the centre of suspension from the centre of rotatien is 2in., hence *b c* : 10 : : 8 632 : 6·632, therefore $b\,c = \frac{8{\cdot}632 \times 10}{6{\cdot}632} = 13{\cdot}015$in. Then from equation (2) we find $P = \frac{N^2 w\,(bc)}{2935{\cdot}555}$. Replacing (*b c*) by its value in feet, 1·084, and the other symbols by their values, $P = \frac{(200)^2 \times 11{\cdot}1 \times 1{\cdot}084}{2935{\cdot}555} = 163{\cdot}9$lb. The permanent load on the sleeve $= 163{\cdot}9 - 11{\cdot}1 = 152{\cdot}8$lb.

We have given the radii of rotation of the balls for different heights of the plane of rotation; but without showing the method of finding them, which we will now do by aid of the diagram, Fig. 4. *a* is the centre of one ball, *a h* the centre line of the arm supporting it, *e f* the centre line of the spindle of the governor, *h d* a line drawn paralle to *e f* from the point of suspension *h* to meet the radius of rotation *a c* in *d*. In our example *d c* = 2in. Because *h a d* is a triangle having a right angle at *d*, therefore $(a\,d)^2 + (h\,d)^2 = (a\,h)^2 - a\,d = \sqrt{(a\,h)^2 - (h\,d)^2}$. But $a\,h = 12$in., and if $h\,d = 10$in., $a\,d = \sqrt{144 - 100} = \sqrt{44} = 6{\cdot}632$; and radius of rotation $= (a\,c) = (a\,d) + (d\,c) = 6{\cdot}632 + 2 = 8{\cdot}632$in. The height *b c* was found from the properties of similar triangles, whereby *b c* : *h d* : : *a c* : *a d*.

Two or three forms of governors have been invented at different times, in which springs act in aid of the gravity of the balls. From the foregoing investigations, however, it appears that the vertical load should vary as *b c*, and should, therefore, decrease when the balls are rising; the action of the springs as hitherto applied produces an opposite effect as the force of the springs increases with a rise of the sleeve and diminishes as it falls, thus adding to the natural defects of the apparatus; nor does it seem possible so to arrange springs as to obtain the desired result, for if arranged to assist motion, they act with a diminishing effort as the movement proceeds.

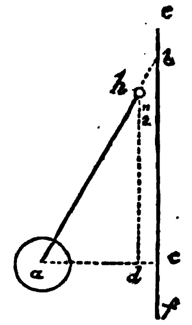


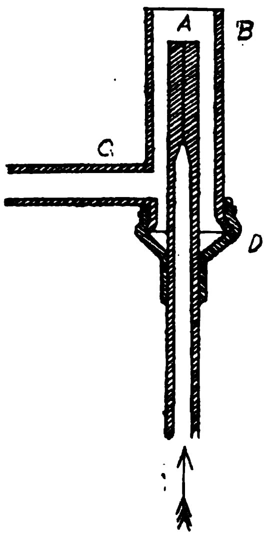
Fig. 4.

The steam-valve actuated by the governor must be perfectly balanced, so that the steam pressing upon it shall not either aid or hinder the movement of the sleeve upon the vertical spindle, and the connections are to be so arranged that the valve shall act immediately upon any alteration occurring in the position of the governor balls. F. C.

ARTIFICIAL SILK.

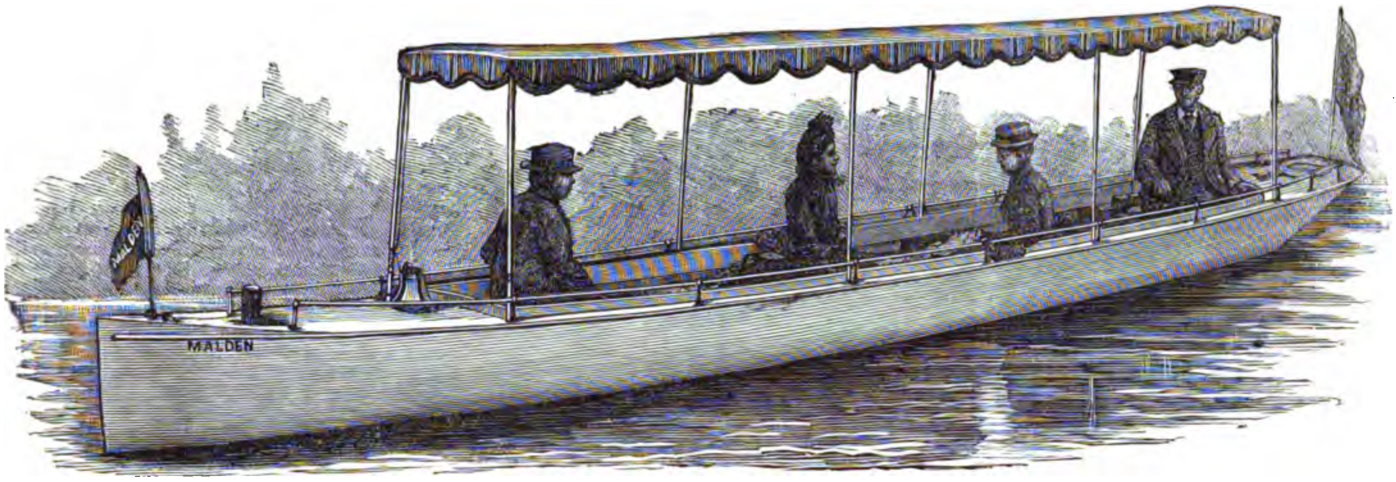
ONE more triumph has recently been added to those won in the domain of the science of chemistry, and the problem of imitating the product of the silkworm has been solved.

The serious epidemics which have from time to time threatened the existence of the silk industry of France and other countries have engaged the attention of many scientists. The biologists have chiefly endeavoured to discover the cause of the so-called silkworm disease, and the means whereby it may be prevented; hitherto their efforts have met with indifferent success. Like the Phylloxera, or grape-vine disease, the silkworm epidemic appears to be due to certain climatal conditions, which are exceedingly difficult or impossible to grapple with.



The difficulty has been approached from a different standpoint by the chemists: these have sought to produce in their laboratories a material which should be not merely a clever substitute for, but an actual imitation of, natural silk.

As long ago as 1884, in the month of May, M. Blanchard, in the course of his presidential address to the Academy of Science at Paris, alluded



to this subject, and challenged chemistry to solve the problem. This she has done. Shortly after the president of l'Académie des Sciences had laid this problem before the scientific world, another French savant, M. de Chardonnet, hit upon a method by means of which he believed its solution could be obtained, and foreseeing great difficulties and much labour before him, he deposited with the secretary of the society a sealed paper setting forth his idea. This was done in order to secure the honour of priority to himself should meanwhile the matter be worked out by someone else. This appears to be the custom on the Continent, and might, by the way, be practised with advantage more frequently in England, for it guarantees a discoverer's priority against those who might lay claim to his ideas. It is often extremely difficult to decide to whom the honour is due, especially where rival scientists belong to different nationalities; but the "sealed paper" system would save endless heartburnings.

M. de Chardonnet, having secured his ground, set to work upon this difficult problem, and on the 7th of May, 1889, he announced its final accomplishment. It soon became apparent that, in order to produce a thread which, by reason of its transparency, silky texture, and brilliancy, should compare favourably with natural silk, it would be necessary to spin it, so so speak, from some liquid solution.

Cellulose ($nC_6H_{10}O_5$) was chosen as the starting point. Various sources of this substance were at first tried; but it was eventually found most convenient to employ cellulose obtained from certain parts of young wood. It was prepared in a state of great purity in order to avoid any complicating sub-reactions with the chemicals employed. With this material a pure octo-nitro-cellulose is made by treatment with nitric acid (HNO_3), and then dissolved in a mixture of 38 parts of ether ($C_4H_{10}O$), and 42 parts of alcohol (C_2H_6O) in a proportion of 6·5 per cent. Such a solution is termed collodion.

The collodion is placed in a reservoir of tinned copper, in which an air-pump keeps up a pressure of several atmospheres. This is connected with a delivery tube lying on an inclined plane, on which are fixed glass tubes, each drawn out into a capillary part, A (vide diagram). A second tube, B, surrounds each of these capillary tubes, and contains water continually supplied at the tubule C. The water, kept in by an indiarubber washer at D, circulates round the tube. The collodion forced out from the aperture A is immediately solidified at the surface on contact with the water, and flows with this water as a thin thread or filament around B. A small automatic arrangement now comes into play, and the filament is led on to a bobbin and so wound off. The thickness of the thread can be regulated to a nicety, and the hanks are made up as in the ordinary way.

The operation of denitration is then proceeded with. Substitution products, consisting of starch or cellulose, in which hydrogen is more or less replaced by nitryl (NO_2) are termed pyroxylins. This "thread" is a pyroxylin. Many pyroxylins lose their nitric acid even in pure water; but more completely in dilute nitric acid itself.

The nitric acid is removed by a process of dissociation which is carried to a greater extent if the bath be kept cold and dilute. The acid should not have a greater density than 1·32, and the temperature should decrease slowly from 35° to 25° C.

In the end the cellulose becomes gelatinous, and capable of absorbing by endosmosis various substances, particularly colouring matters and salts. It will then part with no more than 100cc. to 110cc. of NO_2 per gramme. Collodion can no longer dissolve it, and it has lost those explosive properties which before denitration (being then really a sort of gun-cotton), it possessed. It can now be used for making fabrics without fear of danger; indeed, it is claimed that owing to its great power of absorbing salts, it can be rendered less combustible than hemp or cotton by causing it to absorb ammonium phosphate after it has been denitrated.

After detritration it only remains to dry the filaments.

The density of this artificial silk is about 1·49, that is something between the extreme densities (1·43 and 1·66) of the varieties of natural silk.

The weight which it will bear before rupture varies between 25 and 35kg. per sq. mm.; for raw cocoon silk it varies between 30 and 45kg.

Its elasticity is analogous to that of raw silk. It is able to be dyed by the ordinary processes, and it is said that in brilliancy, texture, and general beauty it even surpasses the natural produce of the cocoon.

At any rate, in spite of the disadvantage of not pessessing skilled workmen, M. de Chardonnet is able to exhibit at the exhibition on the Champ-de-Mars some samples of his artificial silk, which appears well able to compete with the finest produce of the Lyons silk manufactories.

THE ELECTRIC LAUNCH "MALDEN."

THE electric launch, *Malden*, designed and moulded by Mr. W. Sargeant, of Strand-on-the-Green, Chiswick, W., was, during the past summer, an object of interest on the river Thames, especially during the Henley and Maidenhead regattas. This carvel-built craft shown in the illustration is 30ft. 6in. long, 4ft. 10in. beam, with a draught of 2ft. 4in. aft and 22in. mean. The electrical energy is stored in 48 accumulators, contained in ebonite boxes, which are placed in lead-lined trays under the seats. The midship sections of the vessel being perfectly flat, in the event of the craft taking the ground, the acid contained in the cells is not likely to slop over. Twenty-four of these cells are arranged on each side of the boat, and with one charge contain electrical energy sufficient to propel the launch for ten hours, at about ten miles per hour. The motor is a 6in. Immisch, rotating at about 550 revolutions per minute, and calculated to give about 2¾ brake horse-power.

In the counter of the launch is placed a resistance-frame, and over that, upon the deck, are fixed two switches, one for starting the motor, and the other for reversing, both being under the control of the man steering. The ammeter and voltmeter are also in his view.

The motor is fixed under the floor aft, and is connected with the accumulators, which are worked in parallel. In place of the objectionable whistle of the steam launches a large and melodious ship's bell (Jensen's Patent), which is in every way efficient, is placed on the fore-deck as shown in illustration, and sounded electrically by the steersman, the current being supplied direct from the accumulators. All lights—port, starboard, and head lights—are incandescent lamps, all supplied from the accumulators.

All the accumulators being placed under the seats, a clear space is left from stem to stern, which will accommodate twelve comfortably. In fact, the interior of the *Malden*, fitted as she is with well-stuffed cushions and a good awning, becomes one continuous and agreeable lounge. The seats are removable, so that the accumulators may be easily examined if necessary at the time of charging, which is proposed to be accomplished during the night. The charging can be done at a reasonable cost from charging stations, which are now being constructed and placed up the Thames by Messrs. Immisch and Co. The first of these stations was designed by Mr. Sargeant, and in all appearance resembles one of the large house boats common on the Thames. It consists of a river barge 70ft. long by 14ft. beam, on the floor of which, upon a suitable foundation, is placed a semi-portable compound steam-engine of 25 horse-power nominal. Countershafting placed in the fore-part of the barge is driven direct from the flywheel which runs at 120 revolutions per minute. This countershafting drives the dynamos which, through insulated copper heads, supply the current to the accumulators in the launches moored alongside the station. The engine is covered with a large lantern in the roof, which can be quickly removed if at any time it is necessary to take the engine out.

Electrical power for river launches is now an established fact on the Thames, and will probably be much improved during this year. Messrs. Sargeant and Co. are constructing three very elegant electric launches, one of which is expected will be the fastest ever produced, which will contain accumulators provided by the Electrical Power Storage Company. The motor is specially designed for water propulsion, and will be fitted with Sargeant's patent motor shaft and thrust block combined, which is self-lubricating and reduces friction to a minimum.

One launch can be seen in the course of construction at the Kew Bridge charging station, near Kew Bridge. The next charging station above Kew Bridge is situated opposite the water works at Hampton, and is the floating one before mentioned. And it is also proposed by this firm to construct a station above Richmond Bridge. There will be no difficulty in obtaining sufficient energy at any one of these stations for a run of 50 or 60 miles, according to the capacity of the accumulators contained.

The annexed illustration is executed from a photograph of the *Malden* in Bray Lock on her journey from Cookham to Kew Bridge, which was accomplished with one charge of electrical power.

PRETZEL'S BELT PLACER.

IT is not wise to endeavour to put a belt on a pulley when the shaft is in motion; but there are occasions when it is necessary, and therefore the contrivance patented in this country by Mr. Pretzel, of Berlin, may be useful, as, according to the patentee, his appliance enables one to safely put a belt or strap on to a pulley

Fig. 1.

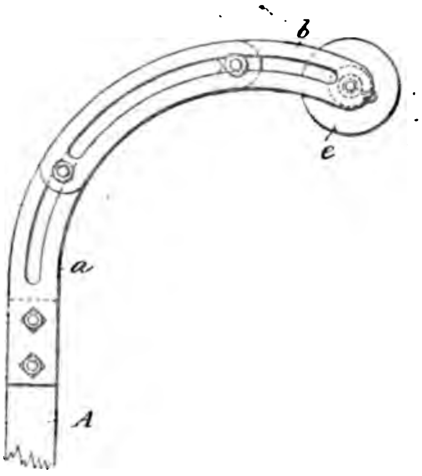


Fig. 2.

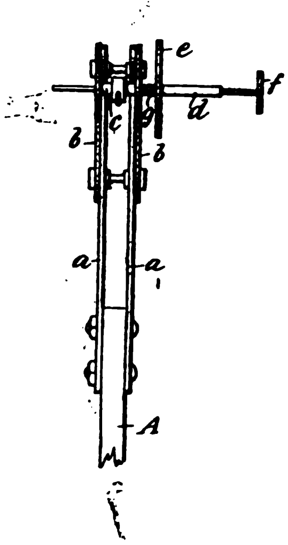


Fig. 3.

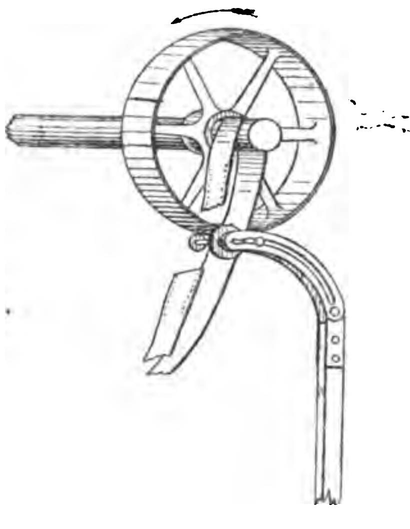
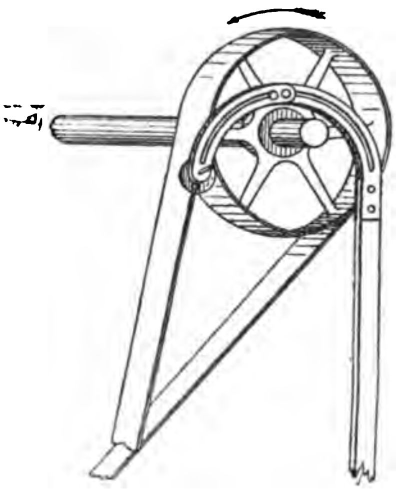


Fig. 4.



while the latter is in motion. The appliance or belt placer is represented in side view in Fig. 1, and in front view in Fig. 2. Figs. 3 and 4 are views illustrating the action of the appliance whilst placing a belt over a pulley. The appliance is composed of two curved bars, *a*, *a*, carried by a rod A of suitable length, and of two curved bars, *b b*, attached to the bars *a a* in such a manner as to be capable of sliding thereon, guide slots (as shown) or grooves, or other guiding devices being provided for the purpose. The bars *b b* are firmly united at their upper end by means of a hollow boss or tube, *c*, in which a spindle or rod, *d*, can slide. This spindle carries two discs, *e* and *f*, which can turn thereon. The belt placer is used as follows:—The two discs *e* and *f* are set at such a distance apart as to slightly exceed the width of the belt pulley. The operator, taking hold of the rod or handle, A, introduces the spindle *d* under the bight of the belt which is to be placed on the pulley, and pushes the same while it hangs loose thereon so far up against the pulley that the small disc *f* comes behind the edge of the pulley. He then pushes the appliance partly around the periphery of the pulley in the direction of the rotation (see Fig. 3), and the pulley will then carry it round until it becomes placed thereon, the large disc *e* preventing it slipping sideways. The placer or appliance thus passes automatically from the position seen in Fig. 3 to that seen in Fig. 4, and gradually comes forward from under the belt. Meanwhile the bars *b b* have slid out along the bars *a a* to a sufficient extent. This sliding movement or elongation of the bars has the further object and advantage of allowing the distance of the spindle *d* from the rod or handle, A, at the commencement of the placing operation to be as small as possible; the power required for lifting the belt would otherwise have to be considered, whereas, when the distance between the spindle *d* and the rod A is short, this power is small. The operator remains in the same position while he places the belt, and this is of importance where the available space is limited.

A MODEL LOCOMOTIVE.—IX.

The Cylinders.

By adhesion we mean the resistance to slipping of the driving-wheels of a locomotive, such resistance being due to the friction between the wheels and rails. By traction or tractive force is meant the power which, through the medium of the pistons, moves the engine and train. The first is dependent upon the weight of the engine, and bears a proportion thereto, variable, however, with the degree of smoothness and specific condition of the rails; the second depends on steam pressure, piston area and stroke, and diameter of wheels.

In reference to adhesion, it is evident that if sufficient pressure is not exercised between the wheels and rails, the wheels will slip and run round instead of moving the load. This is what occurs on wet or greasy rails, especially on starting the engine, and before momentum has been acquired. A general or average rule is that the weight resting on the wheels shall be about equal to six times the power exerted by the pistons. On wet rails, or on rails partly wet and partly dry, the wheels will slip even with this proportion of weight, hence the reason why the sanding apparatus is used to increase the adhesion. The weight is, of course, divided between all the driving wheels; hence the advantage of coupling the heavy goods engines. Only the lightest engines, used for fast passenger traffic, have single or uncoupled wheels, and the load resting upon the drivers is then so great that it is possible to run on greasy rails, and up moderate gradients only by a liberal employment of sand.

The best development of the single-wheel system is found on Mr. Stirling's engines on the Great Northern Railway, where the exceptionally heavy load of about 16 tons is placed on the drivers, which are 8ft. 1in. in diameter. But, by a moderate use of sand, the performance of these engines has been rendered superior to that of coupled engines. Necessarily, the passage of a load so concentrated means the use of heavy rails. But there is no difficulty on that score now that steel rails of heavy section are superseding those of piled iron.

The entire history of locomotive practice presents a story of the balancing of the relations between adhesion and tractive power. The first engines were light, uncoupled, and of small power, and the permanent way light also. With increase in power, coupling became necessary, to give sufficient adhesion. This again necessitated stronger rails. Increase in power and in speed demanded a larger wheel-base and bigger cylinders, and so tractive power, weight, adhesion, big engines, and heavy rails have been continually on the increase.

The early engineers were long sceptical about the workability of smooth wheels on smooth rails. Most readers are familiar with the old devices of Trevithick, Vivian, and others for securing adhesion, such as roughened and jagged wheels, rack rails, &c. It is also matter of history that it was only by Stephenson's persistence that the directors of the Liverpool and Manchester Railway authorised the memorable Rainhill competition, in which the "Rocket" settled the superiority of the smooth-wheel locomotive over the stationary traction-engine for level lines. The first engines constructed for the adhesion of smooth wheels were Hedley's, of the "Puffing Billy" type. The motion of the pistons was transmitted to the wheels by means of toothed gearing. When the power of these engines was increased, it became necessary to divide the weight between eight wheels, and to distribute the adhesion between them by means of toothed gearing.

The formula for estimating tractive power is due to Pambour—

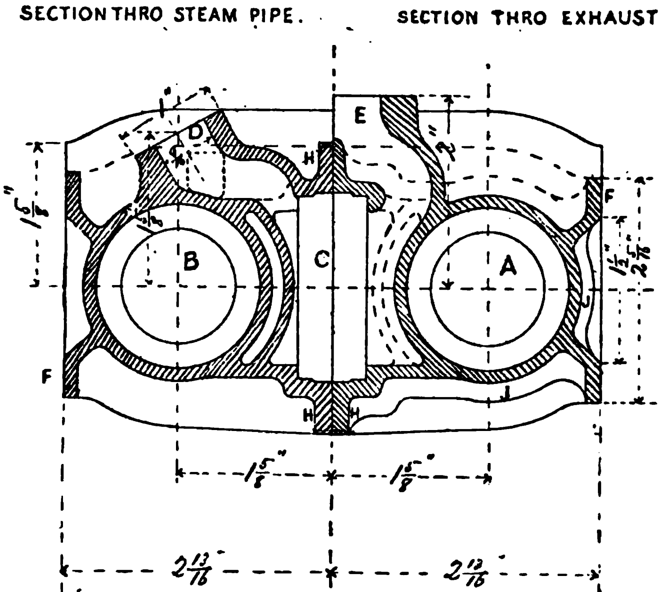
$$T = \frac{d^2 L p}{D}$$

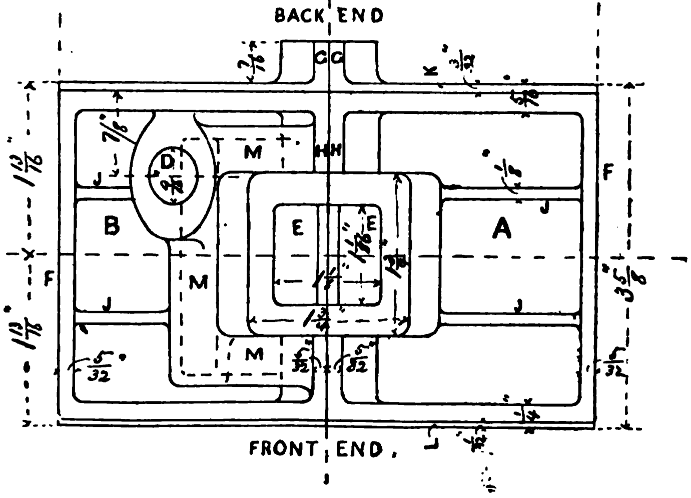
where d = diam. of cylinder in inches
L = length of stroke in inches
D = diam. of driving wheel in inches
p = effective mean pressure on piston in pounds per square inch
T = equivalent tractive force at the rails in pounds.

The cylinders for our model are shown in Figs. 32—37. In this model, and to a far greater extent in one to such a scale as some of our readers have suggested—namely, ¾in. to the foot, the difficulty is to get the various details in their due proportions, without involving a deal of very troublesome work. It is close work in actual engines, much more so in a model. The centres of the cylinders are fixed in relation to the gauge, which determines the position of the frames between which the cylinders have to be bolted. It is necessary to fix the centres in such a manner that the axle-boxes shall have sufficient bearing surface for the journals. Having these fixed, it is impossible to spread the centres unduly to get valve room, because the outer webs of the crank would be thinned thereby, and in a lesser degree, because large cylinders requisite for tractive power could not be used without entrenching on their flange and foot area. In these respects it would be better to bring the cylinders closer together. But then we encroach on the steam-chest area, and on the valve space, and valve rods. As it is, we must follow the common practice and crank the valve rods. If again, in order to get the centres closer together, we put the chests and valves above the cylinders, or in a diagonal position, we introduce complications into the valve gear which it is desirable to avoid.

The evils of inside cylinders are even more apparent when repairs to the valves and valve faces have to be made. But although the outside cylinder engines appear to be gradually growing in favour on some lines, and are a return to earlier practice, the advantages of inside cylinders are so great that they are mostly employed. The case between inside and outside cylinders is briefly as follows:—In the first there

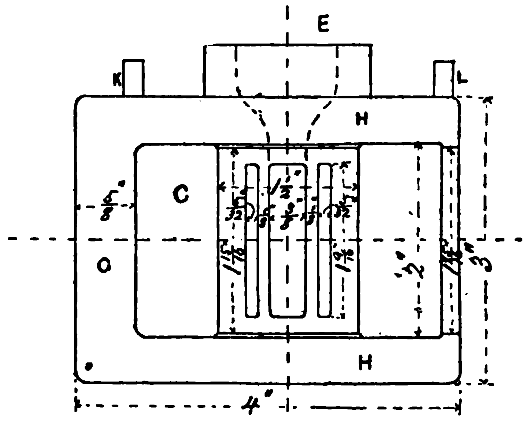
Fig 33.





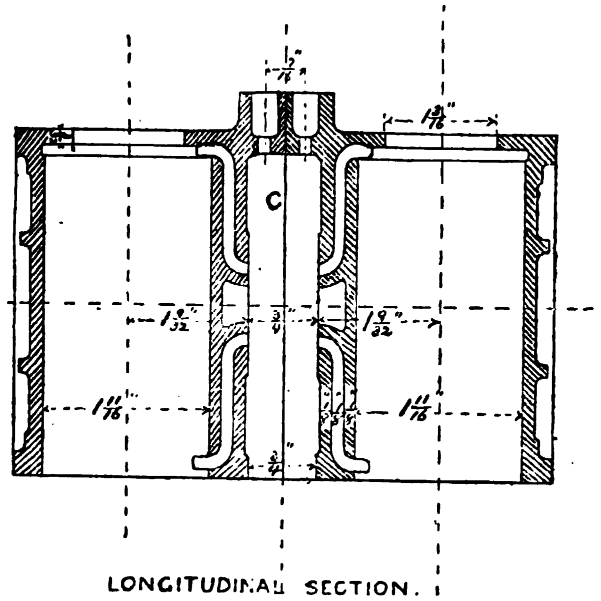
PLAN OF CYLINDERS.

Fig 32



STEAM CHEST FACE - CYLINDER A.

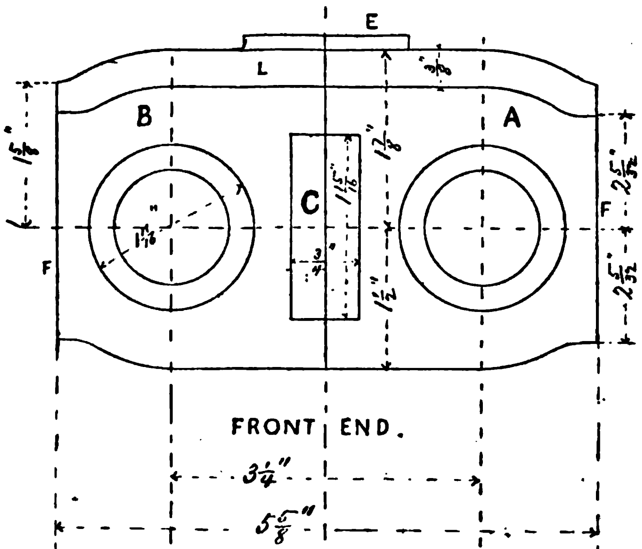
Fig 35

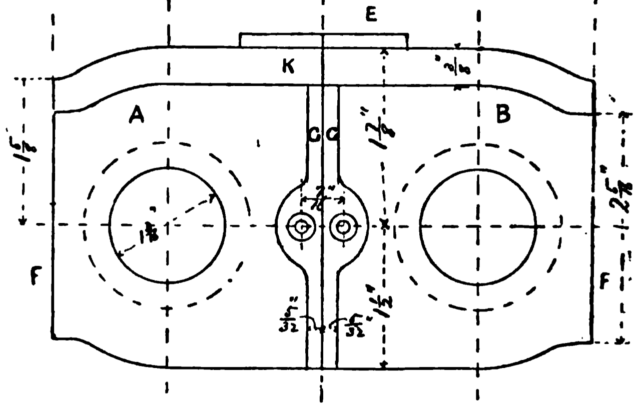


LONGITUDINAL SECTION.

Fig 34

Fig 36





BACK END

Fig 37.

is compactness of arrangement and steadiness of working, but difficulty in getting at the valve faces. In the second there is unsteadiness of action, due to the alternation of stress in the opposite frames, which, at high speeds, is objectionable. But, on the other hand, there is the great convenience of getting easily at the valves, and the advantage of straight axles. On the whole, steadiness of working is of more importance than the inconvenient situation of the valve faces. But more perfect counterweighting and better permanent way, and minute attention to details of workmanship may probably lead to a more extended employment of outside cylinder engines. It was not until 1830 that horizontal inside cylinders were adopted. The Killingworth, the Wylam, Blenkinsopp's engines, and Hackworth's early engines all had vertical cylinders. The cylinders of the "Rocket" were inclined, and in each case the connecting rods were attached directly to the driving wheels. The consequence was that at every double stroke the motion of the pistons caused a lifting and depression of the engine to take place, which produced great unsteadiness of motion at high speeds. The introduction of horizontal cylinders, therefore, conduced to the steady motion of the engines, and brought the action of the springs into more effective play, and, being inclosed in the smoke-box, radiation of heat was prevented. Timothy Hackworth is credited with the origination of this design in an order which he gave to Messrs. Stephenson in March, 1830, for the construction of the "Globe." Stephenson embodied this arrangement in the "Planet," sent out from Newcastle on Sept. 3rd, 1830. At about the same time also, Edward Bury, of Liverpool, had constructed an inside cylinder engine, the "Liverpool," for the Liverpool and Manchester Railway, so that in this year the three first horizontal inside cylinder engines were at work.

In almost every bit of detail these cylinders of ours are the correct models of the actual ones which they represent. The bore, $1\frac{11}{16}$in., corresponds with a diameter of 15in. I should have preferred 17in., but it is difficult to get a bigger bore in this space without making the metal in the body and between the passages too thin for casting soundly, and without crowding the valve room. The thin curved cores, even as shown, are a very troublesome job for the moulder. In this case, therefore, we have to consider the exigencies of model making. If presently I find that the cores can be made, and the metal cast sound to bore to $1\frac{7}{8}$in., I will do so; but I think $1\frac{11}{16}$in. will be the limit. To maintain the power, I have made the stroke slightly longer than usual. A 22in. stroke is perhaps the most common. I make the model for $2\frac{3}{4}$in., equivalent to $24\frac{3}{4}$in. stroke.

In Figs. 32-37, A and B are the two cylinders. These will be cast separately and bolted together. C is the steam-chest, D the steam inlet, E the exhaust to which the blast-pipe is attached. F are the feet for bolting the cylinders to the frame-plates, G is the flange at the back end, H are those at top and bottom of cylinders, J are stiffening ribs, K L are recesses for bolting the tube and smoke-box plates respectively. The block M takes the steam-entry passage coming from D, and passing round the exhaust block, to enter the steam-chest at each end of the valve facing. This arrangement is necessary in cases where the backs of the valves come into almost absolute contact, so that there is no room for the steam to get between them from one end of the chest to the other without excessive wire-drawing.

The pattern and corebox work involved in this is somwhat troublesome, and to that I shall have to devote the whole of the next article. **J. H.**

ECONOMIC VALUE OF BACTERIOLOGY.*

IN what way have the results of bacteriological investigations been applied to matters of every-day life, and what can we expect from them in the future? Of course it is interesting, scientifically, to know that infectious diseases, decomposition, and fermentation are caused by minute plants, and even if we could make no application of our knowledge, the satisfaction of studying these facts amply rewards the student. But, aside from purely scientific interest, it is evidently of great use in matters of common every-day life. In the first place, the benefit that has been derived to the husbandman has been very great. After Cagniard, Latour, and Schwann established the fact that fermentation is due to micro-organisms, Pasteur devoted himself to the study of this phenomenon, and his results have saved the French people many thousands of dollars. He found that the so-called diseases of wine are due to bacteria. The souring of wine and the bitter taste which formerly caused great loss to the wine-growers of France are no longer met with, for by heating the wine so as to kill the bacteria and then sealing it up it does not sour or turn bitter. The silk industry of France is equally indebted to Pasteur. He discovered the remedy for an infectious disease which threatened to break up silk growing. Pasteur also found that by the use of pure yeast the fermentation of beer, the success of which was largely a matter of chance, renders it possible for the brewers to rely upon their results. Although Pasteur's method is a great improvement upon the old method of brewing, it has not found as universal application as that introduced by Hansen. In Holland and Germany the brewers all use Hansen's yeast, which means that they use pure cultures of yeast fungus, which Hansen and others found to make the best sort of beer. Instead of the uncertainty attending the manufacture of beer, which was formerly a source of great loss to the brewers, they have no uneasiness upon this score at the present day. Impure yeast causes beer to have a disagreeable taste.

Bacteriological investigation has, therefore, been of advantage to the wine, beer, and silk industries, but the benefit in the prevention of infectious diseases is still greater. It is not so much in the treatment of each individual case, though even here much good has resulted, but in the prevention of the spread of disease that the advantage is incalculable. If an animal becomes sick, the bacteriologist can say, in many cases, positively whether it is an infectious disease or not, and can isolate the sick animal, so preventing the spread of the disease. It is of great importance to diagnose the first case. Some of you doubtless remember reading of several cases of cholera which occurred on board a vessel in the port of New York about a year ago. A bacteriologist was immediately sent for and declared the disease to be genuine Asiatic cholera, and thus prevented the patients from being allowed to infect other persons. The German Government recognise the importance of diagnosing the first case to such an extent that they required a number of marine and army surgeons to go to Berlin and receive instruction from Koch in his methods for studying the cholera bacterium.

The greatest benefit which has been derived from bacteriology is probably in the prevention and treatment of boils, abscesses, and wounds. All boils and suppurating wounds which are ordinarily met with are caused by certain sorts of bacteria. It seems to be true that certain chemical substances under peculiar circumstances also cause suppuration; but in every-day life the pus which the surgeon or physician meets with is caused by bacteria. If now a substance is known which kills these bacteria, and at the same time does no injury itself, then there will be very little trouble in avoiding suppuration, as it is called. In the old days of surgery, it used to be thought necessary to have a lot of matter come from a wound; but nowadays it is a disgrace to any surgeon to have suppuration under ordinary circumstances. All sorts of operations, from cutting off a toe or finger up to cutting out the breast or a hole in the abdomen, are now performed, and in no case well managed is there more than a few drops of pus. Sir Joseph Lister was the first to attempt what is called aseptic or antiseptic surgery. He used very successfully carbolic acid to wash out the wounds he made, and then bandaged them with many layers of carbolised gauze and cotton batting. But Koch found out that corrosive sublimate, even in very weak solutions, is much better for killing bacteria, or, in other words, is a better antiseptic than carbolic acid. So at the present day corrosive sublimate plays the main part in the treatment of all sorts of wounds and abscesses. If a boil is just started, it can be aborted by injecting corrosive sublimate into it. If an abscess is fully formed, it can be rapidly cured by using solutions of corrosive sublimate.

Where surgeons have kept up with the advances in medicine in this respect there is a great deal less suffering and fewer deaths. In the best hospitals there are no longer such scourges as blood poisoning, lock-jaw, &c. So the study of bacteriology has been of incalculable benefit if we consider this point alone. Since the introduction of antiseptic surgery, lock-jaw never occurs from an operation in the hands of those surgeons who keep abreast with the times. Lock-jaw of new-born infants has been banished where the proper use of antiseptics is resorted to. If a new-born infant dies of lock-jaw at the present day, the attending physician is entirely to blame. These precautions are much more easily carried out in a hospital, and it would be much better to have hospitals in America as they have in Europe, so that our dwelling houses would no longer be infected with disease and where the surgeon could do his work properly.

Although many important processes and many terrible diseases are caused by bacteria, still we are able to control their action to a large extent, making them do useful work on the one hand, and preventing their injurious effects on the other. I have stated that by the introduction of corrosive sublimate solution in the treatment of wounds, the surgeon is enabled to perform the most serious operations with absolute certainty that he will not produce gangrene, blood-poisoning, or even suppuration. But the use of disinfectants, as they are called, is not only beneficial in surgery but in other cases as well. And although corrosive sublimate is the best disinfectant known, it cannot always be applied. In some cases it is better to use steam.

In many cities in Germany they have large steamers constructed so as to subject clothing, bedding, &c., which have been used by persons suffering from small-pox or other infectious diseases, to steaming.

This use of steam as a disinfectant is of great use, and in most cases does no damage whatever to clothes, &c. As soon as the articles are removed from the steamer they are spread out and dry of themselves almost immediately. Such articles as feather beds are dried in an oven built for the purpose. Leather is ruined by steaming, but shoes and other articles made of leather are not injured by corrosive sublimate. In the hospitals in Berlin, in Germany, the clothing and everything else used by a person suffering from an infectious disease are either sterilised by steam or with corrosive sublimate; and the expensive process of burning up infected clothing, &c., is no longer resorted to.

Many other applications of bacteriology to affairs of every-day life might be enumerated, but these incidents are enough to show that this study has already assumed very great importance. It is not going too far to say that the benefit which has been derived and the possible advantages in the future can scarcely be over-estimated. Men of all nationalities are flocking to Germany every year for the purpose of studying bacteria, so great has the importance of this branch become. It was predicted at first that this noise about bacteria would soon die out; that it would be found out that their importance was greatly exaggerated. Just the opposite is the case. Instead of interest lagging, the more bacteria are studied the more important they appear.

Although we are indebted to Pasteur for much valuable work, and his opinion is of the greatest worth, he has probably gone a step too far in his preventive inoculations. He has established the fact that it is impossible to vaccinate for certain diseases and render the animal so vaccinated immune, but the methods are not perfect enough as yet to alow of introduction into general use. It is to be hoped that such will finally be the case, but at present it is a matter of purely scientific value. The time may come when we shall be able to vaccinate for malignant pustule, chicken cholera, swine plague, &c., just as we vaccinate for small-pox nowadays, but in some cases, at least, it is questionable whether this will ever be accomplished. Of course much the best way to guard against infectious diseases is to get rid of the cause of infection, and the study of bacteria has given us valuable means with which to accomplish this end. It has already been stated that Koch has found corrosive sublimate a very potent disinfectant. Now, how would we apply this in case of an epidemic? Suppose an epidemic of chicken cholera were to break out. As we know of no trustworthy means of curing the disease, we should try to limit it as much as possible. In the first place, the fowls should be confined in the chicken-house where this is feasible, and every few days the walls and floor should be scoured with lye and then wiped out with a solution of corrosive sublimate. The sublimate should be allowed to remain several hours, and the walls and floor again scoured with lye or soap. The corrosive sublimate solution need not be stronger than 60grs. or 1dr. to the gallon of water. This is a very weak solution, but of course it must not be left carelessly around so that anyone would be likely to drink any of it, as it is a deadly poison. It has been recommended to colour the solution with a small quantity of some cheap dye stuff, so that it would not be mistaken for water. It would be better to have two hen-houses, to disinfect them with the corrosive sublimate solution and transfer the fowls every few days from one to the other, disinfecting every time as soon as the fowls are removed in the manner already described. Our hen houses and stables should be so constructed that they could be wiped over with a solution of corrosive sublimate and leave no corners unwiped. There should be no sharp corners where dust can accumulate and which are difficult to reach. If, in spite of disinfection, the fowls all die, the house should be thoroughly scoured with soap and water, and corrosive sublimate solution applied liberally and allowed to remain a day or so, and again scoured and again disinfected several times before other fowls are allowed to go in. If the yard is also infected, it should be liberally doused with freshly-slaked lime. It would be more effectual to use corrosive sublimate even for disinfecting the yard, but that would hardly be advisable. Freshly-slaked lime is a good disinfectant, but it must be applied to every part of the yard. The fences and ground in every nook and corner should receive a thorough drenching. Not only in chicken cholera, but in other infectious diseases the same means should be used.

The fact has been mentioned that lock-jaw does not occur any more after surgical operations. If the wounds in animals are treated at once with corrosive sublimate or strong carbolic acid, there need be no fear of lock-jaw. If a horse has run a nail in his foot, the wound should be thoroughly washed out with a strong solution of corrosive sublimate and stopped up with a plug of cotton soaked in corrosive sublimate solution. The bacteria of lock-jaw are very wide-spread. They have been found in garden earth, upon splinters of dirty wood, in old rags, and in the dust of rooms.

Consider now the part played by bacteria in decomposition. As you already know, the chief supply of food for the higher plants is furnished by decomposed animal and vegetable matter. The higher plants cannot make use of elaborate food—they can only assimilate such simple bodies as the nitrates, &c. Complicated substances, such as animal and vegetable matter, must be broken up before they can serve as food. Now these complicated substances are just the things which form the best food for bacteria, and bacteria decompose them so that the higher plants can use them as food. It is, therefore, evident that bacteria are necessary to the higher plants, and without them there would soon be no life upon the earth, for animals are all ultimately dependent for food upon plants. So bacteria prepare the food for the higher plants, the higher plants supply food to animals, and animals and plants supply food to the bacteria. For the sake of illustration, take the nitrogen found in various albuminous substances. It amounts to 16 or 18 per cent. in different cases, but as long as it is contained in the albumen it is useless to the higher plants. The bacteria feed upon these albuminous substances and liberate the nitrogen in the form of ammonia and nitric acid, the only compounds of nitrogen which the higher plants are capable of using. The higher plants require nitrogen in the form of these two compounds. Now here is a formula: $C_{17}H_{33}No_3$, showing that this substance called *cerebrin* contains nitrogen, but the nitrogen is held so closely by the C, H, and O that the higher plant could not use it at all if it were not liberated. Nitrogen is used merely as an example. What is said applies equally well to other substances besides. Thus the mineral salts are also liberated from complicated compounds by bacteria.

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* By B. M. Bolton, M.D., Professor of Physiology, Hygiene, and Bacteriology in the University of South Carolina, from his report to the Department of Agriculture of South Carolina.

Now, if decomposition is caused by bacteria, it is important to find out whether all bacteria cause it, or whether there are only certain kinds which do so. Also, whether they do so under all circumstances. It has been discovered that all sorts of bacteria do not produce decomposition, at least, not entire decomposition, and those which do require certain conditions. Prof. Wollny states that those bacteria which are concerned in the process of decomposition require abundance of air and moisture, and also warmth. Applying this knowledge to every-day life, we see it is necessary to keep vegetable and animal matter moist and warm, and allow abundance of air to prepare it as a fertiliser. It follows that if your compost heap is too dry it will not decompose, and if it is too cold it decomposes very slowly. If the compost heap is too wet it will not thoroughly decompose, for reasons to be given presently. For the same reason, crops which are turned under have to be kept moist and warm and allowed to have plenty of air. Of course, the exact preparation of the compost of the soils which are turned under must be varied to suit each case. If soil is sandy, the crop should be turned thoroughly under and the earth above it rolled so as to retain as much moisture and heat as possible. With clay land, of course the opposite course is indicated. Again, if a compost pile is too much packed to allow access of air, it should be opened up; at the same time it must not be too loose, otherwise it will dry out too much and lose heat.

So we have to bear in mind that the bacteria which prepare the food for our crops will only do so when they have the conditions favourable to their growth. If the conditions are unfavourable, they either do their work imperfectly, or they are supplanted by other bacteria which split up vegetable and animal matter into substances which are for the most part of no use to plants as food. This takes place when the air is partially or wholly cut off. If a crop is turned under and the air is not allowed free access there will be very little benefit derived, and in some cases even injury to the soil may result. It can readily happen in a clay soil that the earth may become so packed that the air is excluded. Even in a sandy soil the pores may become so clogged with water that the air is kept out.

Pasteur first called attention to the fact that there are two kinds of bacteria, one not requiring free access of air, and the other unable to grow in full oxygen. To repeat: those which require the presence of free oxygen cause decomposition, and those growing without oxygen cause only partial decomposition.

But besides the influence exerted by the presence or absence of oxygen there are other things which influence the growth of bacteria. Certain metallic salts interfere with it. The concentrated solutions of common salt act in this way. Corrosive sublimate, which is a salt of mercury, even in very dilute solutions kills bacteria. The same is true, to a greater or less extent, of mineral acids or other substances.

So a soil must not only have abundance of moisture, warmth, and air, but it must also be free from substances injurious to bacteria. This can be tested even without a chemical analysis, by simply taking cultures derived from the soil, and seeing whether the bacteria from them grow in the soil to be examined. This is a more direct test than a chemical examination.

Not only do these principles underlie the process of decomposition, but they also find application in the opposite direction—namely, in preserving perishable articles from becoming decomposed. Meats, vegetables, and fruits are kept from spoiling in various ways.

1. They can be heated up to a temperature which kills the bacteria, and then sealed up so as to prevent any bacteria from getting in. This method is employed in the ordinary process of canning. The meats, vegetables, or fruits are put into cans, which are then heated up to the boiling point of water or higher, and then sealed up. In actual practice the cans containing the meats or other contents are nearly sealed before they are heated, all except a small opening in one end, which is closed with a drop of solder after the cans have been heated long enough to kill the bacteria. But instead of sealing the substances up in cans, they can be preserved by stopping up the vessel containing them with cotton, as with a tube of nutrient agar. Most bacteria are killed by a temperature much below the boiling point of water. Still, certain sorts of bacteria have the power of forming so-called spores which are very resistent. It has been recently discovered that there are several kinds of bacteria in the ground which form spores so resistent that they can be boiled several hours without being killed.

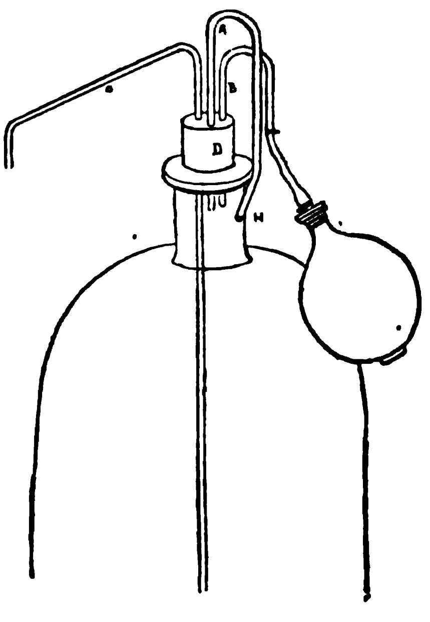
2. Meats, vegetables, &c., are also preserved by drying. This needs no further explanation, for moisture is essential to the growth of micro-organisms.

3. The addition of certain substances which are injurious to bacteria is also often employed. Concentrated solutions of salt—that is to say, brine—prevents the growth of bacteria. Other substances, such as salicylic acid, copperas, and a great number of other things, either kill bacteria or prevent their growth, and consequently, may be used as preservatives. The most effectual of all is corrosive sublimate. The great objection to this method of preserving substances for food is that most of the germicides, as they are called, are injurious to health, and many of them are very poisonous. Of course, this objection does not hold in the case of brine.

4. Articles are preserved on ice, but generally for a short time only. As this is an expensive method, it is hardly worth while to explain the principle that bacteria require warmth in order to grow. The study of bacteria has thus led to a clearer understanding of the way in which the food is prepared for the higher plants on the one hand, and the preservation of perishable articles on the other. It has led to the prevention of many infectious diseases of animals and plants, and an improvement in wine-making and brewing.

A SIMPLE ACID PUMP.

ALTHOUGH this device, in slightly different forms, has been in use for some time, yet the convenience of the modification here figured may render it worthy of description.



A, B, and C are three glass tubes passing through the rubber stopper, D, A, and B ending just below the stopper, and C reaching to the bottom of the bottle. To B is attached a double-valve rubber bulb. A is so bent that while the bulb is clasped in the hand, the thumb can easily be held over the open end of A at H. Acid can then be forced out through C, and the flow may be checked instantly by removing the thumb from H. The left hand is thus left free to hold under C the vessel into which the acid is to flow. A glazed earthenware dish is placed upon the table under C to catch the drippings.

For the use of large classes of beginners in general chemistry this apparatus is well adapted, since accidents resulting from careless handling are rendered almost impossible, and both acid and time are economised.

The same device may be used for carboys, the tube C being extended upward so that an acid bottle may stand on the box beneath it, and H being kept closed by a piece of rubber tubing and a pinch cock.—L. M. Dennis in *Amer. Chem. Jour.*

THE GREENWICH VISITATION.

ON Saturday last the Board of Visitors held their annual visitation of the Royal Observatory, Greenwich, the members present being the President of the Royal Society (Sir G. G. Stokes, M.P.), the Earl of Rosse, Lord Rayleigh, Sir G. B. Airy, Professors Rev. B. Price, J. C. Adams, A. Cayley, R. B. Clifton, Rev. C. Pritchard, G. H. Darwin, Drs. Glaisher and Huggins, Mr. E. J. Stone, and Captain Wharton, R.N. The report of the Astronomer-General, giving the history of the Observatory and the work done in the year ending May 10th, shows that, even under very trying circumstances, the efficiency of Greenwich Observatory has been maintained. The first paragraphs of the report announce that the 18ft. dome is ready for the reception of the 13in. equatoreal now being constructed by Sir H. Grubb for the Observatory. This telescope is to be used for the international photographic chart of the stars. The Astronomer-Royal proposes to erect a building to serve as a museum for the scientific instruments superseded by others more modern, but yet possessing great historical interest.

The transit-circle has been used on every available occasion for observing the sun, moon, planets, and all stars in the catalogue of Groombridge not observed at Greenwich since 1867. The next large catalogue of stars issued from Greenwich will thus contain (in connection with its two predecessors) material for utilising Groombridge's observations for determining the proper motions of over 4,000 stars. With this instrument 5,360 transits and 5,133 observations of polar distance were secured. The average numbers for the preceding ten years, ending in 1879, were 3,910 and 3,650. When it is remembered that the stars observed this year are mostly circumpolar, it will be at once seen that the increase of nearly 40 per cent. in the number of observations does not sufficiently represent the increase in work, which may fairly be said to have increased by one-half; and yet there has been no increase in the regular staff, the only addition being the occasional employment of one or two temporary computers. Notwithstanding the increase of work the reductions are up to date, and the various investigations depending on the observations of 1888 are complete.

With the altazimuth the moon was observed on 70 days to supplement the observations with the transit-circles. These observations and those of the necessary stars for instrumental errors are completely reduced.

All the equatoreals have been kept in good working order, and with them seven occultations of stars by the moon, nine phenomena of Jupiter's satellites, and 21 complete observations of comets were secured. The 12¾in. refractor has been used for spectroscopic work, and 254 measures were made for determining the motions of recession or approach of some 50 stars. Comet *e* 1888 and Saturn's ring were also examined with the spectroscope. The 7in. equatoreal has been used for experiments in stellar photography. Twenty photographs were taken last year on curved plates, and it has been found that the images of stars can be transferred satisfactorily to flat plates, which are more convenient for measurement. Measurements of the plates indicate that the positions of stars can be obtained with sufficient accuracy over a field 4° square, and are independent of a considerable change in focal adjustment (allowance being made for change of scale), and of a considerable difference of exposure.

Sir H. Grubb has obtained a very satisfactory pair of discs for the new 28in. refractor, and has made an experimental glass, which is being tested at the Observatory. A 6in. object-glass of the form decided on for the 13in. photographic telescope is also being tested. In the year ending May 10th 370 photographs of the sun were taken in 182 days. For the year 1888 Greenwich photographs, supplemented by those taken in India, furnish a record of the state of the sun's disc on 359 days out of 366.

The photographs show that the sun was free from spots on 155 days, and that the mean spotted area was only half that of 1887. From the correspondence of the area of spots and faculæ and their mean distance from the equator with the last minimum the Astronomer-Royal expects a minimum this year. From a comparison of the results obtained from 8in. and 4in. pictures it does not appear that the precision of measurement of areas or positions of spots has been increased by the adoption of the larger scale.

The magnetic observations have been continued as in former years, the elements for 1888 being—Declination, 17° 40′ West; horizontal force, 3·9480 (in British units); dip, 67° 25′ 33″ (by 6in. needle). There were only three days of great magnetic disturbance and 20 day of lesser disturbance during the year 1888.

The continuous record of the meteorological phenomena has been maintained. New springs have been attached to Osler's anemometer; but in consequence of forms being printed on unsuitable paper, the Stationery Office is answerable for the two months' register of this instrument being unsatisfactory. The meteorological records show for 1888:—Temperature, highest, 87·7°; lowest, 18·4°; mean, 47·7°, or 1·6° below the average of 47 years; rainfall, 27·5in. (2·9in. above the average of 47 years); hours of bright sunshine, 1,068 (250 below the average of 11 years).

The printing of the 1887 volume of observations is not quite complete. The increase in the size of the annual volume of observations is appealed to as evidence of the enormous increase of the work in the Observatory. In 1881 there were 796 pages, and in 1886 the number had increased to 1,078. The Astronomer-Royal is now face to face with the question of how to meet the congested state of the Observatory caused by increase of work without a corresponding increase of staff, and has even to mention the possibility of having to discontinue printing the original observations. From the time of the foundation of the Observatory, over 200 years ago, every Astronomer-Royal has printed his original observations, and when a few years since it was suggested that this might be given up, the idea was condemned not only by English astronomers, but by astronomers the world over.

In the chronometer department the number received was 668; issued, 601; sent for repair (after examination), 282; thus showing that in 30 years the work of this department has doubled. This increase is continuing.

The Greenwich time-ball was successfully dropped on 364 days; on the other day it was not raised on account of high wind. The proposal to establish hourly time-signals at the Lizard remains as it was last year, on account of the pressure of the Observatory staff. The error of the Westminster clock was insensible on 33 per cent. of the days of observation, one second on 28 per cent., two seconds on 28 per cent., three seconds on 8 per cent., and four seconds on 3 per cent. The Post Office has taken over the maintenance of the time-signal wires and batteries.

The re-determination of the difference of longitude between Greenwich and Paris was successfully carried out last autumn, and it is intended to measure the difference of the longitude and latitude between Dunkirk and Greenwich this month. The French observers made a series of pendulum observations at Greenwich last year, and a series is now being made with the Indian invariable pendulum; thus the French and Indian pendulum determinations will be connected.

For the past two and a half years the preparation of a catalogue of stars observed in the years 1877-86, and the subsidiary investigations attendant on such a work have pressed very heavily on the inadequate staff; but astronomers and navigators will be pleased to learn that the reductions are practically complete and ready for press. The catalogue contains 4,059 stars, embracing some 40,000 observations. One quarter of the catalogue is printed. The Greenwich Star Catalogues contain probably the best material for determining the proper motions of stars, ranging as they do from 1690 to 1880; but, although this is one of the objects for which the Observatory was founded, the task of utilising the observations made at our Observatory has, owing to the small staff, been left to foreign astronomers.

MAKING CARBON RODS AND PLATES.*

CARBON rods and plates of the finest quality can be made economically only by the use of expensive machinery and apparatus, such as pulverising mills, hydraulic presses, and retorts or ovens; but the amateur, without a great deal of trouble, and with very little expense, can make carbon plates and rods which will answer a good purpose. The materials required are coke, wheat flour, molasses or syrup, and water. The tools consist of a few moulds, a trowel, or its equivalent, for forcing the carbon mixture into flat moulds, tubes to be used as moulds for carbon rods, and ramrods for condensing the material in the tubes and forcing it out, and an iron mortar or some other device for reducing the coke to powder.

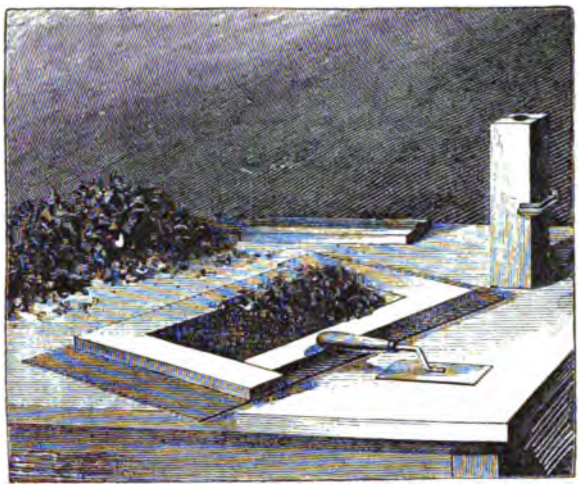


Fig. 1.

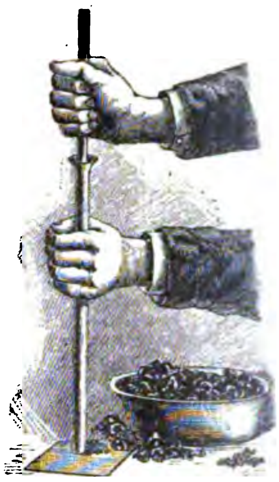


Fig. 2.

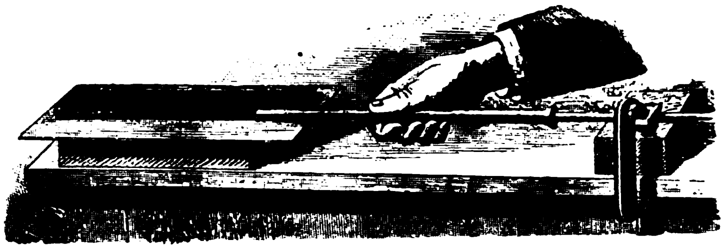


Fig. 3.

Clean pieces of coke should be selected for this purpose, and such as contain no volatile matters are preferred. The coke is pulverised and passed through a fine sieve. It is then thoroughly mixed with from one-sixth to one-eighth its bulk of wheat flour, both being in a dry state. The mixture is moistened with water (or water with a small percentage of molasses added) sufficiently to render it thoroughly damp throughout, but not wet. It should now be allowed to stand for two or three hours in a closed vessel to prevent the evaporation of the water. At the end of this time the mixture may be pressed into moulds of any desired form, then removed from the moulds and dried, slowly at first, afterwards rapidly, in an ordinary oven at a high temperature. When the plates or rods thus formed are thorougly dried, they are packed in an iron box, or, if they are small in a crucible, and completely surrounded by coke dust to exclude air, and to prevent the combustion of the plates or rods during the carbonising process. The box or crucible must be closed by a non-combustible cover and placed in a furnace or range fire in such a way as to cause it to be heated gradually to a red heat. After the box becomes heated to the required degree, it is maintained at that temperature for an hour or so, after which it is removed from the fire and allowed to cool before being opened. The rods or plates are then boiled for half an hour in thin syrup, or in molasses diluted with a little water.

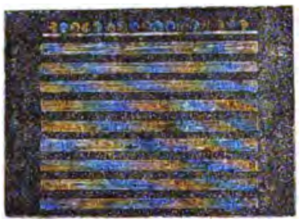


Fig. 4.

They are again baked in an ordinary oven, and afterwards carbonised in the manner already described. This latter process of boiling in syrup and recarbonising is repeated until the required density is secured.

As some gases are given off during carbonisation, it is necessary to leave the box or crucible unsealed to allow these gases to escape.

Fig. 1 shows an inexpensive form of mould for flat carbon plates. It consists of two right-angled pieces of wood of the thickness of the carbon plate to be made, and a thick plate of sheet iron. The iron should be oiled or smeared with grease before the mould is filled. The carbon and flour mixture is pressed into the mould smoothly, the wooden pieces are removed, and the carbon is left on the iron plate to dry. When dry, it is easily separated from the plate and may be handled without danger of breaking.

Cylindrical carbon rods may be formed in a wooden mould, as shown in the background of Fig. 1, and dried in a grooved iron plate adapted to receive them, or a brass tube may be used as a mould, as shown in Figs. 2 and 3. To facilitate the filling of the tube, a funnel may be formed on or attached to one end. The tube may be filled with carbon entirely from the top, or it may be partly filled by forcing its lower end several times down into the carbon mixture, finishing the filling at the top. The lower end of the tube is placed on an iron plate and the contents are rammed from time to time during the filling operation. When the tube is filled, it is discharged in the manner illustrated by Fig. 3, i.e., by pulling it over a fixed rod while its discharge end delivers the carbon cylinders to the iron plate on which they are to be dried and baked preparatory to carbonisation. The plate in this case should be oiled to prevent the adhesion of the rods. The rod by which the contents of the tube are ejected should be on a level with the top of the iron plate. Fig. 4 shows in section an iron box containing plates and rods packed ready for carbonisation.

A Cheap Telephone.—A correspondent in the *American Artisan*, who claims to have had considerable experience in that line, says a good working telephone may be made as follows:—Make two tin drums 6in. in diameter and 4in. deep. They should have a heavy wire formed in same as half gal. cup. The wire should not be less than No. 9. Take raw hide that has been divested of hair and stretch it over the drum while wet, and band it on with a small wire; let it remain till perfectly dry. A very thin hide, such as squirrel, cat, coon, is the best. Thick hide will not work well. Now to erect your drum, wire, &c., having set your posts and put up your insulators, which may be made of wire and suspended from arms which have been nailed to the posts, bore a hole in the wall where the drum is to be placed, run the wire through your drum and through the raw hide in the centre, having a button ready. Pass the wire through the eye of the button and back through the drum, and twist tightly, letting the button go, resting it on the hide. Put up the wire at the different insulators (string loop suspenders) till it reaches the other end of the line; then proceed to do as at first. If the wire has been properly stretched, and all the work has been done as it should have been done, you will have a good and cheap telephone. No. 1[illegible] copper wire for main line should be used.

A PATENT has been taken out by a Wakefield foundryman, it is said, for a method of casting pipes without sand moulds. "In superheated steam or gas-jacketed metal moulds" pipes are cast which are uniform, sound and true, as [illegible] turned or bored by a lathe. It is stated that the pipes so cast are not spongy or chilled, and they have excellent finish.

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* By Geo. M. Hopkins, in the *Scientific American*.

SCIENTIFIC NEWS.

THE comet known as *e* 1888 Barnard will increase in brightness slightly during this month, its position being for June 9, Berlin midnight: R.A. 22h. 40m. 4s.; N. Dec. 2° 38·1′; with a brightness rather more than double what it was at time of discovery.

Dr. Gill, of the Cape Observatory, has prepared a scheme for observations of minor planet Victoria (No. 12, discovered by Hind of London in 1850) at its opposition on July 16 next, with the view of calculating the parallax of the sun from heliocentric measures. Thirty-seven comparison stars are given, and it is hoped that as many observatories as possible will co-operate by determining the places of the stars and at the same time taking as many meridian observations of the planet as possible. Dr. Gill issued a similar scheme for minor planet Iris (No. 7) in 1888, and the observations of the planet and the comparison stars as made by Mr. A. A. Rambaut, of Dunsink, will be found in the *Monthly Notices* of the R.A.S. for March last.

A baronetcy has been conferred on Prof. G. G. Stokes, President of the Royal Society; a Companionship of the Bath on Dr. J. Bell, F.R.S.; and a Companionship of St. Michael and St. George on Mr. Ellery, director of the Melbourne Observatory.

The German Geological Society will hold its thirty-sixth general meeting at Greifswald from August 12 to 18, under the direction of Prof. E. Cohen. As the immediate neighbourhood does not offer many features of geological interest, the principal excursions will be to the islands of Rügen and Bornholm.

The Geological Society of France will hold its special annual session this year at Paris, commencing on August 18. The programme for the week includes excursions to Sézanne, Epernay, Rilly, and Dammery. A party will afterwards visit the volcanic district of the Auvergne, under M. Michel Lévy, while another party will study the crystalline schists of Brittany, under the guidance of Dr. Barrois.

The Senatus of Aberdeen University have resolved to grant degrees of Doctor of Science and Bachelor of Science, which are now to be obtained only in London, Edinburgh, and Glasgow. The attendance in the qualifying classes must extend over three academic years, one of which must be passed at Aberdeen University, and for the B.Sc. there will be two examinations conducted by written questions as well as orally and practically. The fee will be five guineas. The fee for the D.Sc. will also be five guineas.

Gaston Planté, whose death we announced last week, was a native of Orthez, in the Basses Pyrénées, where he was born on April 22, 1834. He received his real training at the Conservatoire des Arts et Métiers, where he became assistant to M. Becquerel. It seems that while in the service of Christofle and Co., Planté studied the electric light and injured his eyesight by the experiments he made, some of which were made with a battery of 800 elements. Although M. Planté never made a fortune by his discoveries, he had the satisfaction of knowing that those of his countrymen competent to judge estimated his services to Science at their true value, and he received the Lucaze prize from the Academy of Sciences of Paris, and the Ampère medal from the Société d'Encouragement. Of late years M. Planté devoted himself to the study of atmospheric electricity, and we believe that some important papers and notes remain to add to his "Phénomènes Electriques de l'Atmosphère." Like the majority of real students, M. Planté lived a quiet life, and never sought to make a fortune by any of his discoveries. Such a man dies all too young at the age of 55 years.

In a recent number of the *Comptes Rendus* is a paper on "The Alloy of the Standard International Kilogramme," by M. J. Violle. The alloy of platinum and iridium, in the proportion of 10 per 100, prepared with the greatest care by Mr. Matthey, is found to be still somewhat defective. M. Violle's researches show that an alloy of nine parts platinum and one iridium yields more uniform and accurate results, both as regards density and specific heat. The density thus obtained is an absolute constant, incapable of further modification under cold-hammering, annealing, or any other severe test.

Many determinations of the atomic weight of chromium have been made, with the result of showing that the true value lies somewhere between 52·0 and 53·5. The mean value of a series of determinations recently made by Mr. Rawson is 52·06.

A very interesting discovery in chemistry seems to have been made by M. Péchard, the details of which he has submitted to the Paris Academy of Sciences. It is a new substance derived from oxalic and molybdic acids, and is named oxalo-molybdic acid. It is a solid in large monoclinic prisms, and, rather curiously, it seems Berzelius must have missed its discovery, for he experimented by adding molybdic acid to hot solutions of oxalic acid. The value of the discovery made by M. Péchard lies in its applications, for it seems that the crystals of oxalo-molybdic acid when dry may be preserved unchanged without special precautions; but, if moist, they quickly become coloured blue when exposed to the sun's rays. Therefore, if characters are written on paper with the solution, they remain invisible in a weak light; but, when exposed to sunshine, they become visible, turning to a deep indigo. It is curious that this effect only happens when the solution is spread over paper or other surfaces, for the solution itself may be kept unaltered in the bottle for any length of time, except for a trace of blue at the edge of the meniscus, where, by surface action, a little is spread against the interior glass walls. If a sheet of paper is immersed in a saturated solution of the acid, dried in the dark, and then exposed behind an ordinary photographic negative, a sharp print in blue may be obtained by exposure to sunlight for about ten minutes. The colour instantly disappears in contact with water, so that if a piece of this sensitised paper be wholly exposed to sunlight, one may write in white upon the blue ground by using a pen dipped in water. If, however, the paper with its blue markings be exposed to a gentle heat for a few minutes, the blue changes to black, and the characters are then no longer destroyed by water. There is apparently a good deal of practical usefulness in M. Péchard's discovery.

In a paper left by the late Prof. Wroblewski, doubt is expressed as to the liquefaction of hydrogen by Pictet and Cailletet; but as that is a question which can be settled by repeating the experiment, it is only necessary to mention that other chemists have failed to liquefy hydrogen.

There is to be a gold-mining exhibition at the Alexandra Palace in July, under the patronage of the representatives of the Colonies.

A telpher line is in course of erection at the Alexandra Palace to take passengers, &c., from Wood-green station (G.N.R.) to the Palace up the steep gradient, which is about 650 yards in length. The line is rigid, consisting of two rails or "roads," carried about 25ft. above ground, and the train will consist of five carriages with a "locomotive" weighing about 21cwt., capable of exerting 15 horse-power.

The Midland Railway Co. have adopted the electric light on some of their express trains, the dynamo being driven from an axle on the rear van, accumulators being provided to sustain the light when the train stops. If found really successful and economical, it is possible that all the trains on the system will be fitted.

A canal through the Isthmus of Perekop, which will have the effect of making the Crimea an island, is about to be commenced.

The works of the North Sea-Baltic Canal are now progressing with considerable rapidity, and a large staff of men are engaged in this large undertaking. At Grünthal, the highest point on the canal, about 600 men are at work. At this point a bridge of large span will carry the Heide high road across the canal, and will also serve as a railway bridge for the west railway. It has to be high enough for the largest ships to pass under it. There are five excavators at work.

The new *Calais-Douvres*, a steamer built for the Continental traffic of the L.C. and D.R., seems to be a decided success, making the trip from Dover to Calais in little over an hour. She is 325ft. long, with a beam of 36ft., and a moulded depth of 21ft. 6in., and a rudder at each end. The engines are compound, of the diagonal direct-acting type, with a high-pressure cylinder of 59in. placed over a low-pressure of 106in. diameter, the stroke being 6ft. The paddle-wheels have feathering floats. The vessel has accommodation for 900 passengers.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—Montaigne's Essays.

VISIBILITY OF CRESCENT OF VENUS TO THE NAKED EYE.

[29998.]—I SHOULD be glad if Mr. Hopkins would inform me where I can find Mr. Stoddart's letter, quoted by him on p. 281. Webb, on p. 50 of "Celestial Objects" (4th ed.), mentions that the crescent has also been seen in Chile, and by Theodore Parker. Who was the Chilian observer, and where is Theodore Parker's statement to be found? I very much doubt myself the reality of the alleged observations, though, of course, I do not question the bona fides of the observers.

On April 27th Venus subtended the same diameter as a halfpenny viewed at 48 yards distance. Surely Mr. Dixon's (letter 29980, p. 281) sight must be very abnormal if he could see whether a bright object—say a piece of silver glass illuminated by sunlight—of the size of a halfpenny at that distance appeared as a crescent or not. **H. S.**

VENUS, SATURN, AND KEEN SIGHT.

[29999.]—I TRIED the experiment of observing the crescent of Venus with a small pocket telescope, with object-glass 1in. diameter, during this last superior conjunction of the planet. I certainly saw it: the magnifying power being ten diameters. Knowing what I was looking for, I found it easily; but an inexperienced observer would probably have failed to detect the crescent. That anyone has seen it with unaided vision, seems to me, to say the least, that "the wish was father to the thought."

A little while ago a man assured me that he had often seen Saturn with the naked eye! He was my next-door neighbour, but I never argued the point with him.

Competitors for keenness of vision seem to be increasing. Now as some large telescopes do not show Temple's nebula in the Pleiades, and the generality of small ones do, may I ask if anyone can see it with the naked eye? I see it, but with a telescope under 4in. of aperture. **D. B. L.**

SATURN.

[30000.]—JE crois que l'observation rapportée par M. W. R. Waugh (lettre 29978, p. 281 de "l'E. M.") et d'où l'auteur croit pouvoir conclure que la tache blanche de l'anneau de Saturne est un simple phénomène de contraste, est sans aucune valeur à ce point de vue. De ce qu'un détail, vu avec de faibles grossissements, ne se voit plus avec des grossissements supérieurs, l'on n'a jamais été en droit de conclure que ce détail est illusoire. M. Waugh peut en faire l'expérience sur Saturne lui-même, si son instrument est assez puissant; avec de faibles grossissements il constatera peut-être que la principale bande du globe est surmontée d'une autre bande plus faible, et que la séparation un peu plus claire des deux bandes est bien visible; un grossissement moyen lui montrera même peut-être un aspect moutonné dans cette séparation un peu claire; mais avec de forts grossissements il lui sera beaucoup plus difficile de constater cette séparation; en conclura-t-il que cette séparation n'est qu'une illusion d'optique? Et de même, bien souvent, des détails délicats, distincts seulement par de faibles nuances, de faibles degrés d'intensité, lui échapperont avec des grossissements forts et seront très visibles avec des grossissements faibles.

S'il s'agit d'un effet de contraste, je demanderai à M. Waugh, comme à M. Holmes, de me dire pourquoi cet effet de contraste ne se manifeste nullement de l'autre côté de l'ombre, c'est à dire sur le globe lui-même?

S'il était prouvé que cette tache n'en est pas une dans le sens rigoureux de ce mot, il ne s'en suivrait pas encore qu'elle est une pure illusion, un simple phénomène subjectif qu'elle n'a aucune réalité objective. Ne pourrait-il être question d'un effet spécial de lumière comme celui auquel je fais allusion dans ma dernière lettre (29955, p. 258)?

Mais je ferai même observer à M. Waugh que nous connaissons bien peu de choses sur la rotation de l'anneau, et il aura la avec interêt, sous ce rapport, la lettre 29979, p. 281, qui suit la sienne; cette lettre de "W. G. P.," que j'ai eu à peine le temps d'examiner, car je vous écris au reçu de "l'E. M." le 31, a au moins le mérite de ne point sacrifier des observations positives à des notions qui ne sont point péremptoirement établies. Je suppose que M. Waugh observe distinctement dans la planète Vénus un phénomène inconciliable avec les périodes de rotation de Bianchini, de Schröter, ou de De Vico; rejettera-t-il son observation comme illusoire on cherchera-t-il à concilier ce fait avec les notions précédemment reçues? Au besoin, n'invoquera-t-il point les contradictions de ces notions et leur peu de base?

Je saisis cette occasion de dire aussi que j'ai reçu de M. McLeod, de McGill Observatory, Montréal, Canada, une lettre relatant ses observations de la tache de l'anneau de Saturne. C'est la premier astronome qui ait réussi ce détail après l'annonce que nous en avons faite, et il l'a vu dans tout son éclat, dès le 14 Mars; M. McLeod a constaté que la tache est devenue plus petite à la fin de Mars et en Avril, confirmant ainsi, indépendamment, ce que je vous écrirais dans ma lettre 29955, p. 258.

Comme la tache de l'anneau semble avoir réveillé une grande incrédulité parmi les astronomes Aréographes qui s'intitulent *Anticanallites* puis qu'ils appellent les partisans des canaux les *Canallites* (lettre 29977, p. 280), je me permettrai d'exprimer le désir de savoir si l'on accueille avec la même incrédulité l'observation d'un canal noir traversant la tache polaire de Mars en 1888, et qui n'a été faite que par trois *Canallites*, MM. Schiaparelli, Perotin, et votre humble serviteur,

Louvain, Mai 31. **Dr. F. Terby.**

ASTRONOMICAL.

[30001.]—I can assure Dr. Terby that I shall not at all regret to find that he is right in regard to the supposed discoveries upon Mars and Saturn. He, however, has not sought to explain the reticulations upon Mars being seen as straight lines, or nearly so, in all positions upon the disc.

As to white spot on Saturn, he asks me, if an effect of the nature of complementary phenomena, why it has never been seen before. I cannot tell—except that of late the shape of the shadow upon rings has been much scrutinised, and therefore the fixed blackness has made a strong impression on the retina, resulting in the ghost upon moving the eye. Formerly this shadow was not so much examined. We might ask when a non-existent star has been seen by an eminent astronomer, and his seeing confirmed by other eminent astronomers, why no one fancied that star was there before; or on the day when so many people saw the stone lion on Northumberland House wag his tail after one man had said he saw it move, we might ask why no one saw this before.

As to the reason why no one has noticed it on the globe, I think that is very simple. The attention of all observers has been given to the outline of shadow on rings—not to other margin; and therefore the axis of eye has always inclined to the right. The ghost would appear on that side, and not on the side to which attention was not drawn. I am not sure I follow his last suggestion. If he means that possibly a brighter portion of the globe of Saturn is so situated as to reflect sunlight upon the rings close to the shadow, I think he will see this will not bear looking at. Saturn turns on his axis, a bright place would come round, it would need a bright belt to *always* throw light on same portion of rings. This we should see on globe, as we should also a spot. But I do not think I need say more about this. I ought to add that I do not think the failure of the gigantic instruments at all a reason for doubting these observations, since I am satisfied that for eye observations upon the planets 12in. to 15in. exhausts all that we may hope for, and that a larger aperture is actually injurious to the perception of detail.

With regard to visibility of crescent of Venus, will Mr. May take the trouble to see at what distance he can read a posting bill, of which he does not previously know the words or subject, with, say, 4in. letters upon it. If he will also make a bright wire crescent, and place it at a corresponding distance from his eye that will make it subtend the diameter of Venus, he can experiment without atmospheric undulations interfering. I note the air was not in very good state when he saw Venus as a crescent, which certainly adds to the difficulty, and also to the difficulty of believing he was not deceiving himself. I have known friends see a thing when told it was there, when really they did not. I intend to make some experiments on a model of crescent of Venus, and try different people upon it. If I find one who can see the crescent I will report.

With regard to letter in this week of Mr. Dixon (29980), it is admitted that only people of very exceptional sight can see the crescent. How marvellous that not only Mr. Dixon, but his two friends, should be so gifted.

Now, I wish to refer to another matter which perhaps ought to go to the *Journal* of the L.A.S.; but as that is only issued once a month, and probably would not admit my questions, while, if admitted, they must wait six months for a reply, I think I am not overstepping courtesy in sending them to the "E. M." instead.

In an article entitled "Why has the Moon no Polar Caps" occur a number of statements which require proof. I will quote verbatim, and to each add a query:—

"Venus . . . has not cooled down so much as the earth, while Mars already shows signs of incipient glaciation in the conspicuous snow caps and attenuated atmosphere." What grounds are there for the assertion *re* Venus? Are the snow caps of Mars more conspicuous than those of the earth would be at similar distance, and do we know that the atmosphere of Mars is "attenuated"?

"The asteroids are presumably but little above the temperature of space—say, minus 150°—and are probably refrigerated to the core." Does any human being know anything of the condition of a single asteroid?

"When we may assume she (the moon) had water." Is there a particle of evidence the moon ever had any water? Does not her surface show rather that none ever existed? The very writer I quote from says: "the conspicuous absence of drainage constitutes the moon's great peculiarity"—"one might playfully say that 'nature abhorred drainage' on the moon"; yet he assumes she is snow-covered. Will he answer a question? If snow-covered, how does he account for no sign of vapour obscuring the face of the full moon? Here we have an unclouded sun, with an unbroken impact of his heat for 14 days without melting, with no protecting atmosphere, and at the lunar equator practically a perpendicular incidence for days together, and not a snow crystal can be warmed into vapour enough to obscure even in the slightest degree our vision. Moreover, lacking atmospheric pressure, and with less gravitation, steam would be raised on the moon much more easily than on the earth. We find almost all substances throw off vapour with a small amount of heat in a vacuum—certainly few liquids refrain. How is it no such results follow on the moon? Snow would certainly vaporise under such conditions; therefore the inference is it does not exist.

Edwin Holmes.

β LEONIS.

[30002.]—The "Celestial Cycle" gives, on the authority of Mr. Knott, a list of *comes* as herewith:

AB	206°	4′	42″	B	8th mag.
AC	187	11	30	C	10th mag.
AD	202	19	30	D	7th mag.
AE	116	5	3	E	12th mag.
AF	120	10	est.	F	11th mag.

I omit fractions in position angles, and "Cycle" adds that Burnham found another companion 345°; 77″, and also noted that D is a close double 337°; 1·52″; 6½ and 11.

I find all these easily visible even before quite dark; but I also find Knott's E has a small *comes* at about 10°, and Burnham's star at 345° has also a *comes* in the same direction nearly. I am surprised these were missed. There is also another star at 300° about as distant as D. I think there are more stars; but β Leonis has now gone too far west for me to observe. **E. Holmes.**

SEEING MERCURY IN FULL SUNSHINE THROUGH A 6in. O.G.

[30003.]—Will any of your astronomical correspondents, who may possess 6in. silvered-glass specula, say whether, with the said mirrors equtorially mounted, they can see the planet Mercury *in full sunshine?* I have often tried, but always signally failed, and am precluded by houses from seeing it when near the horizon.

Also will someone who knows kindly say how the theoretical point of "greatest brilliancy" is arrived at with the planet Venus. I can see that it is nearly, but not exactly, half-way in time and distance between inferior conjunction and greatest elongation. **Al Fard.**

EXTRAORDINARY METEOR.

[30004.]—On May 29th, at 10h. 44½m., a very large meteor was seen here. It ranks as the second largest meteor out of over one thousand that I have recorded. It moved very, very slowly from Leo into Gemini. The colour was yellow, and slightly tinged with a blood-red on the outer edge. An elongation perhaps 1½° long followed the head of the meteor, giving it the appearance of a club. There was an apparent blazing-up of the head several times, as though flames of gas were shot forth from the body, but no vaporous nor phosphorescent streak was left in the track of the meteor after its extinction.

During the last 1½ or 2secs. its light became gradually less, as though the substance of the meteor was being consumed, and after extinction a small cloud of apparently incandescent dust took up the meteor's motion for about half a degree.

I recorded what I observed at the commencement of the flight of the meteor as 141° ± 20°, and its finish at 113° + 23½°. I hope other observers saw this remarkable body, and will give a correct description of its path amongst the stars as seen by them, for the purpose of calculating the heights of the commencement and finish of the path of this remarkable meteor in our atmosphere.

Leeds, June 3. **David Booth.**

REMINISCENCES OF SOUTHERN SKIES.

[30005.]—In letter 29984, the following corrections require to be made:—Paragraph 11, observation C of external contact, for 3h. 5m. 7s. read 3h. 8m. 7s. Pons Comet, 1884: the name of the comparison star should read γ (gamma) Pegasi. In last paragragh but three, the cluster should be ω (omega) Centauri. **E. E. M.**

ORNAMENTING IRREGULAR SURFACES—MR. J. H. EVANS—WATER MOTOR.

[30006.]—I noticed "Namwen's" request for more information as to how this was done, and hoped "C. C. E." would reply, as he has much to tell us if he could make time to do so. I believe unturned irregular surfaces, such as the outside of a coco-nut, can be ornamented by drills, cutters, &c., by means of a rose engine, by regulating the depth of the cut by means of the "touch" resting on the surface to be ornamented, close to the tool, and upon that part of the surface as yet untouched. A coco-nut is easily sawn in two and smoothed by rasp-file and sand-paper, and it takes a fine polish; then, if mounted in the rose engine, it could be ornamented, and would, I think, look very well.

I was glad to see a paper from Mr. Evans not long ago, and beg to ask if he will not give us one upon the dome chuck and another upon the spherical rest, supplementing what he has told us in his book? On the first I should like to hear in particular—though I can partly guess it—what are the uses of the extra circular movement shown in the illustration of his chuck in his book, which movement does not appear in Holtzapffel's; he does not mention this in his description. As to the second, I should like to ask him to show us how the spherical rest is connected with the spiral apparatus, so as to cut spirals on spheres and beads. Thirdly, I think it would be very interesting to have a comparison of the powers of these two pieces of apparatus, showing how far they can do the same work, and what powers are peculiar to each. I have been trying to make such a comparison, but it is not easy without having the apparatus by one.

If the water-motor referred to by C. White on p. 285 has an arrangement by which the crank-pin is moved by the governor while the motor is running, that seems just what is wanted. Perhaps someone will tell us more of Hastie's patent?

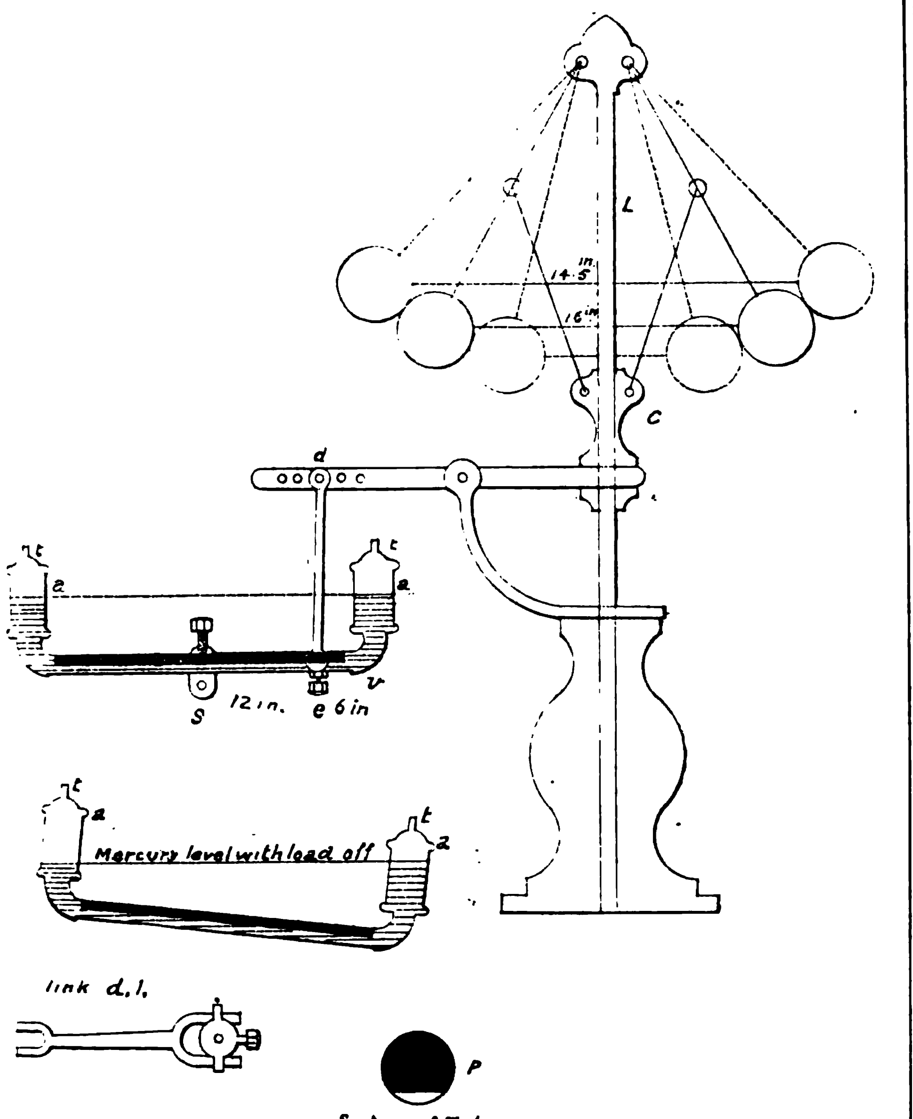
F. A. M.

WATER MOTORS.

[30007.]—In reply to "F. A. M." (letter 29966), a motor such as he asks about has been patented, and is made by Arthur Rigg, 42, Old Broad-street, London. The speed is regular, and the quantity of water used is proportioned to the work to be done, obtained by varying the length of stroke according to the power required. Description briefly as follows:—A revolving three or four cylindered engine, with trunk pistons; each cylinder is cast with a projection outside the closed end, which may be likened to a thick washer placed on edge against the end of cylinder. These washers (valve facings) are so placed on each cylinder that when they are all strung on an axle (the centre-pin) through holes in their centres, the cylinders all radiate with their centre lines all in the same plane, like the spokes of a flywheel. The water enters and returns from the cylinders through ports in a line parallel with the centre pin, turning at right angles up into each cylinder. A disc flywheel is hung in front of the cylinders, with three or four crank pins at equal spaces near its edge, projecting towards and over the cylinders, to which their piston-rods are attached. The varying length of stroke is thus managed. If the centre lines of the centre pin and flywheel axle are in a line, of course no motion can be made; but if the centre pin be lowered, the flywheel will move just as though it were driven by a crank with an arm of a length of the amount that the flywheel centre is out of line with the centre-pin centre, and therefore the more the centre pin is lowered the longer the stroke. The centre pin is carried on a slide, which is automatically moved by the governor. **G. M. S.**

MERCURIAL SPEED REGULATOR.

[30008.]—In controlling the speed of steam-engines, &c., the centrifugal governor is largely used; and, as is well known, this is not strictly correct, we will take for our illustration a governor of



the Watt type. Let L be the vertical height from the point of suspension to the plane of revolution. In this case let L = 16in. when the engine is at its normal speed (or the sliding collar C is in the middle position), by the formula $\frac{187·5}{\sqrt{L}}$; the speed will be, not taking into account the weight of rods, &c., $\frac{187·5}{\sqrt{16}}$ = 46·87 revolutions per minute; let the sliding collar travel 1½in. each way, then the speed will be, when the balls are in the highest position, as shown by the dotted lines = $\frac{187·5}{\sqrt{14·5}}$ = 49·3, or a difference of 2·43 revolutions per minute; the same difference will occur if extra load goes on, or the steam goes down, and the balls fall into lowest position. A device was invented and patented in 1881 for correcting this difference. The sketch will assist in showing what the arrangement is; *a*, *a* are two mercurial vessels set level when the engine is at its normal speed, the vessels are then nearly half filled with mercury; if the load goes off the balls diverge into the higher position, and the vessels are tilted or inclined to each other, and the mercury flows from the higher to the lower vessel and assists the governor to rise. Again, when extra load goes on, or the steam goes down, they act in a contrary direction.

The tube connecting the vessels is wrought iron steam pipe. A piece of round iron with a flat side is driven into it to lessen the passage, so that the mercury will not flow too suddenly; it also strengthens the tube. P shows a section of tube, a tap may be screwed into one of the air tubes to answer as a check upon the flow of mercury.

To find the weight required, count the number of revolutions with engine at normal speed, then throw the load off, and add weight to lever at *d* until the normal speed is gained. Suppose this to be 10lb., take the length from swivel *s* to centre of vessels $v = 18$in., and take hold with link *l* 12in. from *s*, then the weight of mercury will be, with lever at *d* moving 1½in. as at sliding collar $c = \frac{12 \times 10}{18} = 6·66$lb., the depth of vessels will be twice their travel. Thus $= \frac{1\frac{1}{2} \times 18}{12} \times 2 = 4\frac{1}{2}$in., say, 5in. deep, allowing ½in. for working margin. Again the diameter will be, taking 2c.in. of mercury to weigh 1lb. (which is nearly correct) $= \sqrt{\frac{2 \times 6·66 \div 4·5}{1 \times 7854}} = 1·94$, nearly 2in. diameter. The vessels can be fixed at any point between the governor and throttle-valve, a stud can be screwed into engine frame to receive swivel at *s*, with the set screws at *s* and link *e*, the weight can be adjusted.

Before this appliance was introduced, we had continual complaints of unsteady turning; since applying the above, we have had no complaints and no unsteady running. Any one can make and apply this, as the patent was allowed to run out.

Todmorden. **W. H. Sutcliffe.**

HAYDON'S CUTTER-BAR.

[30009.]—Looking through the last half-dozen numbers of the "E.M.," I find under this heading considerable discussion as to the capabilities of the Haydon bar.

I think, however, the majority of our mechanics using a lathe are fully satisfied that "Notes by the Way," from "J. K. P.," should be accepted as correct, and his statement, *vide* p. 156, No. 1,256, is that "He would not be without it on any account."

Now, as stated by several correspondents, the vital question is this: *Are the reputed Haydon bars* (which have been used by such writers as have not found them satisfactory) *accurately constructed?* Evidently this is not the case from their performance, and, having lately had no less than six different bars sent here for examination—not one being correct, and no two being alike—I am fully satisfied that such imitations are the sole cause of the difficulties which have occurred.

The fact of the Haydon bar being unquestionably *a thoroughly good and reliable lathe tool*, has led to its being copied by a host, who have not the remotest idea of the principles which the inventor embodied in its design, and the consequence is, with this as with other equally good apparatus, those who unfortunately have been deluded by the reduced prices, and similar systems of entrapping, have imagined the principle of the bar to be incorrect because their own particular tool will not afford satisfactory results; and, I may add, that unless the maker of this bar has an accurate mechanical knowledge of the correct principles of its construction, so as to be enabled to design it to meet the exigencies of the case in hand, it will most probably be a failure.

Griffin Works, Norwich. **Edward Hines.**

PHRENOLOGY.

[30010.]—In your issue of April 12th Mr. Mark Moores refers to Mr. Bridge's book on Phrenology. I am unacquainted with this work, and should be glad of a further statement of his method of measuring "the size of the different signs of the usual faculties." The method as given is by comparing the relative volumes of the brain (I should myself say of the brain case) above and below a line drawn through the centre of ossification of the frontal bone, and "parallel with a line drawn through the opening of the ear." As far as my mathematical knowledge goes, it tells me that one point in a plane is not sufficient to determine the direction of any line in that plane. I should be glad to learn the other point through which the base line "through the opening of the ear" should pass.

The bearing of this will be seen on an inspection of the figures given by Mr. Moores. In Fig. 1 the base line ends about the extremity of the nasal bones; in Fig. 2 somewhat lower down; in Fig. 3 it is clear of the nasals altogether; and in Fig. 4 ends about the level of the superior maxillary border. If the line be drawn in each case through corresponding points, the differences pointed out by Mr. Moores are far less distinct; and if the comparison be made between the region above the line (which is all brain) and that portion only of the lower skull which actually contains brain, not with the part of the skull including the osseous base which lies below the line, the differences become too small to found any theory upon.

Mr. Moores' method of measurement at the most seems to me to give only a rough method of estimating the development of the cerebral hemispheres; and it is pretty well established by this time how little reliance can be placed on this as a test of the intellectual power of any one individual, though it is of value as a facial feature. I am one of those doctors who, as Mr. Moores says, "sometimes venture an opinion about something they do not understand"; but I think that if Mr. Moores had had, as I have, opportunities of examining the skullcaps and brains of men of whom he had a more or less intimate acquaintance during life, in the relative positions of doctor and patient, he would place far less reliance on the external form of the skull as an index of individual peculiarities. For the last six years I have examined carefully, as a part of my duty, the skulls of all men who have died under my care, have dissected and weighed their brains, and, as far as my experience goes, I can trace very little relationship between the external conformation of the head and the state of development of the brain, and of both with the intellectual powers of the men. In the first place, the thickness of the cranium varies, and most irregularly; secondly, the degree of complexity of the convolutions varies mainly as to depth, their general character and distribution, of course, being constant; thirdly, the relative proportions of grey and white matter vary considerably. Those are the results of the examinations of the brains of men whom I have known more or less intimately prior to death, and of whose intelligence I have had opportunities of judging.

I am far away from any library, and can only refer at present to Quain's "Anatomy," Ed. 1876, Vol. II. p. 580, where the researches of R. Wagner are quoted as showing—1. "That superiority of size cannot be regarded as a constant accompaniment of superiority of intellect, even when due regard has been paid to the comparative stature and other circumstances of the individuals"; and, 2. "Exceptional instances make it impossible at present to deduce any certain conclusion with respect to the relation between the number or extent of the convolutions and the intellectual manifestations in different persons."

The matter seems to me to stand thus:—From external appearances—1. No true estimate of the size of the brain can be made. 2. From the size of the brain, no idea can be formed of the state of the convolutions—i.e., extent of the grey matter. 3. When you have an estimate of their complexity, you are still without any reliable indication of the mental powers of the individual.

This being so, we may be excused for doubting the conclusions of phrenologists.

Shaikh ul Jabal.

SAFETY-LAMPS.

[30011.]—The following is interesting, and if not already used may be useful, so I send it in case it has not been used.

When working in a chemical laboratory a little time since, I was using two pieces of wire gauze, one above another, to support a beaker over a Bunsen burner. I noticed that although the bottom piece of gauze quickly got red hot in the flame, that the upper piece, when at a distance of about two millimètres, did not get red hot even with the full flame. But when the second piece was raised to about a centimètre above the lower piece, a flame at once came on between the two, and quickly heated the second.

If this has not been already made use of, might it not be an improvement in safety-lamps to have two layers of gauze. Will someone who knows about safety-lamps kindly say if such an arrangement is used. **Ignotus.**

HEAT, SOUND, AND LIGHT.

[30012.]—The thanks of all interested readers are due to Mr. W. G. Penny for the very able series of letters recently appearing in this paper on "Light—Visibility of Objects, Colours, and Phosphorescence," and "The Conversion of Heat into Light."

In letter 29575, the first paragraph stated that, "When an object is visible, it must be giving out light to render it so, and when it is doing so it must be in a state of activity of some sort, as distinguished from its quiescent state at other times."

If we accept the theory of "heat as a mode of motion," this "quiescent state" does not exist, for all bodies, whether visible (i.e., illuminated) or not, *must be* in a state of molecular vibration.

In letter 29642, Mr. Penny treats both sound, light, and heat as due to precisely the same cause, or as varying rates of the same mode of molecular motion. Also in the same letter he refers to a case in which the temperature of a body is gradually raised until it becomes self-luminous, and gives "Ganot's" explanation of the simultaneous evolution of heat and light. And in the next sentence we have a parallel case in which sound and heat are manifested precisely as heat and light are in the first instance. Now, Mr. Penny refers to the undulatory theory, and applying it to sound, light, and heat, states that the "history of what happens (in the two preceding cases) is of the simplest possible kind"—"when different vibrations are excited by any given cause, some of them become sensible sooner than others," &c.

But these three forms of energy, sound, light, and heat, are sensible to us only through separate and distinct senses. And are the vibrations which are sensible to us as light of the same kind as those sensible to us as heat? That is, is the mode of molecular motion which gives us the light identical in all but *rate* of motion with the molecular motion which we call heat? If so, then why is not light sensible to us through our sense of touch? for we are easily sensible by touch of heat as intense as that accompanying the most powerful light known.

The fact that we are sensible of sound vibrations before those of heat, and of heat vibrations before those to which light is due, does not necessarily prove that sound vibrations are the slowest, heat the next in point of speed, and light the highest rate of motion. To determine the relation of the order in which we are sensible of these three forms of energy to their rates of molecular vibration is a much more intricate problem.

One other point: Is the theory of sound, light, and heat, as simply varying rates of the same mode of molecular motion, sufficient to account for their very different means of transmission and diffusion? It certainly does not explain the joint appearance and increase of heat and light and of sound and heat, as in the two instances given.

Now, suppose we take heat to be a high rate of molecular vibration: the vibrations being irregular, following no distinct course, but each molecule or group of molecules vibrating independently of its neighbouring molecules, and increasing in volume as they vibrate, they communicate their motion to any body with which they are in contact, the intensity of the heat, of course, depending upon the rate of the vibrations, and the quantity or volume of the heat upon the number of molecules so vibrating.

It is evident, seeing the vast numbers of molecules which go to make a comparatively small piece of a given substance, that whilst in a state of active vibration a large number of molecules would necessarily be vibrating in unison, and the greater the number of vibrating molecules, the greater would be the number which would vibrate in unison. To these simultaneous and collective vibrations it is proposed light is due—sound being the manifestation of a similar collecting action of much slower vibrations—so slow, as to be generally inappreciable as heat.

The theory of light as the collective action of varying numbers of molecules vibrating in unison is greatly strengthened by recent experiments upon the Leyden jar discharge by Prof. O. Lodge, who has succeeded in showing that the oscillating discharge of the Leyden jar possesses all the characteristics of light, though I believe he has not as yet succeeded in obtaining a result capable of affecting the retina.

These same oscillations have been so reduced in speed by Prof. Lodge as to become sensible as sound, thus clearly demonstrating that light and sound are due simply to differing rates of one and the same mode of molecular motion, and that this mode of motion is a collective action of vibrating molecules is also evident; for if electricity be a fluid or material substance, the oscillations of a material substance have the same effect as the collective action of vibrating molecules. And if electricity be a form of energy—a mode of molecular motion—then these oscillations can only be due to a collective action of the molecular motions manifested as electricity.

I purposely refrain from introducing into this letter any theory as to the nature of electricity; but if Mr. Penny would kindly favour us with his views of this subject, I would ask if he shares the opinion expressed by Dr. Lodge in a lecture delivered at the London Institution, and published some time since in *Nature*: "Electricity may possibly be a form of matter—it is not a form of energy." **Wallace H. Paull.**

Cwmystwyth, near Aberystwyth.

A CURIOUS PHENOMENON.

[30013.]—I beg to hand translation of an extract from the *Jornal de Noticias*, Bahia, of what is styled a curious phenomenon.

"During the day (20th April) rain fell incessantly, and at 11.30 a.m. slight rumblings of thunder were heard in the distance.

"At night, however, without lightning and after a torrential rain, a tremendous flash of intense brightness was suddenly seen, which was immediately followed by a fearful clap of thunder, long and very loud, such as is commonly called 'plate thunder' (trovoadas de pratos). In a few seconds all was quiet, there being no more lightning and the rain ceasing, continuing only later on. The unexpectedness of the violent shock caused great and general terror, producing nervous attacks in many cases.

"Since the fearful thunderstorm of 6th October, 1870, which the population still remember with terror for its intensity and results, we do not remember to have heard such a long and continuous electric discharge. All the more wonderful for being a single thunder-clap."

Rio, 9th May, 1889. **G. W. Nicolls.**

A PIANO FOR EVERYBODY.

[30014.]—"Vandal's" letter (29992), in response to mine on this subject, has evidently been written by an expert in piano construction, and so he is able to set forth some of the mechanical difficulties involved in the attempt to design and construct a portable, cheap, and fairly good musical instrument for the million—an instrument which, if it only could be produced, would drive the concertina, accordion, and melodeon out of the field, which consummation, in my opinion, would be a clear gain to the cause of musical culture.

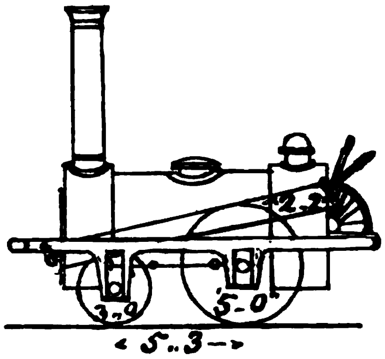
In my letter on the subject I suggested the use of wire gongs for the lower octaves. These might also be used for the middle octaves, and then only the upper octaves would need to be strung, and thus the necessity for a large and heavy soundboard would be abolished. I venture to suggest that the tone and quality of a musical instrument does not depend upon the magnitude of its soundboard, but is rather determined by the material of which it is made and its shape. A violin is neither heavy nor large, but its quality of musical resonance is something wonderful. The zither is a mere toy in size compared with the piano, yet its tone will bear comparison with the larger instrument for sonorous quality. These and many other examples prove that, other things being equal, a small piano ought to be nearly as good in quality of tone as a large one. **W. Nettleton.**

Fitzwilliam-street, Huddersfield, June 1.

LOCOMOTIVES.

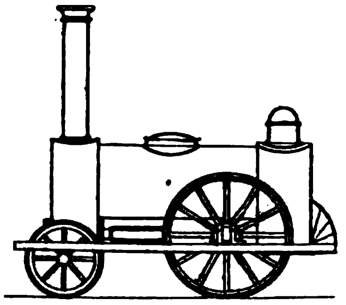
[30015.]—The illustrations of the "Rocket" and "Northumbrian," which appeared on p. 260, show that the first eight engines constructed by Stephenson for the Liverpool and Manchester Railway were of the "Rocket" type, having the driving-wheels in front, and "outside" cylinders. Following the opening of that line, Stephenson constructed for that company a new class of engine, having inside cylinders, a crank-axle, and the driving-wheels at the rear. It was named the "Planet," the dimensions being as follows:—Cylinders, 11in. diameter, 16in. stroke, 2ft. 6⅝in. centres; wheels, front 3ft. diameter, hind 5ft. diameter; boiler, 6ft. 6in. long, 3ft. diameter; 129 tubes, 1⅝in. diameter. Heating surface in tubes, 370·41sq.ft.; firebox, 37·25sq.ft.; total, 407·66sq.ft. Area of firegrate, 6·50sq.ft. Weight in working trim, 8 tons; on driving-wheels, 5 tons 2cwt. 2 qrs.

The "Planet" was tried for the first time on December 4th, 1830, and drew a mixed train of passengers and goods weighing 76 tons, exclusive of engine and tender, from Liverpool to Manchester in 2 hours 39 minutes, the highest speed on the journey being 15¼ miles an hour. It will be observed that the frame of the "Planet" No. 9 was below the driving-axle; but in the "Mercury" No. 11, and "Mars" No. 12, the frame was placed *above* the axle. Cylinders, 11in. diameter, 16in. stroke, 2ft. 7in. centres; wheels, front 3ft. diameter, hind 5ft. diameter; boiler, 6ft. 6in. long, 2ft. 9in. diameter; 84 tubes, 1⅝in. diameter.

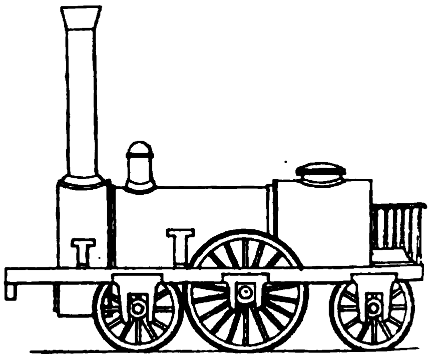


"Mars," No. 12.

Engines of the "Planet" class were found to work exceedingly well; but, as their weight and speed increased, oscillation resulted in consequence of the short wheel-base, and the permanent way became seriously damaged; Stephenson, therefore, decided to add a pair of small wheels, the first engine of the new design being named Patentee No. 33; it was put to work in January, 1834.



"Planet," No. 9.



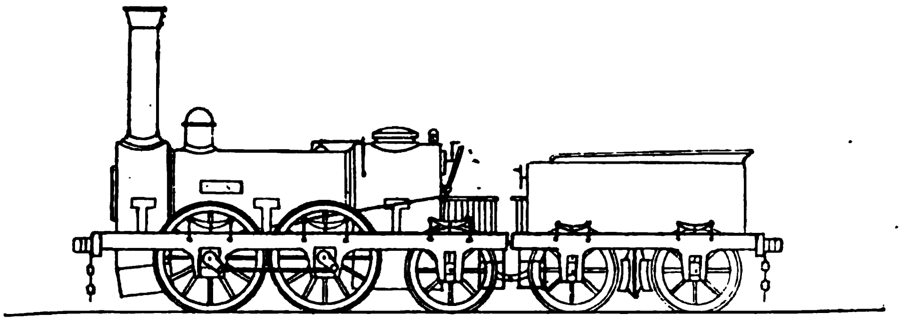
"Patentee," No. 33.

Diameter of cylinders, 12in.; length of stroke, 18in.; diameter of driving-wheels, 5ft.; length of boiler, 7ft. 1in.; number of tubes, 106.

This engine was named "Patentee" because it was the first built under Stephenson's patent of 1833, which provided that the driving-wheels should be *without* flanges.

The above illustrations, taken together with those which appear on p. 260, are interesting, as they show very clearly how, in a period of nine years, the locomotive gradually grew from the "Locomotion" of 1825 to the six-wheeled passenger engine of 1834.

Clement E. Stretton.
Consulting Engineer Asso.Soc.
of Engine-drivers and Firemen.
Saxe Coburg-street, Leicester, May 24.



LOCOMOTIVES.

[30016.]—IN my letter, p. 261, an illustration of the "Comet" appeared. That engine, it would be observed, ran upon four wheels. R. Stephenson and Co. afterwards constructed three other engines of a similar design for the Leicester and Swannington Railway, named "Phœnix," built 1832, "Samson" and "Goliath," 1833; but these three had coupled wheels of 4ft. 6in. diameter.

It was found in practice that these four-wheeled engines, having a short wheel-base and overhanging frame, caused considerable oscillation and damage to the permanent way; it was therefore decided to build the next engine for that railway upon six wheels. It was completed by Messrs. Stephenson and Co. upon the 17th December, 1833, being No. 36 in the books of the makers, named "Hercules," and No. 5 in the books of the Leicester and Swannington Company.

The annexed illustration clearly shows the design of this engine, and is drawn to a scale of ⅛in. = 1ft., or $\frac{1}{96}$.

Diameter of cylinders, 14in.; length of stroke, 18in.; diameter of coupled wheels, 4ft. 6in.; Diameter of trailing wheels, 3ft. 6in.; length of boiler, 8ft. 0¾in.; number of tubes, 125; diameter of tubes, 1⅝in.; heating surface of firebox, 53·63sq.ft.; heating surface of tubes, 460·62sq.ft.; total, 514·25sq.ft.; weight in working order, engine, 11 tons 6 cwt.; weight of tender fully loaded, 4 tons. Total, 15 tons 6 cwt.

The overhanging frame of the "Comet," it will be observed, was avoided in the "Hercules," as is shown by the following figures:—From front of frame to ⊙ leading wheels, 5ft. 2in.; from ⊙ leading to ⊙ driving wheels, 4ft. 9in.; from ⊙ driving to ⊙ trailing wheels, 5ft. 2in.; from ⊙ trailing to back of frame, 2ft. 0¾in.; total length of frame, 17ft. 1½in. From rails to top of frame, 3ft. 3in.; from rails to top of chimney, 12ft. 6in.

When the "Hercules" was constructed, it will be seen it had a flange upon the driving wheels, this was, however, removed after the engine had been at work about three months.

Leicester, May 27. **Clement E. Stretton.**

[30017.]—I BEG to inform "J. A.," p. 283, that the diagram of the "Northumbrian" which I gave upon p. 260 is perfectly correct, being drawn to scale from an official diagram. The "Northumbrian," it is well known, was an outside cylinder engine of the "Rocket" type.

I am aware that in one of the early editions of Mr. West's very excellent sheets of locomotives an engine named "Mercury" No. 11 was placed under the name of the "Northumbrian" No. 8. No doubt this was a slight error on the part of the printer of the "sheets," and has, I believe, been corrected in all the later editions.

Clement E. Stretton.
Saxe Coburg-street, Leicester, June 1.

[30018.]—IN reply to your correspondent, "J. A." (29986), p. 283, I have no doubt Mr. Stretton is right in his account of the Northumbrian having been an inside-cylinder loco., with cylinders in front, and wheels as he describes them. The illustration on my sheets was taken from the only one I could find at that time—viz., in "Gordon on Locomotion," plate 7, p. 55, which figures and plainly describes the Northumbrian as I gave it. That work being published in 1836, and seeming a carefully-compiled book, with well engraved illustrations, and having several of curious early locos. I could find nowhere else, I thought it might be relied on. The way in which locomotives in those early days were at times modified and altered soon after their first completion, and names altered or used on different railways, has, in some noted instances, led to confusion in recent works, and makes it difficult at times to ascertain the truth in conflicting statements and illustrations.

Theodore West.

AN OLD AMERICAN LOCOMOTIVE.

[30019.]—THE valve-gear of the "Ironsides" consisted of a single loose eccentric for each cylinder controlled by "drivers." By means of reversing levers upon the foot-plate the eccentric rods, together with the eccentrics and valves, were pulled or pushed into backward or forward gear as required. The reversing levers were in motion the whole time the engine was running in the same manner as those upon the Leicester and Swannington engine, illustrated p. 261.

The system of employing two fixed eccentrics for each cylinder was first fitted to an engine by Messrs. Hawthorn and Co. in the year 1837, and the "link motion" was invented by William Howe at Stephenson's works, Newcastle, in 1843, when it was at once fitted to a new engine for the North Midland Railway Company.

Clement E. Stretton.

EXPLOSIVES.

[30020.]—MY letter (29989) in your paper of last week has an important misprint, evidently of the type-setter. You will find in my manuscript that the solid contents of gunpowder are "saltpetre, charcoal, and sulphur, in the relative proportions of 75, 15, 10"; but my 75 is given as 17 in your paper. Please correct the error, since it is misleading.

In my last I endeavoured to explain that the second heating of the gases generated by ignition, turns weak gases of 400 volumes into a powerful "propellant" of 1,200; and, I added, that ordinary "blasting" force was the 400 volumes, which, from their mode of use, received no second heating.

On reference to my notebook I find that gunpowder closely confined—as it might be—for a "blast," exerts a force on ignition of about 42 tons on the square inch.

Observe, then, that the influence of the gun or barrel which, so to speak, is open at one end, makes the powder-force *progressive* when "propelling," while that force is instantaneous when closely confined for "blasting."

I have hitherto written only of gunpowder, for we all know that term, though little else about it. Of the innumerable "ites"—i.e., dynamite, bellite, and the like, experiments are going on, and I may write another time.

John Shakespear,
Col. late R. Artillery, A.M.I.C.E.
25, Great George-street, S.W., June 3.

OXYGEN.

[30021.]—THE Arabian alchemists (about A.D. 732—800) knew that if such substances as nitre, &c., were heated, a gas came off which could be collected in bottles, and which, if a light was applied, would sometimes explode with such violence as to break the bottle to pieces; and thence concluded, as it was invisible and so powerful, that it was like the spiril of man, which can do so much and is yet invisible. For this reason it was called "spirit."

Geber, or Djafer (born in Mesopotamia about A.D. 830), states that if a certain weight, say a pound, of iron, copper, or lead is heated in an open vessel, it will weigh more after calcination than it did before, but could not explain why.

Roger Bacon (born 1214) invented the experiment of burning a candle in a bell-jar over water, and showed that the candle went out when the air was partly consumed by burning.

Paracelsus (born 1493 at Einsiedel, Switzerland) pointed out that air feeds flame, and that if iron is put into a mixture of sulphuric acid and water, a peculiar air arises from it.

The Hon. Robert Boyle (born 1626) and Dr. Hooke (his assistant). Hooke published a theory in 1665 that air acts on heated substances and so produces fire; for, said he, that in making charcoal the wood glows, yet so long as the air is kept away, it will not be consumed. Boyle showed that animals could not live without air, neither can a candle burn without it.

John Mayow (born in Cornwall, 1645; died at York-street, Covent-garden, 1679) heard Boyle lecture at the Oxford meetings, and showed that a candle did not consume the whole of the air. He experimentally proved the air which was burnt existed in nitre and in many acids, and he named it *fire-air*. He burnt out the air of a bell-jar by means of tinder, camphor, and a burning-glass, and reasoned that it lost bulk because there was no more fire-air left to burn the camphor. Amongst other experiments, he placed mice and candles over water in jars, and proved that respiration and combustion are the same; and he put a mouse in a jar of air exhausted by a candle, and vice-versâ, as a further proof of the same.

John Joachim Becher (1625—1682) and Ernest Stahl (1660—1734) invented what is known as the theory of phlogiston. Stahl imagined that all bodies which would burn contained an invisible substance (phlogiston), and that when the body was burnt it gave this up to the air, and could only regain it by taking it out of the air or another substance.

Priestly (born 1733, died 1804) discovered oxygen Aug. 1, 1774, by decomposition of mercuric oxide (also discovered by Scheele [born 1742] in 1775). Priestly was so imbued with "phlogiston" that he did not really understand the great discovery he had made, but called the oxygen "dephlogisticated air." He died without giving up the "phlogiston" theory—and this after proving its properties!

Antoine Laurent Lavoisier (born at Paris 1743; guillotined May 18, 1794) in 1770 suspected that "Phlogiston" was false; he cited Geber (metals gain in weight after calcination), and found that the air lost just as much as the metal gained. He worked for eight years with lead, tin, iron, phosphorus, sulphur, &c., with oxygen (of the air), and, at last, in 1778, it occurred to him that Priestly had separated mercuric calx into mercury and a gas. To prove this he boiled mercury for twelve days in a limited volume of air, collected and weighed the powder and the air left (nitrogen), and proved that the loss of weight of air equalled the gain of weight of mercury. He also proved the composition of carbon dioxide, diamond (by combustion in oxygen), water, &c., and named the gas oxygen (Gr. *oxys*, acid; *gennao*, I produce), and even then had the greatest difficulty in overthrowing the theory of phlogiston.

Thus we see, even in this brief sketch, that if men would but follow up the clues given to them, how much sooner we should arrive at that grandest thing in nature, the truth. **Principia.**

SAFETY BICYCLES: BUILD VERSUS WEIGHT.

[30022.]—HAVING recently seen some queries about safety bicycles in your columns, I venture a few conclusions that I have come to after riding several makes of machines, thinking they may be of interest to the many subscribers who, like myself, make cycling a favourite pastime.

I adopted the above heading because it is my experience that the position of the rider with regard to the crank axle and handles, and the disposition of the weight between the two wheels, is of more importance than the reduction of the machine's weight for comfort and ease of propulsion. Comparing two machines, both with balls throughout, free steering, and geared 54in., but one with somewhat vertical steering centres, upright seat pillar, and the weight nearly between the wheel centres; the other with a considerable rake to the steering (the handles coming far back), a similar rake to the seat pillar, and the weight more on the back wheel. In the first case, the steering a "bee line" is easy; the rider is in a good position when hill-climbing, and the share of the weight on the front wheel seems a distinct advantage for that purpose. On the other hand, such a machine is rather liable to side slipping, especially when turning, and is readily bowled over if it comes against a wheel-rut.

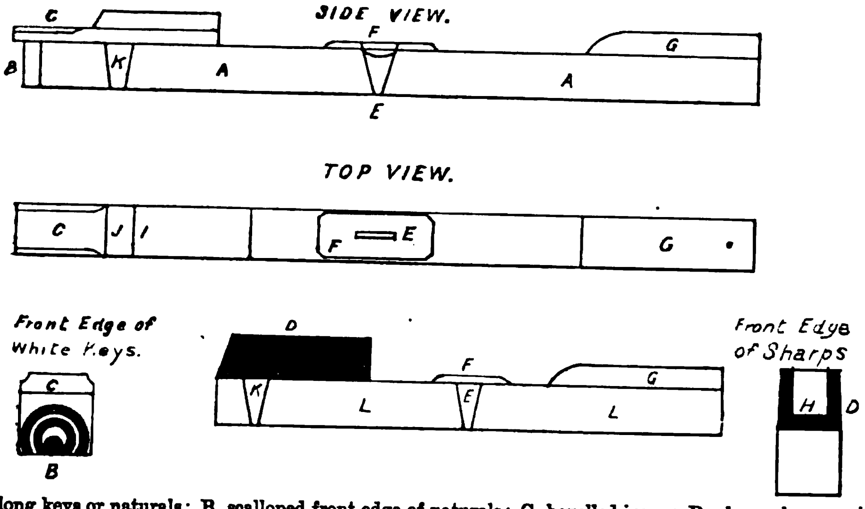
With the second form of machine, steering straight is not so easy without a good pace, hill-climbing with it needs more exertion, though it may be 10lb. or 12lb. lighter than the former, but I think it is less liable to side slipping. I should like to hear if other of your readers have similar opinions.

Many safeties that are made to sell have the handles come too far back, so that the hands are at one's side on the level, and causing much loss of power on hills. The hands should be out somewhat in front of the body, with elbows nearly straight, and such a position will prevent cramp and much improve the steering.

Gloucester. **W. A. Walton.**

ORGAN MATTERS.

[30023.]—WILL Mr. Audsley and Mr. Robinson both please accept my best thanks for their valuable information *re* my organ? I beg herewith to annex particulars as asked for by Mr. Audsley. I am glad to find that I have really got hold of a *really ancient organ*; but, if possible, I should like to get at the age of it more definitely. Between what years did Snetzler build? I will look again—as Mr. Robinson suggests—for the name, and should be only too pleased to find it correct. Concerning the stop *tacett*, I find that there is a false table (above the slider table), and that a comprehensive slide runs under the whole of it, and shuts off all except open and stopped diapason, as mentioned by Mr. Robinson. But all the appertaining action has disappeared, and the said slide was pinned fast to upper table, so that I overlooked it previously. It, however, seems to have been drawn in and out in the usual manner. The keyboard still retains



A, long keys or naturals; B, scalloped front edge of naturals; C, bevelled ivory; D, ebony sharps, with ivory lines in centres; E, pin mortise; F, guide-block for ditto; G, register block (for sliding keyboard); H, section of ivory inserted in sharp keys; I, line intersecting ivory at front edge of sharps; J, line intersecting ivory at beginning of bevel; K, front pin mortise; L, sharp key.

the old leather-covered register block at ends, but is now converted from a sliding action to ordinary sticker action.

Length of naturals end to end, 19in.
Length of sharps end to end, 17¾in.
Length of ivory bevel, 1⅜in.
Length of ivory in total, 5¼in.
Width of ivory, ⅞in.
Width of sharp ebony, 1/16in. each side of white.
Width of white ivory lines, 4/16in.
Depth of white ivory lines, 4/16in.
Depth of sharp ebony, ⅜in., decreasing to 4/8in. at back.
Depth of natural keys, ¾in.

The pull-downs also still work in their leather *boursettes*, and not by the brass plate method. The stopped diapason is on a separate board (by itself), which is fixed at back of wind-chest proper, the slider working on its own edge at right angles to others, but the wind is supplied from the one set of pallets. There is also ample room for a large recessed book-board between keys and wind-chest, which slightly overhangs. I may say also that it has been taken from an old country church some time since, and, as I understand, was not used for a long time, being much out of order and tune.

I shall be pleased to have any ideas or opinions from other esteemed correspondents to the "E.M." on the subject, and should also be very glad to see that the "war of words and sarcasm" has ceased between our valuable contributors.

Tacett.

ORGAN NOMENCLATURE.

[30024.]—I suspect the question about Gedackt will have to be settled by the lexicographers—not by organ builders. In the "Technologisches Wörterbuch," published by the famous house of Vieweg und Sohn, Braunschweig, I find "Gedackt, gedeckt, adj. (Orgelb.), covered with a lid (said of organ-pipes)." In the "Technologisches Wörterbuch," published by Tauchnitz, of Leipzig, I find "Gedackt, gedeckt (Org.), stopped, covered with a lid." It would seem therefore that Gedackt is quite correct. In Ellwell's German dictionary I find "Gedackt, adj. T., covered with lids." The T. means a technical word. There does not seem to be an adj. Gedeckte; and Gedachte has evidently something to do with thinking, memory, not with a lid.

Organon.

CONCERT ORGAN.

[30025.]—Having been a lover of organ work and music in bygone days, and coming by chance across an article by Mr. Audsley on Concert Organs, some of the old love and zeal returned, the more especially as his ideas seem to open up a way to remove many of the difficulties over which I fell as a learner. I possessed myself of all the back numbers of "E. M." containing his articles on Chamber, Church, and Concert Organs, also Mr. T. Casson's work on Modern Organs. Mr. Casson's book I could not understand at all pedal, pedale, pedallier, pedallier helps, ventils, &c., seeming to me a hopeless mixture; but by pegging away at Mr. Audsley's articles, studying, restudying one point at a time, light began to dawn, and on again turning to Mr. Casson's masterly system, find myself agreeing with him on nearly every particular, and on planning a concert organ, adopting his plan as far as possible. This concert organ, which I hope to see erected one day, would be in a hall 80ft. by 42ft. and 24ft. high, with a longitudinal opening above that height in the centre of roof, 14ft. wide and 8ft. high, the hall has a raised platform 5ft. high at one end, and the organ would occupy a position so as to leave a proscenium opening of 21ft. wide by 11ft. high; the organ case and pipes forming the actual proscenium. This being a novel position for an organ, hope it will answer. The specification is also a novel one, as follows:—

GREAT OR FIRST ORGAN.

Manual Stops.

1. 16ft. tone Bourdon, not inclosed.
2. 8ft. tone Stopped Diapason.
3. 4ft. tone Stopped Diapason.
4. 8ft. Open Diapason, not inclosed.
5. 4ft. Principal, not inclosed.
6. 8ft. Second Open Diapason.
7. 4ft. Second Principal.
8. 2⅔ft. Twelfth.
9. 2ft. Fifteenth.
10. Mixture.
11. Octave Coupler to First Organ.
    Full Great Organ.

Pedal Stops.

12 pipes only, remainder borrowed from Manual Pipes.

1ᵃ. 32ft. tone Bourdon, not inclosed.
2ᵃ. 16ft. tone Stopped Diapason.
3ᵃ. 8ft. tone Stopped Diapason.
4ᵃ. 16ft. Open Diapason, not inclosed.
5ᵃ. 8ft. Open Principal, not inclosed.
6ᵃ. 16ft. Second Open Diapason.
7ᵃ. 8ft. Second Open Principal.
8ᵃ. 4⅔ft. Twelfth.
9ᵃ. 4ft. Fifteenth.
10ᵃ. Mixture.
11ᵃ. Octave Coupler to First Organ Pedal Stops.
Full Pedal Great Organ.

SECOND ORGAN OR ORCHESTRAL WOOD WIND ORGAN.

Manual Stops.

12. 16ft. tone Lieblich Bourdon.
13. 8ft. tone Lieblich Gedakct.
14. 4ft. tone Lieblich Flute.
15. 8ft. Concert Flute Harmonic.
16. 4ft. Concert Flute Harmonic.
17. 2ft. Concert Flute Harmonic.
18. 8ft. Clarinet.
19. 8ft. Oboe.
20. Mixture.
21. Octave Coupler.
    Full Second Organ Manual.

Pedal Stops.

12ᵃ. 32ft. tone Lieblich Bourdon } 12 pipes re-
13ᵃ. 16ft. tone Lieblich Gedakct } mainder from
14ᵃ. 8ft. tone Lieblich Flote } Manual Stops.
15ᵃ. 8ft. Concert Flute Harmonic, all from Manual Stops.
16ᵃ. 4ft. Concert Flute Harmonic, all from Manual Stops.
17ᵃ. 2ft. Concert Flute Harmonic, all from Manual Stops.
18ᵃ. 16ft. Bassoon, 12 pipes, remainder from Manual.
19ᵃ. 8ft. Oboe, all from Manual.
20ᵃ. Mixture, 12 pipes, remainder from Manual.
21ᵃ. Octave Coupler.
Full Second Organ Pedals.

THIRD ORGAN, OR ORCHESTRAL STRING ORGAN.

Manual Stops.

22. 8ft. Violincello.
23. 8ft. Violin.
24. 8ft. Second Violin.
25. 4ft. Second Violin.
26. 4ft. Viol.
27. 8ft. Violin Muted.
28. Mixture.
29. Octave Coupler.
Tremulant.
Full 3rd Organ Manual.

Pedal Stops.

12 Pipes only, Remainder from Manual.

22ᵃ. 16ft. Violincello.
23ᵃ. 16ft. Violin.
24ᵃ. 16ft. Second Violin.
25ᵃ. 8ft. Second Violin.
26ᵃ. 8ft. Viol.
27ᵃ. 16ft. Violin Muted.
28ᵃ. Mixture.
29ᵃ. Octave Coupler.
Full 3rd Organ Pedals.

FOURTH ORGAN, OR ORCHESTRAL BRASS ORGAN.

Manual Stops.

30. 8ft. Tuba, not inclosed.
31. 8ft. Trumpet.
32. 8ft. Horn.
33. 8ft. Ophicleide.
34. 8ft. Cornet.
35. 4ft. Clarion.
36. Octave Coupler.
37. Chimes.
Tremulant.
Full 4th Organ Manual.

Pedal Stops.

All from Manual 12 Pipes, rest from Manual.

30ᵃ. 8ft. Tuba.
31ᵃ. 16ft. Trombone.
32ᵃ. 8ft. Horn.
33ᵃ. 8ft. Ophicleide.
34ᵃ. 8ft. Cornet.
35ᵃ. 4ft. Clarion.
36ᵃ. Octave Coupler.
Full 4th Organ Pedals.

Accessories.

2nd Organ to top keyboard } Off and on pneumatic
3rd do. do. } buttons over top
4th do. do. } keyboard.
1st do. to lower keyboard }
2nd do. do. } do. do.
3rd do. do. } above lower keyboard
4th do. do. }
1st do. to pedal keyboard }
2nd do. do. } do. do.
3rd do. do. } under lower keyboard
4th do. do. }
Hitching pedal to 4th Organ, soft, medium, and full.
do. 3rd do. do.
do. 2nd do. do.
do. 1st do. do.
do. to all organs do.
Hitching pedal to 1st swell-box.
do. 2nd do.

This organ, to my idea, is but the logical conclusion to which some of the theories of Mr. Audsley and Mr. Casson must lead; and rightly so, to the vast improvement of the present system of organ building.

1. There are only 2 manuals, all the purposes of a 3rd and 4th manual being achieved by the pneumatic buttons, whereby any combination of stops can be prepared and then brought "on." Is not this idea of Mr. Casson's an easier, simpler, and cheaper method of producing an infinite variety of effects?

2. Pedal Organ.—Every manual stop has here its corresponding bass—another idea of Mr. Casson's. The pedal bass stops are here treated as simply a continuation of the manual stops for another octave, with the lowest 30 notes taken on to a separate keyboard for the feet, for melodic purposes, variety, and flexibility.

3. Manual couplers are not required, as every organ can be brought "off" and "on" to either keyboard, or both, except the Great or 1st Organ, which need only be brought "on" or "off" to the lower manual.

4. There are two swell-boxes, and every stop, both on manual and pedal, inclosed, except those actually required for show, when the whole of each stop, manual, and pedal so required should be uninclosed. Great and 2nd Organs in 1st swell-box; 3rd and 4th Organs in 2nd swell-box. At the same time taking care, as far as possible, that the effect when the swell shutters are fully opened would be nearly the same as if the stops were uninclosed by having as much swell shutter space as possible in front, back, sides, and top.

5. The action would have to be pneumatic lever or tubes, which is best, as the console would be placed on the floor of the auditorium in the centre against the proscenium wall, which forms the front of the stage, the player being with his back to the audience and facing the stage, a similar position as that usually occupied by the leader of the orchestra in theatres. The soundboard undoubtedly Roosevelt's, or one similar, whereby the slider is abandoned.

6. The Great or 1st organ, good scale, copious windage, low pressure—say 2½in.—thorough organ tone, un-imitative throughout; the other three organs to be imitative to the highest degree possible of orchestral wood-wind, orchestral strings, and orchestral brass instruments, to contrast as strongly as possible with great or 1st organ and each other.

7. The quality and description of stops, especially for orchestral strings I have not been enabled to study sufficiently to decide, and would invite the

very kind criticism and assistance of Mr. Audsley and other valuable contributors to your paper, if I am not asking too great a favour, and apologising to them for trying in a feeble way to adapt their ideas to suit my own. **H. F. Swynfin.**

Erratum.—In letter 29991, p. 284, "inside" compound is an error; it should be "imide."—C. E. Sohn.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67995.]—**Ivory.**—To imitate the grain of ivory in celluloid, two or more blocks of this material are made in different shades of white, and are sliced up into thin sheets; these sheets are placed on each other, intermingling the ones from the different blocks, and by pressure and heat are made to adhere to each other, thus making a solid block again. If this block is placed out of level on the machine and cut in sheets, the effect will readily be imagined, as will that which will be produced if the block is curved by heat into a section of a circumference and the knife passes horizontally through it.

Cosmopolite.

[68104.]—**Catering.**—The tea would not enter the measuring vessel unless a vent-hole were provided at the top, to allow for escape of air. Probably "Phos. Bron." intended to show this.

W. Perren Maycock.

[68195.]—**Largest Locomotive.**—I notice in my "E. M.," (which comes regularly out here) in the answers to queries (No. 68195, page 99, issue of 29th March) an answer relating to the "Largest Locomotive." I think it will interest some of your many readers to know that there are some "Fairlie" locomotives at work on the nitrate railways in Peru weighing 85 tons loaded, on 16 wheels, or six coupled wheels, and a pony truck to each bogie. These engines were made by the Yorkshire Iron Co., Meadow Hall Works, Sheffield, who would, no doubt, be pleased to give any information, and where photos. might be obtained, and a very fine photo. they make.

Jalapa, Vera Cruz. R. G. F.

[68230.]—**G.W.R. Automatic Vacuum.**—I am ready to admit that "B. R. W.," p. 285, knows more than I do about brakes; but it may be as well to point out that "time" is a very important factor when you are summing up the disadvantages of a brake. I have not the slightest interest (worse luck!) in any of the brakes; but I believe I have just a grain or two of sense, and I don't mind being cross-examined when I say that the Westinghouse brake is the best device for the purpose yet invented. I notice that even the Chatham and Dover is beginning to think so, too. Nun. Dor.

[68230.]—**Brakes.**—Your correspondent, "B. R. W.," p. 285, when expressing his opinions upon continuous brakes, does not appear to take into consideration the fact that at some portion of a stop, every brake, whether it be the simple lever upon a coal waggon, or a screw brake applied by hand in the ordinary way, or by air, or other power, will be doing the best attainable work under the then prevailing conditions as to state of rails, gradients, and number of wheels braked; in other words, every brake for at least a short interval of time will be to that extent a theoretically perfect brake, hence it of course follows that as all brakes have ample power when they are full "on," it is most necessary that they should be capable of being brought into action instantaneously, because the time lost in applying the brake can never be regained during the remainder of the stop. As a fact, the Westinghouse automatic brake can and is applied in less time than any other brake which has ever been invented; it comes into action and causes the speed of the train to be retarded in the shortest possible time, therefore it follows that as the Westinghouse brake commences first it, of course, stops its train in less time and distance than any other system.

Clement E. Stretton, C.E.

Saxe-Coburg-street, Leicester, June 1.

[68353.]—**Electro-Plating on Ferns, &c.**—I shall be very thankful to "Nun. Dor." for the promised information, as I find the number to which he refers (908) is out of print. My reason for using copper in place of silver was, that I thought of experimenting with copper first, and when fully conversant with the *modus operandi*, to use a more expensive material.

Beginner.

[68402.]—**Incandescent Lamp Stands.**—Would not one similar to that described by Mr. Bottone on page 287 suit your purpose?

F. W. Mason.

[68403.]—**Chromic-Acid Batteries.**—It is surprising to hear anyone nowadays recommend Bunsen cells as being more economical than the bichromate. Even if one gets well rid of the fumes, how about cost of acid, damage to clothes, corroded terminals, &c.? A new weekly, about which much fuss was made, gave in its first number full particulars concerning use and construction of Bunsen cell, than which a more useless article could hardly have been placed before the electrical portion of its readers. Its later numbers go from bad to worse.

W, Perren Maycock, A.I.E.E.

[68406.]—**Battery, Bunsen's.**—To F. W. Mason.—"Nimrod" could form a square, as it were, with four zincs, one on each side of cell, joined together at top by means of a suitable casting, or else by means of a suitable connection of copper wire. F. W. Mason.

[68441.]—**Trade Directory.**—One of the most valuable assets of a wholesale firm is its list of retail traders, marked as to who can be trusted and who cannot. It is not likely that any firm would publish such a "directory," and I fail to see what interest it can be to "E.M." readers to reply to the question of "Amor Bosquets." Let him advertise for a list—perhaps he may get it. J. M.

[68447.]—**Painting.**—This querist has adopted the silly practice of addressing his query to individuals, and the result follows: he has had no answer, so far as I have seen. Let him add some terebene to his paint or varnish, or whatever it is, and it will dry as quickly as possible. If there is anything quicker in drying he had better patent it; but when he writes again let him leave his question "open" to anybody. Freeman.

[68451.]—**Red Shadow.**—The "explanation" of this phenomenon must, I think, be that the querist is colour-blind, and sees shadows red when they should be black. Or he is mistaken as to the colour, which, as there was red glass in the window, may have appeared red from the colour of the glass.

M. D.

[68453.]—**Dumpy Level.**—For what purpose can "Pink" want a "sectional sketch" of the conical axis of a dumpy level? X.

[68454.]—**Enamelling Iron and Steel.**—Directions for enamelling iron have been given many times. All that "Primus" has to do is to coat the articles with the varnish of the required colour, and "stove" them. D. N. K.

[68458.]—**Metal Slips.**—Any of the mechanicians who advertise in this paper will supply the "Constant Reader" with what he wants. What are the "slips" for? If there is much friction, type metal would not last long; but they might be easily cast in brass, or even in iron.

S. P.

[68459.]—**Greek Pitch.**—This query is best answered by asking what is meant by "Greek" in connection with pitch? Can find no mention of Greek pitch in connection with insulators, and suspect it is only some fancy name for a mixture of guttapercha and pitch. Nun. Dor.

[68466.]—**Breech Block Lock.**—What is the sketch wanted for. All sorts of devices can be seen in sketch form at the Patent Office Library.

M. H.

[68468.]—**Queen's Taxes.**—The tenant of a house can be made to pay only those taxes which are due while he was or is tenant, and the landlord can be made to pay only that portion of the property tax which is leviable on the rent he actually received. I constantly see in different papers questions on this and cognate subjects; but if people would only write and state the facts to the Chief Examiner of Claims, or the Inspector of Taxes, Inland Revenue, Somerset House, they would escape much vexation. As regards Income-tax, address the Chief Examiner, for other things the Inspector of Taxes; but, mark you, no humbug. State the truth, for if you try to come the "old soldier" it will go very warm for you.

Nun. Dor.

[68552.]—**Maxima and Minima.**—If "W. J. A." refers to any textbook, he will find that the vanishing of $\frac{d^2 s}{dx^2}$ does not necessarily imply the existence of a point of inflection. For instance, if $\frac{d^2 s}{dx^2}$ and $\frac{d^3 s}{dx^3}$ vanish for a certain value of x while $\frac{d^4 s}{dx^4}$ is finite, there is no point of inflexion for that value of x. A maximum does exist in "M.I.C.E.'s" problem when $x = \frac{1}{\sqrt{3}}$, and if "W. J. A." continues the calculation of the differential coefficients, he will find that the first that does not vanish is of an even order, in which case maxima or minima values do exist.

Portsmouth. A.M.

[68558.]—**Chiming Clock.**—To Mr. Chas. A. Jones.—Referring to your interesting remarks on pp. 245-246, would it be asking you too much to send us also the music for the Westminster Chimes?

G. E. H.

[68604.]—**Ellipse.**—It would be interesting to know where J. L. D. Partridge obtained his method of contructing an oval, for with all its intricacy it is not correct. For, if it is correct, $LA = LN = LH + HN = LH + HD = GH + HD = \frac{2}{3} FD + (ED - \frac{2}{3} FD) = \frac{2}{3} FD + ED = \frac{2}{3}(CD - CF) + \frac{CD}{2} = \frac{2}{3}(CD - AB) + \frac{CD}{2} = \frac{7}{6} CD - \frac{2}{3} AB.$

LA is also $= AE + EL = \frac{AB}{2} \sqrt{LH^2 - EH^2} = \frac{AB}{2} + \sqrt{\frac{4}{3}(CD - AB)^2} = \frac{AB}{2} + \frac{2(CD - AB)}{\sqrt{3}}$

These values of LA must be both equal—i.e., $\frac{7}{6} CD - \frac{2}{3} AB = \frac{AB}{2} + \frac{2(CD - AB)}{\sqrt{3}}$ or $\frac{7}{6}(CD - AB) = \frac{2}{\sqrt{3}}(CD - AB) \therefore \frac{7}{6} = \frac{2}{\sqrt{3}}$ and $\frac{49}{36} = \frac{48}{36}$.

There are, however, many ways of performing the operation correctly, some of which will give any degree of bluntness or acuteness at will. One of the latter methods is as follows:—Taking axes as in Mr. Partridge's answer: In E A take a point, W; in C E take a point, X, so that C X = A W. Join W X, bisect in Y, draw through Y a line perpendicular to W X, and call the point where it cuts A B, or A B produced Z; then Z and X will be the required centres. The greater A W, the greater will be the bluntness of the oval. R. N.

[68629.]—**Bulk of Sphere.**—The process of "Lux" (p. 287) is preposterous. If you are comparing spheres, merely cube their diameters. A ball of 2in. diameter contains eight spherical inches; one of a foot contains 1,728 spherical inches. But to bring spherical into cubic measure, multiply by 11, divide by 3 and 7, and deduct a 5,000th of the original number; or if you will be still more exacter, an 18th also of this last.

1,728 × 11 $\begin{cases} 17{,}280 \\ 1{,}728 \end{cases}$

3)19,088·

7) 6,336·

905·142857

deduct $\frac{1}{5000}$ = ·3456

and $\frac{1}{18}$ thereof ·0192

= 904·7880 cub. in.

This will always be correct to six figures, often also the seventh. E. L. G.

[68636.]—**Cycles Up-Hill.**—When a man weighing, say, 150lb. is pushing a 30lb. cycle up hill, his weight is utilised in retarding the downward course the cycle would take if left to itself. If he stands still he has no tendency to run backwards, it is only the 30lb. cycle that wants to do that. When, however, he rides up the incline, he has to counteract the tendency of 180lb. to rush down hill, which naturally requires more expenditure of power to accomplish. B. Harcourt.

[68636.]—**Cycles Up-Hill.**—I think the following may help to answer this question:—When a cyclist begins to mount a hill on his machine, he has, in addition to the usual friction, to overcome the tendency of his own weight and that of the machine to regain the level, until a point is reached where the back pull is greater than his strength. If he now dismounts, only about one-fourth of the weight tries to run back—viz., the machine. The cyclist can now push forward, his weight-bearing muscles have been at rest while he was mounted.

R. G. B.

[68642.]—**Moulds.**—Scrutiny in the Patent Office of the list and record of patents would inform "Founder" that the methods of procedure in obtaining chilled-iron castings have often been subject matters for patents; the names of Howard, Ransome, &c., for agricultural implements; of Harlow, Peyton, &c., for bedsteads, appearing at various dates since about 1850; but the specification of Howard's first patent would, I conclude, give all the information actually necessary. As to sash-weights and fire-bars, a visit to one of the small makers in the Black Country, or to one of the large Scotch ironfounders, would, I expect, satisfy "Founder" that competition on a large scale with either of the above extremes would ultimately result in another sort of foundering—financially, at least. The Lydney Dispenser.

[68660.]—**Electrical Repairs.**—In answer to W. Perren Maycock, I know that the answer I gave sounded somewhat unreasonable; but if he will try the experiment, he will see for himself that it is perfectly true. I know perfectly well that the usual way to recharge the cells is by means of a battery or other electro-generator; but having a cell working (for last month) satisfactory with the method I named, I gave it in answer. The way I came to know this way was, that having a cracked cell lying in my laboratory in connection with an electric bell that was not in use (the cell which was useless, and as the bell was not wanted it was left as it was). One day, however, we were surprised to hear the bell ring. Knowing that the cell was useless and had never been recharged, we naturally inquired into the cause of it, and found that it had been lying in some permanganate solution that had been upset. We did not see how this could have charged the cell, so we took another useless cell that we had by and bored a hole in top and bottom and allowed a strong solution of permanganate of potash to run through; the consequence was that it has been running a bell since April 27th. How this is caused I am not now in a position to state, but hope in a short time to be, when I am going to communicate to "E. M." on it.

F. W. Mason.

[68662.]—**Telephone.**—"Ex-Watchmaker" has left out one of the microphone connections.

W. Perren Mayoock.

[68671.]—**Micro-photographs.**—To Mr. Bottone.—There are two modes of producing these. The first is one which has been largely practised on the Continent for the production of these minute photographs commercially. A short treatise by M. Wulff, of Rue Richelieu, Paris, gives full and explicit directions whereby anyone conversant with the manipulations of photography can take these bijoux photographs with the greatest ease. A translation of this article was published in the *British Journal of Photography* for March 24, 1865. A very convenient and cheap apparatus of this class can be fitted up on the lines described by Mr. Hislop. It consists of a rigid mahogany board of about 3½ft. long and 6in. wide. At one end there are two uprights, between which a miniature camera, fitted with a microscope objective of 1in. focus, can be raised up, or lowered down, so as to bring the centre of the lens opposite the centre of the negative to be reduced, whatever may be its size. (The negative must be one full of detail, and with good clear shadows, not veiled or over-developed, and may have been taken by any of the ordinary processes, either from nature or from an engraving, as may be required.) The objective is screwed into a brass tube projecting from the camera towards the negative, the tube itself being fitted with stops of different sizes. A micrometer head, for fine adjustment of the lens, is generally necessary, since unless specially constructed for this purpose, microscope objectives are only corrected for visual rays, and not for actinic rays. (Messrs. Swift and Son produce a micro-objective, specially corrected for photography.) As a focussing screen, a sheet of glass coated with collodion, then sensitised, washed, and dried, is substituted for the ordinary ground-glass screen, as this latter would be much too coarse for the delicate focussing required. The sharpest visible image must be found by the aid of a powerful focussing glass, and unless the objective be specially corrected for photography, the exact chemical focus must be found by trying several plates at slightly varying distances from the visual focus. When the chemical focus has once been found, it will be the same in every instance, provided the negative is placed at the same distance from the objective. The negative itself is placed in a frame at any required distance on the long mahogany board, but its plane must be perpendicular to the axis of the tube holding the objective. In Mr. Hislop's apparatus the frame was constructed so as to slide along in grooves cut perpendicular to the axis. The illumination may be either by natural or artificial light, but in every case must pass *through* the negative. When using natural light the whole system, except the side of the negative farthest away from the lens, must be inclosed in a dark box, and that side exposed to the sky. Artificial light is much less troublesome, and all the operations may be conducted in a drawing-room, moderately lighted, without any of the usual photographic "messes." A paraffin lamp behind the negative, with a condenser intervening, and very close to the latter, gives very nearly parallel rays, which, without any covering between the negative and the camera to shut out extraneous light, will impress the sensitive plate in from 5 to 40 seconds, according to the strength of the illumination and the density of the negative. Collodion is generally employed in this process, as the image is cleaner and brighter than when gelatine is used. The collodion used to coat the plates must be absolutely structureless; otherwise a disagreeable, reticulated appearance will be presented when such "pin-head" photographs are examined under the microscope. For a similar reason pyrogallic acid, and not ferrous sulphate, should be used for the development, since the latter gives a much coarser deposit than the former. A good formula for the developer to be employed with collodion for such pictures is: Distilled water, 1oz.; pyrogallic acid, 3 grains; glacial acetic acid, 30 minims. On no account must the development be pushed, otherwise the shadows will become veiled, and the picture ruined. The nitrate bath to be used in conjunction with this may conveniently be the ordinary 30 grains of silver to the ounce of water, saturated with iodide to prevent pinholes, and acidified with a trace of nitric acid, to insure clear shadows. M. Dagron, of Paris, who has been most successful in this kind of photographic practice, uses collodio-albumen plates. The above is extracted, with some additions and alterations, from Sutton's "Dictionary of Photography." It will be seen that the process as described above resolves itself into taking a good, clear negative, by any of the usual processes, of the ordinary size, reducing this by means of a small lens and camera to the desired size, and taking a positive from this negative by means of the said small camera, preferably by the collodion process. The only difficulty which the ordinary expert in photography will be likely to encounter is in the development. It will be perfectly evident that, unless the eye be aided by a pretty powerful lens, the operator will have to be guided entirely by experience in the matter of development, since he cannot possibly see when he has brought out the details of a picture the whole of which may be $\frac{1}{60}$in. in diameter. The second mode of producing micro-photographs is one which I have used extensively myself, and which, in my hands, has given perfectly satisfactory results. It requires no special lens or camera, a good ordinary quarter-plate portrait lens of about 4in. focus being all that is required. This does away with the necessity of correction for actinic rays, and places the process easily within the grasp of any photographer possessing the ordinary outfit. The only thing absolutely necessary is a rather long room, with one window open to the sky. All the other windows (if any) and all the panes of glass, except the one at which it is intended to admit the light, must be carefully blocked up. If a long room is not available, a long passage, say 20ft. long, with a door looking out to the light at one end, will do very well, and if the sky is not get-at-able, in consequence of buildings being near, a square of ground glass of sufficient size may be inserted in a temporary frame, to fit in the opening at the end of the passage; or finally, the whole room or passage may be entirely darkened, and a paraffin lamp used as a source of illumination. A piece of 1in. floor-board, about 6in. wide and 20ft. long, is now obtained, and to insure rigidity, a similar piece is nailed along its centre at right angles to it, so that it presents the form (in section) of a T. If it be decided to produce the reduced pictures by artificial light in a darkened room, then this long T-shaped table must be supported by a trestle at each end, at a convenient working height, say 4ft. from the floor level, and perfectly horizontal. If, on the contrary, it is desired to take advantage of an existing window, the board or table must be supported as before on two trestles; but the one nearer the window must be of such a height as to bring that end of the board on a level with the uncovered pane, while the one at the other end must be of such a height as to admit of easy manipulation of the camera, focussing, &c. At the end of the table near the window, or other source of light, a frame to take the negatives to be reduced must be affixed, perpendicular to the table, *id est*, at right angles to it. This frame should be at least a foot square, and in its centre should have a square hole cut to take carriers of at least three sizes, in case negatives of different sizes are at any time required to be reduced. (The most convenient size negative for this work is undoubtedly the ordinary 4¼in. by 3¼in.) At the four corners of the square aperture cut in the frame on the side facing the camera four small cross-pieces must be glued (to serve as supports for that side) for the negative or carrier; and if the table is horizontal, a little turning catch must be fastened in front, to prevent the negative from falling out. With a fret-saw the operator now cuts a rather bold design at the top and bottom, and also at the two sides of the frame. This will be found very convenient in the after-operations of focussing and developing. The camera must be fixed (when wanted for reducing) at the opposite end of the table or board by means of a sewing-machine or similar clamp, which has jaws of sufficient width to grip both the table and the tailboard of the camera. The next step is to procure a suitable negative for reduction. Perhaps we have a nice quarter-plate view already; or perhaps we desire to take a view specially for reduction. In the latter case we select a position at which we can get the entire view in a space on the plate as nearly 3¼in. square as possible. If smaller, so much the better. (I have used the word "view" here; but the subject may be a young lady, a church spire, a street scene, or a banknote.) The greatest care must be exercised to focus sharply, as much of the after-success will depend on the sharpness of the original negative. A negative must now be taken by any of the usual processes, and attention must be paid to obtaining a negative which is at once clean and brilliant, not hard, with plenty of detail, and no fog or veiling. A good negative having been obtained, it must be carefully dried, but not varnished. The negative must then be taken to the operating room or passage, placed in the frame on the table, with the film side facing the camera. All light, except that which passes through the negative and the fret-work design on the frame, having been carefully excluded by means of a cloth or velvet hood, extending from the window-pane, or other source of light, to the frame. The image is now examined in the camera at the other end of the table by means of a powerful focussing glass. (A good glass, 1in. focus, fitted in a horn tube, similar to the ones used by watchmakers, will be found very useful). By moving the camera to or from the negative, the size of the image can be increased or diminished to any desired extent; but, in practice, as these pictures are generally viewed with microscope objectives of 1in. and ½in. focus, the size of the image on the focussing screen (which should be a collodionised plate, as directed in the first mode) must lie between ⅛in. and $\frac{1}{16}$in. diameter. It will now be seen where the utility of the fretwork design makes itself felt. As this design will be at least three times larger than the negative being copied, it will be found to assist very considerably in focussing the tiny image itself. When a sharp focus has been obtained without the uses of a stop, if the image be not considered sufficiently sharp, a stop may be inserted in the lens tube, and the image again focussed. If a ¼-plate portrait lens be employed, a stop will rarely be necessary if the lens be of fairly good quality. The desired size and sharpness of focus having been obtained, the operator next proceeds to collodionise a plate, sensitises it in the ordinary manner, and exposes. One or two trials will be necessary to obtain the correct exposure, according to the light he is working in. It is well to over-expose rather than under-expose, and as soon as the lines corresponding to the fretwork appear, immediately to wash off the developer, to avoid veiling the image by over-development. It is here that the "fretwork arrangement" proves its usefulness. The picture is then fixed with hyposulphite, washed and dried in the usual manner. If it is intended for examination in the microscope as a slide, the plate may now be cut to the standard size—viz., 3in. by 1in., taking care, of course, not to touch the collodion surface, and to have the image perfectly central. The image is then covered with a thin covering glass in the usual manner. If it is intended to mount the picture at the end of one of the cylindrical lenses, used as "charms" to hang to the watchchain, the picture should be taken on a thin glass, and when dry fastened to the flat end of the lens by means of a drop of Canada balsam. When this is quite dry and set hard the superfluous glass may be cut away cautiously by means of an ordinary diamond, assisted by a pair of fine pliers. It will be evident that if many such pictures are required, say for the microscope, it will be well to fit a special carrier to the camera, to take plate 3in. by 1in., and thus avoid all waste, either of collodion or of glass; and also to note that a mere central film of collodion will be needed. Or, if none but bijoux pictures for cylindrical lenses are required, it will be well to use small circlets of micro-covering glasses, fastened to the centre of the larger glass by means of a drop of Canada balsam (which can afterwards be unstuck by means of a drop or two of benzole). Allowance must of course, be made, in focussing, for the extra thickness of this covering glass.

S. Bottone.

[68674.]—**Link Motion.**—Your correspondent, "Nimrod," page 287, appears to forget, in his reply, that when crank is upon a dead centre, the value is open to the extent of the "lead"; therefore, when the crank is at either end of the stroke steam can enter the cylinder.

Clement E. Stretton.

[68696.]—**Pipes.**—One hundred 2s. comes to £10 only. This is the figure quoted for 2in. cast-iron pipes 6ft. long at all the leading ironfounders who care to make these articles, worse than profitless, except their manufacture is upon a gigantic scale. Laidlaw, in Scotland; Jones and Atwood, at Stourbridge; Spittle, at Newport, Mon., are firms whose price is as above. "W. Tin" will find that the plant he would have to lay in would amount quite to £10; then the manufacture of the pipes would still land him in a loss. Jones and Atwood are patentees of a certain process in core-making. All the large iron-founding firms use moulds in a vertical position, the molten metal running direct from cupola to the mould, while the sand, loam, &c., cost the large founders practically nothing. Why not apply to the Patent Office for specifications of lapsed patents, numerous and instructive enough, both in core-making and in cast-iron pipe moulding? Their perusal will be instructive, and will somewhat damp the manufacturing ardour of the querist.

The Lydney Dispenser.

[68699.]—**Copper Sulphate Deposition.**—Will Mr. F. W. Mason be kind enough to explain meanings of abbreviations (HC_{10}) (HC_8).

W. Perren Maycock.

[68699.]—**Copper Deposition.**—The scheme of copper deposition by electrolysis suggested by "Sauros" is utterly impracticable. It is not likely that the mine water has a copper-content of more than 100 grammes per cubic mètre (possibly not half of this), and that would mean the treatment of about 2¼ million gallons, or 10,000 tons of the water for the production of one ton of copper, assuming that the whole of the metal present was recovered. When such water is available by gravitation from an adit it may be profitably treated; but when it has to be raised from 100 to 200 fathoms before it can be treated, the wear of working parts—pumping water so corrosive—will not be compensated for by the produce. To deposit the copper electrolytically within the mine, without raising the water to the surface, is a suggestion wildly visionary. At first, in any such installation, there might be deposition of the soluble copper immediately around the electrodes; but in the absence of systematic circulation of the water through the workings of the mine, this would cease as soon as the electrolyte in the immediate neighbourhood had been deprived of its copper. H. B. F.

[68707.]—**Screwing to Wedges in Walls.**—Bore a small hole first in the wedge less than size of screw required, and the full depth. Take a steel screw the full size, and file two sides off into the core—thus you make a tap, which will tap the hole in the wedge if screwed in, working backwards and forwards, using oil or grease, and screwing full depth; then screw up with full size screw, and it will hold perfectly. Wm. Hosken.

[68709.]—**The Harp.**—Mr. Morley, of 6, Sussex-place, South Kensington, W., has several books treating upon the harp and its construction. Boshca's instruction books are the best. One is published at B. Williams, Paternoster-row, at 5s. "The First Six Weeks," published at Brewer and Co., 23, Bishopsgate-street Within (price 10s. 6d.), and a fuller one at Chappell and Co., 50, New Bond-street, W., price 15s. 6d. Harpist.

[68711.]—**Great Western Locomotives.**—The Great Western engines are provided with a pump to maintain the constant vacuum in the automatic vacuum brake. This arrangement was introduced upon that railway by Messrs. Sanders and Bolitho, and the action of the pump causes the noise to which "Ferro" refers; all the other railway companies employ a small ejector in place of a pump. Clement E. Street.

[68713.]—**Electric Light.**—This is the usual action of the battery; you can only alter it by using larger plates or more solution, or by doing away with it altogether, especially if you are going to light a lamp. To get a steady and continuous current, you must have some means by which the solution can be kept in rapid circulation to prevent the plates polarising. I should advise you to use a double-fluid battery, which can be relied upon for steadiness, as the using of a second fluid does almost the same work as when you shake the bichromate solution, only chemically. A bichromate battery, with its proper charge of solution, runs down in about 20 minutes. Of course, if you use larger plates or more exciting solution, the longer will the battery last; but then if you increase the surface of the plates or solution, it is really connecting on another cell, or adding a fresh charge to the original size battery respectively; but you do not have to do this in other batteries, as the Bunsen, for instance. Here is a good double-fluid cell for electric-light purposes—Outer cell: A carbon cylinder or plates of carbon, in a solution of nitrate of soda and sulphuric acid, an addition of bichromate of potash or soda to take away the smell of fumes. Inner cell: A zinc rod amalgamated in a solution of 1 of sulphuric acid and 12 of water. Six quart cells will light a 5c.p. lamp brilliant white, for about 6 or 8 hours right off the reel, and then by replacing the inner cell solution only with a fresh quantity, it will run about three or four hours more. Solutions can be made cheap, as nitrate of soda can be purchased for 2d. per pound, and sulphuric acid 2d. per pound; bichromate of potash not necessarily needed, only to take away the nitrous fumes. Nitrate.

[68714.]—**To Mr. F. W. Mason.**—My zinc plates are not amalgamated. Solutions: Bichromate of potash dissolved in hot water, the proportion being about 2oz. of bichromate to 1 pint of water. When cold, sulphuric acid added, 1 part of acid to 12 parts of bichromate solution. Thanks to Mr. Bottone. Amateur.

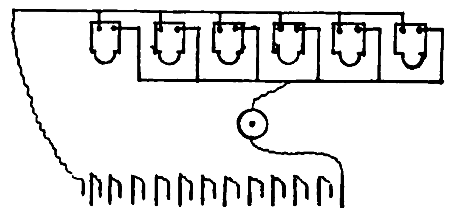
[68718.]—**Steel.**—First harden your screw-plate by heating to cherry red, and chilling in cold water. Then lay it on a red-hot iron till it changes to a straw colour, when it is again chilled in cold water. This is the way I harden and temper my drills and taps, and find them stand well. Major.

[68719.]—**Canvas Hammock.**—Two pieces of No. 4 sailcloth, each 6ft. 3in. long, placed side by side, and sewn together with a double seam ¾in. wide. Ends tabled (i.e., hemmed) ¾in., with 22 eyelet holes in each. Sides tabled ¾in., with a piece of stout cord (house line); inside the hem all round is the usual hammock. The "clews" are variously made; but the strings from a net hammock will serve as a guide. Use stout cord, such as is used for deep-sea fishing. A hammock is an uncomfortable bed for one not accustomed to it, and 9ft. "span" is too little for a six-footer. A sea cot is better, and requires less "span." Vox Mavi.

[68721.]—**Metal Speculum.**—I would advise "Speculum Metal" not to go to the trouble of casting a metal speculum, but to get a disc of glass the size he requires (see advertisement columns), and make a silver-on-glass spec. It will halve the trouble, and he will get a great deal more light from the silver surface than from speculum metal; and if he is not able to silver it himself, he can get it done at comparatively small cost.

Hadleigh, Suffolk. C. May.

[68729.]—**Electric Bell Fixing.**—Use 16 No. 1 Leclanché cells, and connect up as per sketch. In sketch six bells only are shown, but the 24 are connected just the same. F. W. Mason.



[68734.]—**English Concertina.**—The probable cause of unreadiness of utterance in your concertina is keeping the instrument on its end when not in use. It should be always kept on its side—the same position as when being played. When kept on its end the leathers hang down, and for some little time lose their full pliancy. Temperature is also liable to affect the instrument more or less. Before commencing a performance run up and down the whole chromatic scale a few times. With regard to steel vibrators, I may mention that they are now almost universally used among the best concertinaists, the use of brass being principally confined to instruments that are required to produce a certain tone in imitation of other instruments. I had the advantage of studying under the finest player living, and I have seen him perform a piece that would have smashed nearly every reed in the instrument had they been made of brass. As to the "wolf," you will have very little trouble if you get your instrument tuned in "equal temperament" (I think that is the technical term). I should infer from your queries that your concertina does not possess bowing-valves. Without them the concertina is, comparatively speaking, only a pretty toy; with them it is a perfect musical instrument. It is only a simple invention, but it has revolutionised the capabilities of the concertina. Regondi.

[68741.]—**Tarnished Steel Mirrors.**—The mirrors which you have are not made of steel at all, but are made of a poor class of bronze. They are the ordinary mirrors in Japan (kagami). They contain a large proportion of lead in their composition; they are polished primarily by means of a mixture of mercury 1 part, tin 4 parts, and this would do to polish with again. Melt the tin, add the mercury, and when cold, powder and rub it in. As regards the seeing a coin through them, this is, of course, absurd; but if they belong to the class called "magic mirrors," by reflecting a ray of sunlight from the polished side on to a white piece of paper, the figures and characters on the back will be shown on the paper; but it is only an accident of manufacture, and is not thought anything of in Japan, and I doubt very much whether you could polish them again without destroying the magic effect, as the Japanese themselves seldom can do this. R. H. H.

[68742.]—**Largest Organ in the World.**—It is quite correct that Messrs. Hill and Sons, York-road, N., have just built an organ for Sydney, N.S.W., containing a 64ft. stop. Recitals are announced for June 3rd and 4th. It is quite a fact, and is not a fiction as suggested by your correspondent. No. 116 of *Musical Opinion* (Pitman, 2d.) contained the full specification. W. Martin.

[68743.]—**Large Tree.**—I should think most likely the Wellingtonia gigantea, or mammoth fir of California (nat. ord. Coniferæ). It is called by Americans the Washingtonia. Circumference of trunk about 100ft., height 200ft. to 300ft. Some of these trees living now in California are over two thousand years old. There is, or was, the bark of a Wellingtonia in the palm-house at the Crystal Palace; perhaps it is the same tree that was at the Exhibition of 1851. I know of no other tree of such enormous girth, but the African baobab (Adansonia digitata). Adanson computed the age of a baobab tree of 30ft. diameter at 5,150 years. A. E. B.

[68752.]—**Differential Calculus.**—The usual criterion is as follows:—

$$\text{Let } y = x(a-x)^2,$$

$$\frac{dy}{dx} = (a-3x)(a-x) = 0,$$

whence $x = a$, or $\frac{1}{3}a$.

$$\frac{d^2y}{dx^2} = 6x - 4a = 2a, \text{ or } -2a,$$

according to the value of x which is substituted. As $2a$ is positive, we find that $x = a$ gives a minimum, and $-2a$ being negative, $x = \frac{1}{3}a$ gives a maximum. This criterion is generally sufficient for ordinary problems such as those referred to, when, by the nature of the question, the quantity admits of a max. or min. Occasionally the second differential coefficient vanishes, and then, if the first differential coefficient which does not vanish is of an *even* order, the above criterion will apply. If it is of an *odd* order, there may be a max. or a min. of another kind, being of the nature of a cusp in a curve. W. J. A.

[68752.]—**Differential Calculus.**—If u be the quantity which is to be maximum or minimum, then $du = 0$, which equation gives the value or values of x. Suppose that one value of x is h. Then put h for x in the expression for d^2u. If the result is positive, $x = h$ corresponds to u being a minimum; if negative, to a maximum. This is explained in all good books on differentials, which also teach what is to be done if d^2u comes out zero when h is put for x.

$$\text{Thus, if } u = x^3 - 9x^2 + 24x$$

$$du = (3x^2 - 18x + 24)\,dx$$

$$d^2u = (6x - 18)\,dx^2.$$

If $du = 0$, $x = 2$ or 4. If $x = 2$, d^2u is negative; if $x = 4$, d^2u is positive; the corresponding values of u are 20 and 16. The first is the maximum, the second the minimum. The result may sometimes be attained by general considerations. In the first of the two problems mentioned in the query, the result must give a minimum surface, for the surface may be made indefinitely large by taking the radius small enough. In the other case, if one of the parts be indefinitely small, the rectangle is also indefinitely small, so that $x = \frac{1}{2}a$ must correspond to a maximum area. Latris.

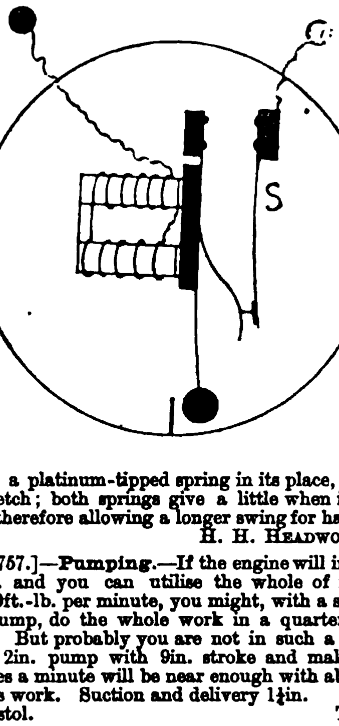
[68752.]—**Differential Calculus.**—If "A Very Old Reader" understands the theory of maxima and minima, he should know that a maximum or a minimum is determined by the sign of the second differential co-efficient for the particular value of the variable which renders $\frac{dy}{dx} = o$. If more than one value of x makes $\frac{dy}{dx} = o$, then each root must be successively substituted in $\frac{d^2y}{dx^2}$, and the resulting sign will indicate a maximum or minimum, according as it is − or +. Here is another method which will sometimes save the trouble of calculating $\frac{d^2y}{dx^2}$. Having determined the value of x, which make $\frac{dy}{dx} = o$, substitute (1) $(a-h)$ and (2) $(a+h)$ for x (where (a) is the root of $\frac{dy}{dx} = o$). If the sign of $\frac{dy}{dx}$ is the same for both these values, then $\frac{dy}{dx}$ passes either from $-o-$ or from $+o+$, and y in the first case decreases, in the second case increases, on either side of $x = a$, and is thus neither a max. nor a min. If, however, the signs are different, then $\frac{dy}{dx}$ passes either from $-o+$ or from $+o-$. It is evident, in the first case, that y is a min., and in the second case y is a max. In no case can a max. or min. be "made," as the query seems to imply. If a problem admits only of a max., then a min. solution is an impossibility, even though it is required for the answer. In the examples given let $y = x(a-x)$, $\frac{dy}{dx} = a - 2x = o \therefore x = \frac{a}{2}$, $\frac{d^2y}{dx^2} = -2$, which shows that y is a max. when $x = \frac{a}{2}$, and also that y can never be a minimum, since $\frac{d^2y}{dx^2}$ is constantly negative. Substitute $\frac{a}{2} - h$ and $\frac{a}{2} + h$ in $\frac{dy}{dx} = a - 2x$, when $\frac{dy}{dx} = a - a + 2h$, $\frac{dy}{dx} = a - a - 2h$ $\frac{dy}{dx} = +2h$, $\frac{dy}{dx} = -2h$—i.e., as x increases to $\frac{a}{2}$, y increases; but for greater values of x y decreases. Therefore, at $x = \frac{a}{2}$ y is a maximum.

Camberwell. A. H. G.

[68755.]—**Slower Striking of Gong.**—Make hammer-stem longer, thereby giving a greater throw to the hammer. Increase tension of pulling back spring, and use stronger current. The bell will have to be raised so that hammer strikes well on edge. W. Perren Maycock.

[68755.]—**Slower Striking of Gong.**—To Mr. Bottone.—Owing to the fact of your action being fixed under the gong, and therefore confined for space, you will find considerable difficulty in getting a slower rate of vibration. In the first place, you may, as you suggest, put on a rather heavier hammer; secondly, you must carry the armature further from the electro-magnets; and, thirdly, you will have to add more wire on the electro-magnets in order to get increased power to compensate for the loss entailed by moving the armature further away. Be careful as to adjustment of contact-screw and spring. S. Bottone.

[68755.]—**Slower Striking of Gong.**—Where the movement is fixed under gong it is difficult to alter as you have very little space. The best way would be by removing contact pillar and screw, and fixing a platinum-tipped spring in its place, as at S in sketch; both springs give a little when in contact, therefore allowing a longer swing for hammer. H. H. Headworth.



[68757.]—**Pumping.**—If the engine will indicate ¾H.P. and you can utilise the whole of it, say 22,000ft.-lb. per minute, you might, with a suitable size pump, do the whole work in a quarter of an hour. But probably you are not in such a hurry, and a 2in. pump with 9in. stroke and making 60 strokes a minute will be near enough with about an hour's work. Suction and delivery 1¼in.

Bristol. T. C.

[68757.]—**Pumping.** — To "Iffery."—¾H.P. Otto should do the work you require. Suction and delivery pipe may be equal size, say 1½ diameter, in the case of a small installation like this. Presuming you work your engine two hours a day and your pump is geared to make 30 strokes a minute, you will require to throw about ⅔ of a pint at each stroke, or, say, 2½ gallons per minute, or 300 gallons during the two hours. A pump barrel 2½ diameter and 9in. stroke will amply suffice to do the above duty. The horizontal or sloping distance between pump and tank is not a factor in the calculation. I should recommend you to have your pump much nearer the surface of the water in the well than 24ft. Theoretically, a pump should "draw" (as it is usually termed) 26ft. or 27ft., but in practice this is seldom done. Immediately following the top valve I should fix an air-vessel to avoid the shock which arises when any considerable head of water has to be dealt with.

Birmingham. W. Hall.

[68760.]—**Hydrostatics.** — "M.I.C.E." kindly notices any queries to which I draw his attention; but not laying claim to being a mathematician, I usually avoid such queries as this. In this case I think he will notice that in the case of the water (the pressure being equal in all directions) the downward fluid pressure is counteracted by the fluid pressure on the sides of the cone upwards (when resolved), leaving only the dead weight to act as with the ice. Of course the same applies to the hemisphere.

Bristol. T. C.

[68760.]—**Hydrostatics.**—When the cone is full of water and suspended as described, the water presses upwards upon the curved surface of the cone, as is evident from the fact that if a hole be drilled in the cone, the water will rise through it. This upward pressure partially relieves the downward pressure upon the bottom, and the consideration put forward in the query shows that it is equal to double the weight of the water in the cone. This also follows from the consideration that the pressure on every surface in contact with a heavy fluid is, per unit of surface, equal to the weight of a column of the fluid of unit section and height equal to the depth of the centre of gravity of the surface. Latris.

[68760.]—**Hydrostatics.**—Let the weight of the water in the hollow cone $= x$, and the weight of the cone itself $= y$. Then when the water becomes ice (neglecting the viscosity, as well as the alteration in weight due to expansion) the total weight is $x + y$. The pressure of the water on the base of the cone is $3x$. But there is also the pressure of the water on the internal sloping surface. Suppose that the cone consisted of a series of flat superimposed cylinders, connected and decreasing in diameter, so as to approximate to the shape of the cone. Then the upward pressure would equal the series of external concentric rings of water, which would complete the circumscribing cylinder. By increasing the number of subdivisions we can approximate to the cone as nearly as we please, and at the limit the upward pressure $= 2x$. So that the total weight (or downward pressure) before freezing $= y + 3x - 2x = x + y$ the same as with the ice. The case of the hemispherical bowl is similar. Let the weight of the water $= 2x$. Then the upward pressure $= x$, and we have the total weight after freezing $= y + 2x$, and before freezing $= y + 3x - x = y + 2x$. W. J. A.

[68760.]—**Hydrostatics.**—The seeming paradox (if such I may call it) involved in this question arises from supposing that the pressure on the base is the only vertical force acting on the cone, no account being taken of the pressure on the surface, which, acting upwards, tends to raise the cone. It is shown in works on hydrostatics that the whole pressure exerted by a fluid on a surface in contact with it is the weight of a column of the fluid whose base is equal to the area of the surface pressed, and whose height is equal to the depth, D, of the centre of gravity of that surface below the surface of the fluid. In the case of the cone, the surface of the water is a point at the apex. For the base $D = h$, and therefore the pressure on the base is $\pi r^2 h$. For the surface $D = \frac{2}{3} h$, and therefore the whole pressure on the surface amounts to $\frac{2}{3}\pi r h\sqrt{r^2 + h^2}$. The forces represented by this expression are really normal to the surface, but are equivalent to horizontal forces in equilibrium with each other, and a vertical force which is

$$\frac{2}{3}\pi r h\sqrt{r^2 + h^2} \cdot \frac{r}{\sqrt{r^2 + h^2}}, \text{ or } \frac{2}{3}\pi r^2 h.$$

Hence, if P denote the resultant of the vertical forces,

$$\begin{aligned} P &= \pi r^2 h - \tfrac{2}{3}\pi r^2 h \\ &= \tfrac{1}{3}\pi r^2 h \\ &= \text{weight of water in cone.} \end{aligned}$$

The case of the hemispherical bowl is best treated as follows: Suppose r to be the radius, and that the hemisphere has a vertical cylinder described about it; then the pressure on the base is the weight of a volume of water equal to the whole cylinder, and the vertical pressure on the surface of the hemisphere is the weight of a volume of water equal to the portion of the cylinder which lies outside the hemisphere. (See Besant's "Hydro-Mechanics," pp. 45, 46.) Hence, if, as in the former case, we denote by P the resultant of the vertical forces, we have

$$\begin{aligned} P &= \pi r^3 - \tfrac{1}{3}\pi r^3 \\ &= \tfrac{2}{3}\pi r^3 \\ &= \text{weight of water in bowl.} \end{aligned}$$

Charing. J. R. C.

[68760.]—**Hydrostatics.**—"T. C., Bristol," has fallen into error through not taking into account all the forces acting on the containing cone when the contents are fluid. When the cone contains water, not only will there be a pressure on the base, but there will also be a pressure on the sides; this pressure on the sides will have at every point a vertical component, and will tend to balance in part the pressure of the base. The resultant force on the cone as a whole will be a force downwards equal to the weight of the water. To see this we have only to remember that the upward pressure on the curved surface at any point is equal to the weight of a column of liquid on the portion of the surface as base, and whose top is at the same level as the vertex of the cone. Considering all the surface, we see that the upward pressure will be equal to the weight of water which would be inclosed between the curved surface of the cone and a cylinder of height equal to the cone, and of radius equal to the radius of the base placed over it. Now, the pressure on the base is equal to the weight of a column of water included in a cylinder of base equal to the base of the cone and of height equal to that of the cone. Take the upward pressure on the curved sides from this latter pressure, and we see that the total force on the cone is downwards, and equal to the weight of water contained. And this is equal to the downward force when the water is frozen, for in this case there is no upward pressure on the side, and we have only to consider the pressure on the base. I hope that this will be a clear explanation; it is not a case of "the calculus," but of common-sense reasoning from all the facts of the case. If there is any further difficulty, I will do my best to clear it up. "T. C., Bristol," asked my opinion on a problem of moments of inertia some time ago, but being busy I could not reply; if the difficulty is still on hand, and he will repeat it, I will try to answer it, and probably shall be able to do so, as I had the idea in my head at the time, but have since forgotten it. If he is fond of applications of mechanics to mathematics, he will find it interesting to read, if he has not already done so, the account of the disc, globe, cylinder integrator, described at the end of the first volume of the last edition of Thompson and Tait's "Natural Philosophy"; the mechanism is neat and simple. Ignotus.

[68763.]—**Feed Pump.**—Probably the feed-pipe where it enters the boiler is partly choked with scale, and so forces out the packing of pump. Clear the pipe, and have a cock on the suction-pipe to regulate the supply if you are unable to shorten the stroke, or do not like to reduce the diameter of ram. The valves would not stick from the cause you name.

Bristol. T. C.

[68763.]—**Feed Pump.** — If the packing is forced out, your gland must want bushing. Is the plunger parallel? If not, it should be made so. The delivery-valve should have a little more lift than the suction. You could stop it lifting so much water by reducing the lift of suction-valve. You should also fit a "pet-valve" to pump chamber, which adds greatly to its efficiency.

Certificated Engineer.

[68763.]—**Feed Pump.**—"One in a Fix" has several remedies open to him. 1st, he may diminish the stroke of the pump itself by using a shorter-throw eccentric. 2nd, he may "throttle" the suction pipe by inserting a tap in it; or, 3rd, he may regulate the supply into the boiler by inserting a T and a tap between the pump and the check-valve, which, I presume, he has close to the boiler. This latter mode I should recommend, as the pump would be always throwing, and would at once commence to feed at a rate proportional to the entire or partial closing of the tap. In any case it is advisable never to pump hot water. Work from cold to pump, thence through the heater (if you have one) or to boiler. A pump working on hot water direct is always apt to become "sick," especially if the supply is stopped or the delivery checked. W. Hall.

Birmingham.

[68766.] — **Persian Cat.** — I should advise "Feline" to allow nature to take her own way regarding this, and not meddle with it; but if he likes he could use an outward application of sulphur 20gr., tinc. cantharides (Spanish flies) 10gr., glycerine ½oz., water 16oz. F. W. Mason.

[68768.]—**Cleaning Battery.**—Try boiling water. F. W. Mason.

[68768.]— **Cleaning Battery.** —Surely not a matter of very great difficulty. If your cells have been allowed to run dry, and the solution has crystallised round zincs, run in some warm water.

W. Perren Maycock.

[68768.]—**Cleaning Battery.**—Presuming this to be an old Leclanché, place the cell in a pail, fill the pail with water, wait until the cell is quite full of water and ceases to give off any air bubbles. Now, without taking it out of the water or otherwise letting any air get in, turn it upside down in the pail, and let it stand 24 hours. By this time, all soluble matter will have dissolved away, and you will be able to remove the zincs, &c., provided they have not been cemented on with pitch or other similar compound. If this has been done, the cells, after having stood in water as above described, may be placed, mouth downwards, in an old saucepan of cold water, which must be gradually brought to a boil. This will soften the pitch and free the zincs and carbons. S. Bottone.

[68769.]—**Electric Bell.**—"Back Parlour Shopman" had better examine his contacts, switch, and batteries. I do not think it is the fault of the wire or bell, as you state that it does occasionally ring. I expect you will find your fault lies in your door contact. F. W. Mason.

[68769.]—**Electric Bell.**—Probably you have not a good metallic contact, either on the door contact or the contact screw and spring of the bell: the slightest dirt or grease will cause a lot of trouble. See that both contact points are well tipped with platinum, and thoroughly bright: if not, touch up with a file; also that the spring of door contact has room to work freely.

H. H. Headworth.

[68769.]—**Electric Bells.**—Such faults as these are very easily discoverable when one is able to inspect the work, though otherwise it is extremely difficult to advise correctly. I should say that there is nothing the matter with bell, but that the alarm is not well adjusted, or has dirty contacts; or that there is a short circuit or loose connection somewhere. W. Perren-Maycock.

[68770.]—**Steam Ports.**—If smooth quite large enough, but I should make them a trifle more—say, $\frac{1}{30}$ at least.

Bristol. T. C.

[68771.]—**"Woolly" Mutton.**—The reason mutton eats "woolly" or "chippy," as it is sometimes called, is, when the sheep are shorn, they get chilled, especially when we get a cold, wet spring. Butchers do not care to buy sheep too soon after shearing if they want to give satisfaction to their customers. It is difficult to tell when they are alive, but when dressed any butcher who knows his business can tell when a sheep has been chilled. The same explanation applies to lamb: although they are not shorn, their jackets are thin, and it the getting chilled that causes the mischief. What is understood by a "muttony" taste is another thing altogether. It is caused by an excess of oil in the sheep, and is usually met with in "rams" or "tups" and ewes, although sometimes it affects wethers. J. W. W.

[68774.]—**Battery.**—Look up back Nos. under heading of bichromate batteries.
W. Perren Maycock.

[68774.]—**Battery.**—I am afraid "Son of Vulcan" will have a tedious and expensive job, and also require a good knowledge of electricity for his purpose, if he is going to form the arc between carbon points by means of batteries; but if he simply wants to make a piece of platinum wire red hot, that is entirely another matter. The first would require 40 bichromate or chromic-acid cells, containing elements of zinc and two carbon plates (about 3s. each), charged with solution of bichromate of potash 1lb., sulphuric acid 4oz., water 6 pints. The cost for this would mean about the following—

40 cells, at 3s. each	£6	0	0
Solution for ditto, lasting four or five hours	2	2	4
	£8	2	4

But if "Son of Vulcan" wants an ordinary piece of platinum wire made red hot, he will only want three or four cells. F. W. Mason.

[68774.]—**Battery for Heating Wires, &c.**—The best kind of battery for this purpose is one that has little internal resistance, so that it can give a large current. The size of the battery depends entirely on the size of the wire you wish to heat. The following table gives the number of ampères of current required to fuse platinum wires of different gauges (B.W.G.):—

No. 40	2	ampéres.
,, 38	2½	,,
,, 36	3	,,
,, 34	4	,,
,, 32	5	,,
,, 28	10	,,
,, 24	20	,,
,, 20	30	,,
,, 18	50	,,

A chromic-acid cell, with 1 zinc and 2 carbons, each exposing a surface of 16sq.in., will give a current on the short circuit of 20 ampères, so it would fuse a few inches of No. 24 wire; price of such a cell, 5s. Must be charged again after three hours' work. The charge consists of chromic acid, 3oz.; water, 1 pint; sulphuric acid, 2 fluid ounces.
S. Bottone.

[68776.]—**Bromide Paper.**—In the *British Journal Photographic Almanac* 1889, Mr. W. Ingles Rogers states that he floated ready sensitised paper on a solution of bromide of potassium for two minutes, dried it, and printed it under a negative for five seconds in diffused light, then developed with the usual ferrous oxalate developer, obtaining an image full of vigour and detail, almost indistinguishable from an ordinary bromide print. Solution of bromide same as used for developing dry plates. Silver Printer.

[68778.]—**Vulcanite Cells, Repair of.**—Dissolve some unvulcanised indiarubber in carbon bisulphide until you get a pretty thick fluid, like treacle. Pour this into the cracked cells, and turn them about, so that it may enter thoroughly into the crevices. Pour away the superfluity, if any, and rear up the cells in a current of air to dry. You can buy the indiarubber solution ready made up if you live in a large town, either of the druggist or the shoemaker. If you make it up yourself, take care, for the carbon bisulphide is injurious to breathe, has an awful smell of rotten cabbage, and is highly inflammable. S. Bottone.

[68780.]—**Easter in 1827.**—In this year Easter fell on April 15. Latris.

[68780.]—**Easter in 1827.**—Easter Sunday is always the first Sunday after the full moon which happens upon, or next after, the 21st day of March; and if the full moon happens on Sunday, Easter Day is the Sunday after. See Church of England "Book of Common Prayer," where tables are given for finding Easter in any year, and in 1827 Easter Sunday fell on April 15th. T. W. M.

[68782.]—**Battery for Motor.**—The double-fluid chromic-acid cell and the Fuller cell are almost identical—quite so after they have been in action a little. You could not have a better battery for the work in hand. W. Perren Maycock.

[68782.]—**Best Battery for Motor.**—If to run eight or ten hours a double-fluid chromic-acid will be found most satisfactory. The addition of a little nitrate of soda (if out of doors), or of my new depolariser (if indoors), will be found to confer great lasting powers—say 12 to 18 hours.
S. Bottone.

[68786.]—**Schohlein's Transposing Pianos.**—I do not know the pianos of this particular maker; but if they are like other transposing pianos—such as Parker's, &c.—the transposition is effected by having the keyboard on a movable table separate from the action, so that it can be shifted half a tone at a time, through a space of three tones up or down; so that, say, a piece of music is written in D flat, and you want to play it in that pitch, while using the easier fingering of D natural, all you have to do is to shift the keyboard half a tone downwards. S. Bottone.

[68787.]—**Horizontal Engine.**—Go and buy a set of castings for 4s. or so, and ask the vendor the sizes. See advertisements in "Ours." Somebody, presumably very young, "wants to see the wheels go round," and coolly requests me and the Editor to waste two or three hours making a scaled drawing to help him. This is decidedly cool.
Bristol. T. C.

[68791.]—**Street Galvanic Battery.**—If "Amateur Electrician" will read up my article on "Coil Making" in No. 1,245, he will find all the information he requires. If he uses 2lb. of No. 36 B.W.G. for secondary, with a draw-tube regulator, and 16-power regulator (each representing 2oz. wire), he will have a serviceable machine fit for public use. He will also do well to read my other article on "Coil Phenomena," which will shortly (with the Editor's permission) be appearing.
F. W. Mason.

[68792.]—**Compounding.**—Usually do not cut off early enough in the l.p. cylinder; but that is a question depending on whether it is a tandem or cranks at right angles, and is not answered offhand so readily as you seem to suppose. For example—it depends on ratio of cylinders, cut-off, cushion, pressure, receiver capacity, and so on, and, after all, would require to be checked by the indicator. But I may repeat that, as a rule, an earlier cut-off in l.p. would be better.
Bristol. T. C.

[68793.]—**Dynamo for Tricycle.**—Certainly not. S. Bottone.

[68794.]—**Gramme.**—Premising that I do not recommend a Gramme for such a small output, owing to the structural difficulty in winding so small an armature, the following dimensions would give 5c.p.:—Armature ring 1½in. diameter, with 6 cogs, thickness of ring ¼in., depth 1in. Wind ring with 3 to 4oz. No. 24 silk-covered copper wire; standards 6in. high, cores with pole-pieces 6in. long, ¾in. diameter; thickness of standards ⅛in.; wire on fields, shunt connected, 1½lb. No. 24 single cotton-covered; voltage of lamp 6 to 8 volts; revs. per minute, 2,000 to 2,500. Will work as a motor. Two good Leclanchés would magnetise the F.M. I don't understand what you mean by winding for direct lighting; the above is for direct lighting. A Siemens H, with armature 1¾ long, 1in. diameter, working in fields 4in. high by ¼ thick, gives a better result with half the wire. S. Bottone.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

68210.	Electrical Query, p. 100.
68211.	Apochromatic Lenses, 100.
68213.	Punch and Judy, 100.
68215.	Fastening Horsehair, 100.
68223.	Achromatic Condenser, 100.
68237.	Electro-Magnets, 101.
68238.	Press, 101.
68247.	Optical, 101.
68248.	Fixing Camera Fittings, 101.
68264.	Brick Making, 101.

68426.	Lamp, p. 183.
68437.	Blowpipe, 184.
68442.	Casting.
68445.	Dust all About.
68449.	Watchmaking.
68462.	Turbine.
68464.	Oxyhydrogen Blowpipe.
68469.	Coil Boilers.

Boilers in United States Navy.—The following new regulations with reference to marine boilers have been issued by the United States Government: Any boiler having been in use ten years or more shall at each annual inspection thereafter be drilled at points near the water line and at the bottom of the shell of the boiler, or such other points as the local inspectors may direct, to determine the thickness of such material at these points and the general [illegible]iler or boilers at the time [illegible]d the thickness of such [illegible]mined thereafter at each [illegible]st. pressure allowed s[illegible] tained thickness [illegible] boiler.

QUERIES.

[68797.]—**Shunt Machines.**—Can any of your numerous correspondents explain the following? S. P. Thompson, in his book on "Dynamos," writes (p. 388) that a shunt machine to be designed for best economy, the following equation must be true—

$$\frac{r}{r_s^2} - \frac{r_a}{R^2} = 0.$$

where—
R = external resistance.
r_a = armature resistance.
r_s = shunt resistance.
r = internal resistance of machine = $r_s + r_a$.

As no proof is given, an explanation would greatl oblige.—Dumbarton Youth.

[68798.]—**Shells, to Clean and Polish.**—Can any of "ours" give the process? Have seen many look beautiful?—Sanders.

[68799.]—**Another old Locomotive.**—Mr. Stretton's recent letters suggest to me to ask if he or another reader can give any account of the origin of an old locomotive, called "Alecto," belonging to my father, and used by him in 1848-9 when he was making the railway from Blackburn to Bolton. She was a queer grasshoppery old beast with a beam the whole length of the boiler, high up on each side. At the fore end these beams were pivoted to some fixture; at the after end they received (through some sort of parallel motion) the thrust and pull of the piston rods of two vertical cylinders fixed near the footplate. Connecting rods passed from some part of these beams (seems to me about one-third from the cylinders) to crank pins in the drivers. She did good work in hauling earth waggons, and I had a great regard for her, for she "was werry good to me, she was" in the matter of stolen rides (and even drives) in the holidays. She justified her name, however, at last by blowing up one fine day and killing her driver or stoker, or both, and so finished her career on the scrap heap. Her general sweetness of disposition was manifested by her deferring her exit until I had gone back to school, and until about a minute after my elder brother had stepped down from her.=G. H. Evans, Leigh, Lancashire.

[68800.]—**Chemical.**—Can any of your readers inform me of the method they have in Oldbury of cooling the rectified acid coming from the glass retorts?—Plumber.

[68801.]—**Checking Blood Flow in Animals Accidentally Killed.**—Is there anything to prevent the renewed flow of blood still remaining in the veins and arteries of a cow or ox in its joints, killed by accident, within an hour or two of its death by pumping through them with pneumatic pressure a continuous flow of clean tepid water?—Sener.

[68802.]—**L. and N.W. Compounds.**—Will some reader kindly oblige with a drawing showing the arrangement in smoke-box, &c., of the steam pipes to and from the high and low-pressure cylinders, and final exhaust into blast pipe? Also say what the small pipe is used for which appears a few inches above the boiler behind the chimney?—T. R.

[68803.]—**Snake and Animal Poisonous Secretions.**—Chemical analysis of the above having failed to find or detect therein any poisonous element whatever, the question arises, From what source (*ex nihilo nihil fit*, mind) and by what agents or organs is the said poisonous fluid elaborated? Moreover, seeing that the poison of the most venomous snake known appears under analysis to be a harmless hydrocarbon (I think) how do our experts, who issue their dogmatic analytical dicta, account for the symptoms resulting from the bite of the cobra, the rattlesnake, the adder, &c., appearing and causing death to the victim?—Physis.

[68804.]—**Geology.**—Could any of "ours" kindly inform me if there is such a thing in London as a class for studying geology in the field for those whose only leisure would be on Saturday afternoons?—Vandembrandt.

[68805.]—**Polish.**—In passing through a paper-mill I noticed the very high polish on the cylinder, which gives the paper its gloss as it comes from the hot presses. How was this polish obtained? I was told that it was not done with emery.—J. Henry Thomas.

[68806.]—**Electrical.**—I want to convert my 45-volt 30 ampère series machine into a shunt one, so that I can use an accumulator to steady the light. Please say what quantity and gauge of German-silver wire (or other metal if better) I must insert between the terminals. Please give sketch showing the correct method.—H.

[68807.]—**L. and N.W. Engines.**—Can one of your correspondents give me the names, numbers, and dates of the North Western engines of the "Lady of the Lake" and "Precedent" classes, and compounds, between 76 and 167? I believe there should be nine Lady of the Lake and five Precedent.—C. F. D. M.

[68808.]—**Cement for Boiler.**—Will any reader kindly inform me how to make a cement which will stick to the side of an ordinary kitchen boiler and oven, making joints with the stone pillars? I have tried mortar and various cements, but they all crack and drop off.—Cement.

[68809.]—**Reducing Temperature.**—Is there any method of materially reducing the temperature of water, in default of ice; at the same time that it shall not injure the hair or the skin? It is required for head bathing in a case of congested brain.—Cerebrum.

[68810.]—**Numismatics.**—When illustrations of old coins are given in books, the figures of the obverse and reverse are usually coupled together by two parallel lines. Between these lines one often sees the characters Æ or AR; but sometimes there is no such mark. Can any of your readers tell me what these mean?—R. X.

[68811.]—**Water Glass.**—Are the silicates of potassium and sodium soluble in ether, alcohol, or any [illegible] volatile liquids; and if so, would the solution set [illegible] rapidly than, and as firmly as, the ordinary one, [illegible]sed?—R. X.

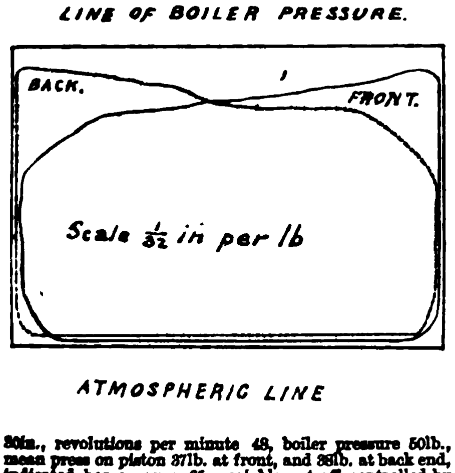
[illegible]]—**Truing Squares.**—I am making two or three small engineers' squares, blades 3 to 8in. long. Could any one tell me a good practical way of truing them up? Have use of surface plate.—A Young Turner.

[68813.]—**Brake for Two-Wheeled Dogcart.**—Can any of your readers tell me of an effective brake for two-wheeled dog-cart? To be of much use it must be easy to manage from driver's seat, and, if possible, be so contrived that the additional weight is not thrown on the horse's back.—Diarmid.

[68814.]—**Best Shoes for Harness Horse.**—I should be much obliged for information as to best shoe for above. Farriers as a rule recommend shoes that, to my mind, are far too heavy: hence horses are handicapped most severely, and many diseases and complaints arise from this abuse. It is a common expression here in Yorkshire that one horse can wear out two pairs of feet, which I believe is only another way of saying that the feet are so badly used under the present system of shoeing, that there is room for a radical improvement; and I should be glad to hear from any of your readers who has had practical experience of a satisfactory kind.—Dimraid.

[68815.]—**Portable Musical Instrument.**—Can one of our musical readers give me a hint as to the best musical instrument I could take with me abroad? It must not be very large, and it must be capable of sounding all the chords of which each note of the scale of the key in which it is tuned is the root. Have I not heard of a Norwegian zither with rather novel chord-making qualities? I dislike a banjo.—Honduras.

[68816.]—**Indicator.**—To "T. C., Bristol."—Kindly tell me by what means we can get 25 per cent. more power out of our horizontal engine, from which the following diagrams were taken:—diam. of cylinder 17¾in., stroke 30in., revolutions per minute 48, boiler pressure 50lb., mean press on piston 37lb. at front, and 38lb. at back end, indicated horse power 66, variable cut-off controlled by governor. Are the present diagrams and the power developed good?—if not, any suggestions for improvement will help.—Young Mechanic.



[68817.]—**Telephone.**—A customer of mine wishes me to supply and fix necessary instruments and fittings for communicating by telephone from, say, station A to B, C, and D. The three latter are not more than 40yds. aparts, neither is A more than 100yds. from B, C, or D. He will require at A to have some arrangement which will enable him to switch on and converse with B, C, or D at pleasure; also in the event of B, C, or D having occasion to speak to B, they can signal him in order to be put in circuit. Will any of our contributors skilled in telephone work kindly explain to me how to accomplish this; also the most reliable instruments to make without subjecting myself to an action at law. I have in my possession the last nine Vols; although they contain much valuable information *re* telephone construction, &c., I can find nothing applicable, that is, so far as regards this particular arrangement required at A.—Bellhanger.

[68818.]—**Tuning Fork Standards.**—What are the three tuning fork standards? I see that there are three tuning forks, each marked C, one vibrating at 518, another at 530, and the other at 540. What is the object of this? They are stamped Society of Arts, and marked Brinsmead and Sons.=A. Baldwin.

[68819.]—**Magnet.**—I am constructing as a hobby an electric telegraph instrument of my own design, with which I mean to learn the Morse system; and should like to know length, thickness, and shape of a horse-shoe magnet, also the weight, size (B. W. G.), and kind of covering to make the said magnet powerful enough to attract a darning needle 1in. distant. Would a Leclanché battery do, as I only want it for one instrument, one hour per night. Any hints will greatly oblige.—Locomotive.

[68820.]—**Telescope.**—I have a 6¼in. altazimuth Calver, which, as I have to use it at an open window, requires to be moved bodily every now and then, an operation, on account of its weight and size, attended with difficulty. Can any reader inform me if there would be any objection to affixing castors to the three legs?—and if so, what form of castor would be the most suitable, and would it be necessary to have any kind of brake on one or all of them? Also what is the best kind of seat to use with a Newtonian, one capable say of rising twenty inches, in the manner of the patent music chairs, which, by turning a handle rise 6¼in. while the operator remains seated.—G. G. B.

[68821.]—**Foxed Engravings.**—Can the above be cleaned or in any way improved without removing them from the book which they illustrate?—L.

[68822.]—**Noisy Fan.**—I am a blacksmith. We have a fan called a Gunter's patent. We have had it about ten years, and it always makes such a humming noise that we cannot hear ourselves speak in the shop. It is a four-fire fan, but only blows for two fires. It is set below the level of the floor with the top off it. It is about 12ft. from the fires; it has a drain walled from it past the fires, leaving two damper pipes for the irons. We can take it forward out of shop to a whole race, which we can get a good heat. I am told that the drain is too large, and that makes it hum. Would it be better to set it level with the shaft, to be level with the floor, and blow through a 4in. pipe instead of a large drain? We run at a very nice speed. I have seen fans run faster than ours, and we could scarcely hear them.—Silent Fan.

[68823.]—**Painting on Zinc.**—I should be grateful for any hints how to paint on zinc. Subjects, coats-of-arms on shields about 8in. square. Have tried artist's oil colour (vermilion), but find it will not dry. Have also tried some oil colours prepared for transparent photo colouring, and find them work well and dry in about 24 hours. What are they mixed with? Should any varnish be applied when finished?—if so, should it be used on gold or not? The colours in this sort of work should be flat and not shining, I believe. Any help welcome.—D. G.

[68824.]—**Foot Lathe.**—I have come into possession of a partly finished 7in. centre, back geared foot lathe, intended for engineers' use. The bed is 6ft. long, the pulley has three speeds, the largest of which is 8¾in., and the smallest 4¾in., made to take 1¼in. flat banding. Will someone tell me whether the pulley is too large for a foot lathe, and if a flat band will be detrimental, as I notice most foot lathes have round bands. If the pulley I have is suitable, what size and weight driving-wheel would be recommended, and ought I to have a flywheel in addition to the driving-wheel?—if so, what size and weight? The crank-shaft runs between two centres. If the pulley is not suitable, please recommend what is.—No Name.

[68825.]—**Dynamo.**—To Mr. Bottone.—I have read your reply to my query about the proportions of dynamos with much interest, and should be very much obliged if you would give me, as you promised, rules for the amount of iron in the different parts of the machine.—R. H. H.

[68826.]—**Harmony.**—Can any reader kindly inform me whether doubled thirds are allowed in four-part harmony? In some books on harmony it says that you should never double the thirds, but in several hymn tunes I have found examples where the third is doubled. Also do not all the mutation stops in an organ violate the rule forbidding consecutive fifths and octaves. As regards the discussion about "Gedacht," and "Gedeckt," I lately saw an organ by a German builder in which it was spelt "Gedeckt" = "Covered."—A. J. Smallpeice.

[68827.]—**Resistance Box.**—Will you kindly tell me how to proceed to cut and fit the brass plugs and bar to the top of box? Is it cut up after it is fitted to top of box or before? As I have already spoilt one by getting the different sections of the bar at slightly variable distances. Is the bar cut up while it is still screwed to top of box?—or how?—One in a Fix.

[68828.]—**Cricket Bat.**—How are the handles made and fixed in the best bats? How wide, and how long is the blade? How long is the handle, and how far does it go into the blade? What is the weight of an ordinary light bat? Any hints would oblige.—Stumps.

[68829.]—**Mushet's Self-Hardening Steel.**—Will some practical reader kindly inform me how to soften Mushet's self-hardening steel, so that it may be filed, turned, &c; also to restore to hardness after being so worked? Explicit instructions *re* above will, no doubt, interest many others, as there is nothing in back numbers of any practical value.—F. Allen.

[68830.]—**Cutting Iron Sheets into Strips.**—I have some iron sheets to cut up into narrow strips, which must be true. This I have only been able to do up till now by hand; but, as I have some thousands of plates to cut, I want a speedier method. Thickness of metal 20 W.G.—Ambigitur.

[68831.]—**Cleaning Marble.**—Will any fellow reader tell me how to clean a Sicilian marble tombstone, deeply carved with flowers and foliage? It is not highly polished, and has become much discoloured by the weather.—Country Parson.

[68832.]—**Archimedes.**—Would any reader be so kind as to tell me how the machine that Archimedes invented (to lift water) worked? Please to send a sketch, and oblige.—Screw.

[68833.]—**Kansas, Mo., America.**—Could any kind reader inform me what the prospects are for a man that understands all kinds of cattle, and the working of most kinds of engines and machines, both for land and factory and general work; also the prospects of Kansas city: whether the climate is good, and what it would cost to go out, and the best time?—Constant Reader.

[68834.]—**Mercurial Ointment.**—I hear from a friend that this is a good thing to put on bright iron or steel, prevents corrosion, and will keep the articles bright and clean even if exposed to the weather. Can any reader give particulars of same? If this is so, is there any cheap kind sold for this purpose?—Certificated Engineer.

[68835.—**Dark Interior Photography.**—Can any of our readers in the photographic line give me the following information? Which is the best kind of dry-plate for dark interior work? What size stop to use, so as to get a well-defined picture? Is there not a plate that is very sensitive to the dark ray of a picture? Also the time required to fully impress the picture on the sensitive film. My lens is a 1-1 plate Rectigraph, by Lancaster and Son.—J. Maddon.

[68836.]—**Bootmaking.**—To "Jack of All Trades."—I have been reading your late letters on bootmaking, and I kave decided to try my hand. I bought a shoemaker's kit of tools, had my measure taken for lasts, sent for French calf and English butt, &c., had my patterns made in zinc, have cut them out, and now I have made a grand discovery. I find that they must be blocked, as it is called, as my patterns are made for military uppers. Now, what these blocks are, where they are to be got, and when I have got them, and how I am to use them, I know not. Now, I could like you to help me in this, and I shall feel grateful. Am I to put the linings in previous to my sewing them, or otherwise? I can do no more until you give me some information through our "E. M."—Nitram.

[68837.]—**To Mr. Bottone.**—Is one Bunsen cell sufficient to regenerate the dry Gassner cell one at a time? Should the zinc connection of Bunsen be joined to zinc of the dry cell, or to the carbon? How long before the dry cell will be fully recharged?—W. P.

[68838.]—**Great Western Broad-Gauge Engines.**—Are any of the engines named on the list given by "Gorgon," in reply No. 68530, new ones, and do the G.W.Ry. Co. still build engines of this gauge? What is the diameter of the largest driving wheel at present in use on this line?—J. S.

[68839.]—**Cleaning and Polishing Marble.**—Could any of "ours" tell me how to clean and polish a marble slab that has got stained with medicine, and is very dull?—Elektron.

[68840.]—**Newtonian Telescope.**—Will "F.R.A.S." kindly inform me what size flat would be most suitable for a silver-on-glass speculum, 12¼in. diam. and 14ft.?—Solar Focus.

[68841.]—**Pocket Camera.**—In No. 1,232, a description is given of pocket camera. Size 3¼ square. Wanted to know, are dry plates made suitable for above size? What size of lens would be required for above, and about what cost should it be? It is described as a spherical wide-angle lens, with fixed focus for all distances from 5ft. upwards.—Cam.

[68842.]—**Spring Bed.**—Would "Phos Bron" be good enough to say how much steel wire it would require to make bed, say, 5ft. by 10ft. by 4ft. 4in.? Would the steel wire wind without being softened? After being pulled out, do they require tempering to keep from further stretching?—Cam.

[68843.]—**Hot Neck Grease.**—I should be obliged if some one would kindly give me an analysis of the above? What it is made from, and the mode of its manufacture.—J. Henry Thomas.

[68844.]—**Railway Coupling Appliances.**—Would our able correspondent, C. E. Stretton, kindly oblige us by giving a few diagrams and descriptions of some of the above appliances? I am sure our railway employés appreciate his able articles on different subjects, and I think that, as these have so much to do with the saving of life and limb, his opinion upon some of them that he thinks might be universally applied to all railway vehicles, would be of immense value to the Board of Trade and railway men.—Old Hand.

[68845.]—**Paper Battery Cells.**—Would battery cells, made of paper, be acid proof if soaked in paraffin wax and varnished with indiarubber varnish?—Elektron.

[68846.]—**Shadowgraphs.**—Can anyone tell me how to show shadowgraph figures on a screen, with light behind, but so placed as to show figure only, and not the rod it is fixed on?—R.

[68847.]—**Galloway Boiler.**—Will some correspondent, who has used a Galloway boiler for salt water, give his experience and describe the boiler?—Vox Mari.

Tin-Lead-Zinc Alloy.—When a mixture of lead, tin, and zinc in the molten condition is well stirred up by mechanical means and then left to itself for some hours at as nearly as possible a uniform temperature, a single homogeneous alloy results if the proportion of tin present is not less than three-eighths of the whole; but if materially less tin than this is present, the mass divides itself into two different ternary alloys, lead predominating in the heavier one and zinc in the lighter one. This phenomenon, according to a Royal Society paper by C. Alder Wright and C. Thompson, is entirely distinct from the segregation of alloys during solidification, in consequence of formation of eutectic or other differently fusible alloys. If there is little or no inequality of temperature at different parts of the mass, separation by gravitation only is complete in a few hours—at any rate, when tolerably pure metals are employed; but if the mode of heating is such that convection currents are set up, the separation is greatly interfered with, and in extreme cases almost entirely prevented. The heavier alloy is a saturated solution of zinc in lead containing tin, and the lighter one a similar solution of lead in zinc containing tin. No matter what the relative proportions between lead and zinc in the original mass, the two alloys always correspond to two conjugate points on the solubility curves of zinc in lead-tin and of lead in zinc-tin. But little, if any, difference in the way in which a given mass divides itself is noticeable, whether the temperature which the molten mass maintained is below 600° C. or above 700° C. The tin contained in the mass does not distribute itself equally in the two alloys except when present in one particular proportion, which varies with the ratio of the zinc to the lead in the entire mass. With less tin than this the lighter alloy, and with more the heavier one, takes up the higher percentage of tin. When no tin is present, lead dissolves zinc to such an extent as to form an alloy containing 1·24 per cent. of zinc, and zinc dissolves lead, forming an alloy containing 1·14 per cent. of lead; the higher values found by previous observers being slightly incorrect through imperfect separation. Nothing abnormal appears to characterise the solubility curves of zinc in lead-tin and of lead in zinc-tin. In each case the amount of one metal dissolved by the other increases as the quantity of tin present increases, in such a way that the curves are somewhat concave upwards.

Mr. Alexander Pourcel has succeeded at the new basic open-hearth steel works of Bell Brothers, of which Sir [illegible] ll is a [illegible], is producing fro[illegible] 1·7 per cent. of sili[illegible] as low as 0[illegible] of the furn[illegible]

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 5, and unacknowledged elsewhere:—

J. C. Q.—C. C.—J. and H. Grace—Glue—Horsekeeper—C. i. f.—Cymro—J. Sydney—Edward M. Nelson—Brass-finisher — M. E. — A Watchmaker — Bacon—Vooght—Provisions—T. W. Buggins—F. W. Mason—Aliquando—F. C. Allsop—Elecktron, Zeraté—Herbert Ingall—A. P. Wire—A Fellow of the Royal Astronomical Society—C. F. D. Marshall.—A. M.

WM. JAMES. (You were answered as soon as possible after the receipt of your letter. If you have taken the paper in "so long," you ought to know that we do not insert articles for payment. Send on the specification of your patent, and if we think it worth the space, we will illustrate and describe it.)—E. G. M. (If it is one of the straight-tube barometers it is a very easy matter to put it right; but what are known as wheel barometers are more trouble, as the mercury has to be shaken over the bend. The simplest way is to take the tube out, and gently tap the top end on the ground, which will have the effect of shaking the mercury together; then fill up with mercury, and, placing the thumb over the end, insert it below the mercury in the cistern. If it is a bent tube barometer, the mercury must be "shook over" by degrees, and it may be necessary to heat the tube (in a spirit flame) to expel the air.)—POWDER AND SHOT. (For how to brown gun-barrels see No. 1,085.)—T. E. N. (There are no special legends about the wishing-bone or "merrythought" of a fowl. It is usual for lovers or husband and wife to each take hold of an end, and break the bone while wishing. The one who gets the biggest piece is supposed to have the "wish" gratified.)—IGNORAMUS. (Better have the bells properly silvered in the plating bath; but if the surface is thoroughly cleaned, a thin coat of silver can be rubbed on by a preparation of a silver salt, recipes for which have been given many times. We suspect that the bells should be nickel-plated, not silvered.)—ILIAD. (What do you mean? Heber is a good English name—how old we do not know. 2. We must draw the line at translating. Replies to queries are, or should be, useful to many.)—W. G. (See indices. It is not easy to resilver a mirror of that kind.) ENGINEER, Govan. (Thanks for the information. The question is about "steel boats" being formed in "one piece.")—FRATER. (Is not the method of calculating the cubic content of anything given in every textbook of arithmetic? Multiply the dimensions in feet together.)—A. (If B. has secured a patent for the same thing a year or even a day previous to A., then B.'s patent stands, and A.'s is of no use. A.'s agent probably did what he could to ascertain if any previous application was in the office. If, as you say, A. had "one at work" *four years* before he took out a patent, that would nullify B.'s patent, and A.'s too, most likely—unless it was kept strictly secret.)—ELEKTRON. (We have given the proportions for making the gelatine copying pad many times. Four parts glycerine, one part glue, sufficient whiting to colour, and as much water as is necessary.)—BREINNER. (Answered many times. Rub the blade over with soap, trace the lines, fill up with crushed sulphate of copper, and wet; or, coat with wax, scratch the lines, and apply the aqua-fortis of the shops.)—H. D. H. (It depends on the rider; but cycle riding is not pleasant in "rainy, muddy weather" in winter. We do not advertise things in this column.)—WORKING MODEL. (For hot-air engines see indices, or pp. 148, 212, 263, 439, Vol. XLIII., and pp. 246, 368, 442, Vol. XLII.)—J. JACKSON. (Field's "Grammar of Colouring," Crosby Lockwood and Son, Stationers' Hall-court, E.C.; 3s. 6d.)—J. T. RAWORTH. (Our opinion is that vegetable carbon is not of the least use in dyspepsia. Try and live according to Dr. Allinson's instructions in the *Weekly Times and Echo*—that will cure your dyspepsia more quickly than blackening you inside with charcoal.)—J. F. CORNISH. (Our blunder, which we regret. We have made amends this week.)—G. JOHNSON. (You are surprised with very little reason, then. Such articles are the property of the writers, and it is quite out of our power to tell you whether or not they intend to publish them separately after their completion in these columns.)—W. J. ROBERTS. (As things are, we decidedly object to giving an opinion as to infringements of telephone patents! You should consult a good patent lawyer. 2. Other query next week.)—SEDGLEY. (You will break no law unless the castings are castings of parts of patented articles.)

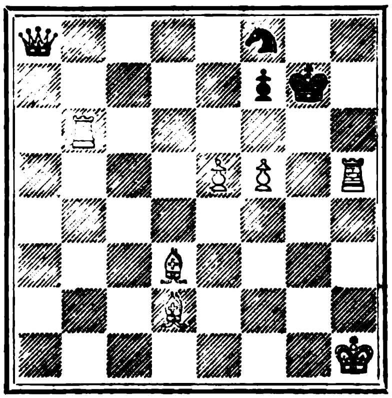
Rupture Sufferers should call at the MEDICA[illegible]TTERY COMPANY'S INSTITUTE, 52, OXFORD-STR[illegible] DON, W. (corner of Rathbone-place), and personally [illegible] valuable Hernia Appliances, which have [illegible] [illegible]nded by the medical profession. An experi[illegible] [illegible] tends daily, and examines patients free of [illegible] [illegible]d post free.

CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLII.—BY G. J. SLATER.

Black.



White. [8 + 3

White to play and mate in two moves.

SOLUTION TO 1,149.

White.	*Black.*
1. Q-Kt 7.	1. Anything.
2. Q mates.	

Also 1. P takes R, and 1. Q-B 6.

IN Problem 1,151 it should be "White to play and mate in *two* moves."

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,150 by A. Dean (2), T. A. Pringle (2), R. T. Hood (2), Litho (3), A. Wheeler, Othello (2), F. C. Cook (2), J. E. Price, J. G. Hankin, Mendelssohn, A. Bolus (2), E. Sanders, Fr. Fernando (2), H. G. Walsh, E. Retchford (3), and J. W. Read; to 1,149 by W. Jay (3), A. Bolus (3), T. A. Pringle, A. Wheeler, F. C. Cook (3) [quadruple if 1. Kt takes P on B 4 (ch), K-Q 2], J. G. Hankin, J. C. Bremner (3), E. Sanders, J. Ough [(3) and triple]; to 1,148 by A. W. and H. Warren.

A. WHEELER.—You were credited with the dual in 1,147.

J. W. READ.—If in 1,149 1. $\frac{\text{Q-Kt 4 (ch),}}{\text{P-Q 5}}$ 2. $\frac{\text{Q-K 7.}}{\text{K-Kt sq.}}$

A PRIZE of 10s. is offered by the Chess Editor of the *Nottingham Guardian* for the best list of problem composers in order of merit. Composers must be living and resident in the United Kingdom, and foreigners are not excluded. The prize will be given to the contributor whose list is nearest to that which is obtained by analysis of all the lists sent in. The first name on any list will score 12 votes, the second 11, &c. The composers obtaining the largest total of votes will be placed first on the list, and the others will follow in the order of votes polled. No list will be received after June 25. Competitors must send name and address.

IN the New York Tourney Tchigiorn and Weiss tie for first prize, Gunsberg third, Blackbourne fourth, Burn fifth, Lipschutz sixth, and Mason seventh.

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Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

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Yes, the Ruptured will still find Dr. SHERMAN at his London Office, 64, Chancery-lane, where his wonderful success draws the afflicted from all parts of England, and where you and all others should go who entertain the hope of ever being cured. Send for his books, English and American, post free, 6d., and inform yourselves.—[ADVT.]

USEFUL AND SCIENTIFIC NOTES.

Explosives.—A paper on "Explosives" was recently read by Mr. C. Napier Hake before the Society of Chemical Industry, Burlington House. Having glanced briefly at the past history of explosives, Mr. Hake referred generally to the theory of the subject. With reference to the relative rapidity of combustion and rapidity of "detonation" of explosives, it was pointed out that a dynamite cartridge 1ft. in length occupied only $\frac{1}{24000}$th part of a second in explosion. At this rate a ton of dynamite cartridges about ⅞in. diameter, placed end to end, and measuring one mile in length, would be consumed in about a quarter of a second by detonating a cartridge at either end; while a similar train, if simply ignited, would occupy several minutes for its combustion. Having explained why fulminate of mercury was the most efficient detonating agent, the properties of explosives in actual use in this country for mining and other purposes were interestingly dwelt upon in considerable detail. Although in Major Cundill's "Dictionary of Explosives" over 400 varieties are recorded, very few of these have come into practical use. Among the dangerous explosives seldom "authorised" in this country was mentioned the chlorate of potassium class. The readiness with which this compound lends itself to the production of powerful explosives offers a great temptation to investors; but the attempt to apply them practically has met with very limited success, owing to their liability to spontaneous decomposition. If it had not been for the discovery of nitro-glycerine, gun-cotton would, no doubt, have played an important *rôle* in mining operations. In this direction, however, it has not kept pace with its development and utilisation for military purposes. Nitro-glycerine compounds, therefore, take the first rank as blasting agents. In speaking of the rapid development of the trade in modern high explosives since the Explosives Act of 1875, some allusion was made to the annual reports compiled by Colonel Majendie, Her Majesty's chief inspector of explosives, and his colleagues, which conveyed an idea of the rapid growth of the explosives industry. During the years 1868-70 inclusive, when no sort of inspection existed, the annual fatalities amounted to 43. The average number for the four years preceding the Act was 37, with 33 factories at work. There are now 112 factories in operation, many of them manufacturing new explosives, and yet in 1888 only six fatal accidents were recorded.

A NEW rifled cannon, constructed by the Société Anonyme des Anciens Etablissements Cail, was tested at the beginning of the present month by the French authorities with, it is said, very satisfactory results. The gun, which is constructed on the De Bange system, is 49ft. 1in. long, with a calibre of 12·6in., and a total weight of 47 tons. The projectile, which weighs 883lb., has a muzzle velocity of 2,130ft. per second, at which, according to the account in the *Moniteur Industriel*, it can pierce 35·4in. of wrought iron and 23·6in. of French steel armour plate. At 1,475 yards its remaining velocity is 1,935ft., and here it can pierce 29·5in. of iron and 19·7in. of steel armour. The range of the piece at an elevation of 30 deg. is said to be 11·8 miles, less than that of the 9in. wire gun which fired the Jubilee shot at Shoeburyness.

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Haydon and other Cutter Bars for Metal Turning. Guaranteed to work efficiently under all circumstances. New Cutter Bar List free per post.—EDWARD HINES, Griffin Works, Norwich.—[ADVT.]

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OPEN TO ALL.

THE MANUFACTURERS OF

THE PATENT DARNING WEAVER

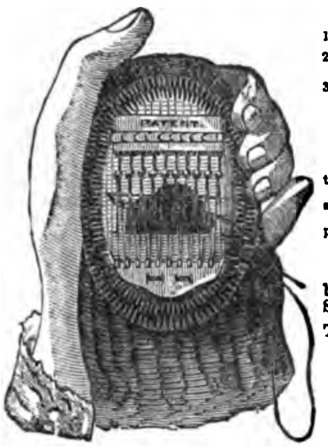
OFFER

£30 IN CASH PRIZES

FOR THE BEST SPECIMENS OF WORK DONE WITH THE WEAVER.

First Prize, £10; Second, £5; Third, £2 10s. Five Prizes of £1 each and Fifteen of 10s. each.

TWENTY-THREE PRIZES IN ALL.



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3rd.—That all Competitors must send in their work not later than JULY 1, to the Editor, *Great Thoughts*, 132, Fleet-street, London, who shall adjudicate as to the Winners.

4th.—That after the Prizes are awarded the garments shall be distributed amongst the poor in the East End of London.

5th.—That the Winners' Names shall be published in *Great Thoughts* of July 27.

6th.—That each Competitor must write Name and Address on a slip of paper, stating that the work was done with the Weaver, and fasten the same to the articles sent in.

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THE QUEEN, Feb. 23, 1889.—"The special advantage of this invention is that there is absolutely no necessity to try the eyes."

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WELDON'S JOURNAL, April, 1889.—"It is time-saving, as well as a most perfect contrivance for insuring smooth and even work."

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WORLD OF FASHION, April, 1889.—"It is really a wonderful little invention, cheap, portable, easily learned, more easily used."

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The WEAVER (price 2s. 6d. in box complete, with full instructions) may be ordered at any Drapers, or obtained direct from the Manufacturers (postage paid) by sending Postal Order for 2s. 9d.

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British Molluscs.—Wanted animals of Paludina, Ancylus, Velletia, Assiminia, Helicella. Will exchange living Testacella, Shells, or Mounted Tongues.—May, 14, Mincing-lane, London.

Locomotive, high-class model, 16in. long, fitted with quadrant link motion, brazed tubular boiler, tested to 45lb., spring buffers, pump, &c. Exchange for Safety Bicycle, Drilling Machine, or Gas Engine to the value of £8. No rubbish.—102, Teviot-street, Bromley, E.

Back-geared **Lathe**, centres 5½in., bed 5ft., slide-est, tools, &c., weight 5cwt. Will exchange for Rover Safety Bicycle to the value of £10.—A. J. Powell, Dudley-road, Tipton, Staffs.

Bessemer Steel, round, 3-16in. to 1in., short bars, What exchange offers for 10cwt.?—Gilbert, Steel Merchant, Oxford-road, Sheffield.

Important.—All kinds of **Scientific Properties**, Apparatus, Instruments received for others or cash by A. Caplatzi, Chenies-street, Tottenham Court-road.

Portable Shop, suitable for workshop, gardener, glass all round, roof, body, floor separate. Exchange to value of £4. Seen after six.—Watson, 36a, Eden-grove.

54in. **Bicycle**, ball bearings to both wheels, hollow forks, &c. Exchange anything useful.—H. Budd, Worsley House, Fawcett-road, Southsea.

Will exchange collection **Coils**, Motors, Wire, Batteries, Vacuum Tubes, good Glass Pump, well made, ¼-plate Camera Lens, good make, Diaphragms, Ruby Vignette Plates.—Below.

Porcelain Bath Dipper, beautiful Magic Lantern, 4in. condenser, three-wick lamp, new, cost £2 2s., for Safety Bicycle value £5. Seen after six p.m.—Amateur, 22, Church-street, Shaftesbury-avenue, Soho.

18ft. **Tandem Canoe**, two masts, two sails, two paddles, rudder, &c., new this year, cost £18. What offers? Also Student's Monocular Microscope, 5 lens, complete in box.—F. Grimshaw, Cromwell-street, Gloucester.

Invicta Safety Bicycle, ball bearings both wheels, good condition. Exchange to value £5 10s.—Address, G. H. Wheeler, 44, Stockwell Park-road, S.W.

Wanted, strong second-hand **Portmanteau**, must be in good condition, size not less than about 24 by 18, any size above that will carry conveniently. Exchange.—Address, giving description, to Shaw, 32, Church-street, Padiham, Lanc.

What offers for numbers "**English Mechanic**," from Feb. 5 to May 21st, 1886; also Aug. 31st, 1888, to present week; also "Family Doctor," from Jan. to May inclusive.—Bairstow, 46, Leeds-street, Keighley.

One pair 3½ctr. **Lathe Heads**, Vertical Engine, ¾ by 1½; ¼-plate Camera, square mahogany sliding box, portrait lens, with rack and diaphragm, one dark slide; lot by Fleming, Oxford-street. Wanted, Tricycle.—Thomas Kelly, Hospital, Tottenham.

Splendid **Wimshurst Machine**, quite new. Exchange to 70s. value.—Clarke, Applegate-street, Leicester.

"**English Mechanic**," 116 parts to date; 51 1s. parts "Chamber's Encyclopædia." What offers? Wanted, Poultry, Pigeons.—Lintin, 170, Freedom-road, Sheffield.

20 volumes "**English Mechanic**," cost £4 6s. 6d. First Vol. "Metal World." Exchange all or part for anything useful.—Immediate, 31, Peckham Rye, Peckham, S.E.

Beam Engine, one-man, capital condition, just re-classed, value 50s. Silver Albert and cash to value 38s.—H. Elliott, 8, Price-street, Newport, Mon.

Hair-Brushing Machine, worked by the brusher, quite complete and equal to new, with new brush, I. R. band, and round leather belt. Offers.—See below.

An **Æolian Harp**, at work all last summer, no window now. Offers.—See below.

Model Vertical Engine, unfinished, cylinder 1¾ bore, 2¾ stroke.—See below.

Five-light **Dry Gas Meter**, no further need for it.—See below.

30-hour **Striking Clock**, brass-cased weights, good timist.—See below.

Six-cell **Smee Battery**, copper and platinised silver plates, G.P. trough, and wood box.—See below.

Wanted in exchange to value, small **Portable** Hearth, Glazier's Diamond, small Files, Insulated Wire for E. Bells, really good singing Canary.—Hall, 14, Broad street Corner, Birmingham.

Referee **Safety Bicycle**, nearly new; also 2 genuine Demons. Will be sold cheap for good exchange. Inspection invited. Seen any time.—George Thurlino, 64, Long-lane, West Smithfield, London, E.C.

Splendid **Cylinder**, ¼H.P., new. Exchange a pair of ⅝in. bore Cylinders for marine engine, or one partly finished Cylinder worth 20s.—Below.

Model Injector, quite new, for feeding model boilers by steam, value 7s. Exchange Model Boiler or Engine Fittings only.—W., 55, East-road, Stratford, E.

"**Knowledge**" (Proctor's), Vol. I. bound, Vols. VI., VII., and VIII. unbound, and a few numbers. Offers.—West, 4, Estelle-road, Mansfield-road, N.W.

For exchange **Model Locomotive** of N. L. Railway, 17in. long, Model Sailing Boat, 42in. long; Marine Engine Castings.—Below.

Model Horizontal Engine, 1⅜in. stroke, model brass and copper Marine Boiler, holds one gallon of water.

Model Vertical Iron Boiler, stands 14in. high, 5½in. wide; Horizontal Engine Castings. Offers.—Tilbury, The Crescent, Stamford-hill.

"**The Observatory**," 15 early numbers; "Astronomische Nachrichten," 1877 and 1878, two Vols.; "Evelyn's Sylva," second edition, 1670. Exchange for "Nature"; wanted, 12 numbers January 5 to March 23, 1882, inclusive; "Knowledge," from Vol. X., and "Observatory," from Vol. IV., or cash.—Address, Ward, Box 75, P.O. Belfast.

Lathe Bed, 5ft., iron standards, 14in. headstock, T and tailstock, for wood turning, power. Exchange offers to—W. Smith, Bilston-road, Wolverhampton.

Lathe Wheel, Crank, an
rest, lot Bicycle Rims (Avery's), 4cwt.
bulator Wheels, 20in. axles, complete.

Anglo-German Concertina,
Watch, &c.—12, Trinity-street, West Br

Cheap Lathe, &c.—Flywheel, 62lb. weight, turned bright crankshaft, driving wheel, grindstone, lathe heads and rest, screw, stocks, dies, and taps, small drills, &c. What offers?—S. Carson, 64, Long-row, Kidsgrove, near Stoke-on-Trent.

Two **Fishing Rods**, jack and roach, brass fittings, 3in. brass winch, with line. Exchange good Telescope.—B., 4, Woodberry-grove, Finsbury-park.

Wanted, Tools, or parts of small power **Engine**, in exchange for Vol. I. "History of Protestantism," and other books.—J., 13, Brook-street, Wycombe.

8in. centre self-acting **Lathe**, 6ft. 9 bed. Will exchange for a good Rover, or offers. Stamp reply.—Sedgley, Witton-lane, West Bromwich.

Exchange No. 12 Cotton-covered **Wire**, and 1lb. No. 18 Bell Wire, for Silk-covered No. 18.—R. Newell, Cheapside, Todmorden.

Wanted, small **Band Sawing Machine**, or parts of one. Good exchange.—Wm. Taylor, Driffield.

2 pair of **Lathe-Heads**, 5in. and 5¼in. centres, single speed, six chucks. Exchange Harmonium or Microscope substage Fittings.—J. Turpin, Drighlington, Yorkshire.

9½in. **Reflecting Telescope**, wood tube, iron stand, eyepieces, and star-finder, amateur made. Exchange Harmonium or American Organ.—J. Turpin, Drighlington, Yorks.

Ruhmkorff Coil, ½in. spark, reverser, large surface condenser, quart bottle bichromate battery, quite new. Offers to value £2.—Geo. Harris, 17, York-street, Nottingham.

Wanted, ¼-horse **Engine and Boiler combined**, in exchange for Vertical Engine, cylinder 5 by 3½, and egg-ended Boiler, 36in. by 12in. Good Violin, bow and case, &c.—H., care of A. Knott, Guildford-road, Chertsey.

Capital second-hand **Horizontal Engine**, nearly equal to new, 6½in. bore, 13in. stroke, 4ft. flywheel, 18in. pulley, feed pump, and all fittings. Exchanged for Piano, or offers to the value £20.—J. Findlay, 15, School-street, Bensham, Gateshead-on-Tyne.

Wanted, a good second-hand **Hot-Air Engine**, about one man-power. Offers in exchange.—G. Twilley, No. 40, Princes-street, North Ormesby, Middlesbrough.

Will post "**English Mechanic**" punctual for exchange. Offers invited for a term. Send list for exchange.—G. Howard, 55, Percival-street, Clerkenwell.

Bicycle wanted, Safety preferred, in exchange for 4½ back-gear Lathe, face-plate, two chucks, and tools.—13, High-street, Wells, Somerset.

Books on **Engineering**, Architecture, Mechanics, Science, and Medicine. Exchange offers only. List sent post free.—J. Massey, Clifton, Cork.

Will exchange ½in. Ruhmkorff **Induction Coil**, new, for ½-plate Camera and Double Backs. Also offers wanted for [illegible] Vulcaniser.—Bertram Ord, 125, Scotswood-road, Newcastle-on-Tyne.

Wanted, an **Induction Coil** (must be Apps's make) giving 1½in. spark, with two cells. Exchange Pocket Spectroscope, quite new, by Ahrens, pair of fine double-image prisms, [illegible] field (all spar, Wollaston's principle), large lantern slit, [illegible] with two extra pairs of curved jaws.—G. G., care of [illegible] Oxford.

Scientific Exchange, 117, [illegible]
-tus of all kinds Bought, Sold, [illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 14, 1889.

MICROSCOPICAL ADVANCES.—XLVII.

By Dr. ROYSTON-PIGOTT, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; former Fellow of St. Peter's College, Cambridge.

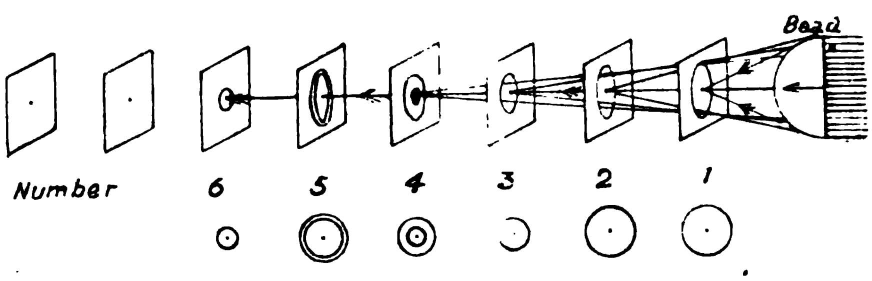
Apochromatic Eidolic Dots and Chromatic Beads.

THE existence of dark *eidolic dots of interference* is an important fact which now requires further elucidation. Darkness has resulted from excessive light. Wave neutralising wave, certain undulations killed each other. This is seen on a grand scale in the solar spectra formed by a small lens in the foci of a very fine microscope. Forty-eight dark rings have been counted developed by an extremely small solar beam. The feeble refractions occurring in a diatomic convexity cannot develop a very numerous retinue of rings; but sufficient diatomic lenses have been accumulated for the purpose indicated. Four millionths of an inch surprises a large number of microscopists deficient in the elements of fractions. This number ought to have been at once stated as four times the millionth of an inch, or 1-250,000th.*

To exhibit successfully a series of *eidolic dots of interference* demands very careful illumination, and a very fine objective. Their size varies with the nature and diameter of the refracting spherule. The 1-8th water lens of P. and L. seems to excel all my others in detecting them in different focal planes. Six have been in order, thus seen; but in small spherules such as those of *Angulata*, many dots are too faint for recognition. My experience of scale molecules has convinced me they also are wonderfully transparent, display black marginal test rings, and often one eidolic dot. In examining those of a gigantic Brazilian (noctua) moth (12in. in wing) with a fine 1-32nd, they were perfectly clear and pellucid, and well separated. The black test rings were marvels of accurate beauty, but no eidolic dot was visible with this glass. Something depends on the aperture of the condenser. Daylight from a bright cloud is preferable. These dots are well developed by large beading of diatoms from 1-9000th† to 1-14000th‡ of an inch in diameter. Extremely large spherical beads are seen in *Creswellia superba* and in *Cestodiscus superbus* (beads 1-12500th); *E. Costatus* and *Coscinodiscus radiatus* are also fine examples.

To exhibit successively all the eidolic dots of interference in successive focal planes demands very excellent glasses, careful precautions, and above all, well separated diatomic beads. They may be caught above very small diatomic- and scale-beading. Remarkably good eyesight has distinguished them above the *Angulata* bosses, and occasionally I have detected two sets of dots, when one stratum of beading lies just below another. In general, except in strongly pronounced diatomic bosses, the observer may rest satisfied with finding the primary *Eidolic dot*, No. 1, Fig. 1 in the diagram. A better glass may enable him to detect Nos. 2 and 3 by daylight. Lamp-light, unless its yellow tint be subdued with a blue chimney and other blue glasses, extinguishes the dot by the flame image produced by the diatomic lens. It may be recovered, however, in front of it by careful manipulation. As the eidola are apt to be confused with diatomic bead images, some other facts demand casual allusion.

FIG 1



Regarding this lens as a refracting body with the same index as silica, thorough decomposition of white light occurs and exposes a variety of different coloured conical shells, particularly those of a crimson and blue colour. The focal images of the round aperture transmitting the illuminating beam can be detected in advancing planes, tinged with different brilliant colours. These are apt to conceal the *eidolic dots*. At one point a resplendent pearly-white disc is seen on a dark grey ground, bordered with an intensely black, most sharply defined jet-black ring. Another dark ring is seen outside all. Fig. 2 greatly enlarged four times.

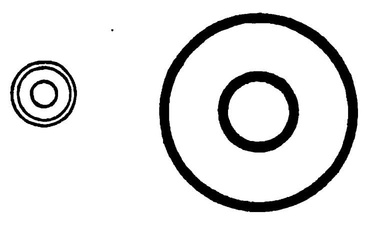


FIG .2

The subject can now be elucidated diagrammatically. Single eidolic dots can be discerned in diatomic beading, if sparsely deposited in a single stratum, *easily*, if the beads are large; with much greater difficulty when very small and close together, as in the *Angulata*. They are found above the focal plane where a sharp circular black margin is well distinguished. It is useless to pry after them, so small, unless this margin has been first clearly focussed. A medium position of the screw collar is favourable; but when once caught, further adjustment perhaps improves their aspect. So many effects are noticeable, that these dots easily escape the observer if too much drowned in light, as an apochromatic does not destroy natural colour.

Another source of embarrassment is the appearance of magnificent coloured beads above the diatom. The most remarkable are deep crimson, black bordered, with black-ringed margins, the same as the diatomic spherules. This ring, formerly named "test-ring," varies in thickness as the aperture of either objective or condenser is reduced. Thus an apochromatic with a lower natural angle than 1-43 (as 1-35, 1-20) gives evidently thicker margins to a diatomic bead. But besides this, often, *above the focal point*, appears the black eidolic dot. Dr. Van Heurck obligingly photographed with the new apochromatic glass the eidolic dot shown by the beading of the angulatum. It is when a single layer of these beads exist sparsely deposited that these dots, as distinct from focal images, make their surprising appearance (see diagram No. 1).

Many years elapsed before the discovery that these beads were chromatic images of brilliant condenser apertures existing in different focal planes corresponding to the different refrangibilities of the various coloured spectra.

An Iris diaphragm, according as the beam is contracted or expanded, demonstrates similar automatic changes in the size of the coloured beads. Crimson, sapphire, and Cambridge blue are the chief colours developed by change of focus, after all the residuary aberration has been nicely balanced. Thus, in rising foci remarkable bead varieties were seen in *Coscinodiscus gigas*.

1. A very dark ring bounding a dark grey floor carrying a red central disc.
2. Dark margin; faint central pearl.
3. Marginal ring very dark, and a brilliantly white pearl surrounded with an intensely black ring.

It was extremely gratifying to discover that a minute diatomic lens should be capable of displaying by a fine apochromatic objective the same kind of phenomena as those observed in a ¼in. ordinary plano-convex lens, transmitting an exceedingly minute beam of solar light. (See Circular Solar Spectra, *Proc. Roy. Society*, by the writer.)

These coloured beads, much smaller than the regular diatomic bosses, were once observed in *nine* different focal planes* rising by minute focal changes. The most remarkable was a very brilliant pearly-white disc. Many years of observation elapsed before the interesting discovery was made that these *well-defined ringed beads were the images formed by the different rays of light of the condenser's bright apertures*—the proof of which was offered by introducing a black central stop, which immediately produced its focal image in the same place on waving it backwards and forwards. Another demonstration was the exact size of these images as produced by a convex lens of the diatom whose focus was calculated in the following manner:—

Let the miniature in the boss be measured to be (m) times smaller than the object placed beneath 2in. lower. Then, if (u) and (v) be the distances of the object and image from the centre of the diatomic bead—

$$u = m \times v.$$

Let also the sum of these distance be (d), or—

$$u + v = d.$$

If (f) be the focal length of the minute diatomic lens—

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}.$$

By eliminating (u) and (v) from these equations, I found (*Transactions* of Royal Society, Part II. 1870) that—

$$f = \frac{d}{m + 2 + \frac{1}{m}}$$

So that, if m be large—

$$f = \frac{d}{m} \text{ nearly.}$$

Example.—The focal length of a minute lens seen in *Creswellia superba* was just 1-6000in., and for a stop placed 2in. below, $m = 2 \div \frac{1}{6000} = 12000$; that is, the miniature was diminished 12,000 times, whilst the stop being ¼in. in diameter, its image was 1-48000, a magnitude measured with little difficulty. A 15in. black disc 120in. distant was diminished by the diatomic bead 720000 times,* and, therefore, measured also 1-48,000in. diameter.

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* As before reiterated, the apparent breadth of a spider web just seemed to many persons to cover a black particle seen on Mercury. Power 1000; size 1-100000th.

† [illegible] discus Superbus.

‡ [illegible]

No. 1,264.

* Fossil diatoms from Richmond, Virginia, mounted in balsam so thin they floated about, and no certain record of position could be made.

The calculation and measurement of the size of these bead images afford a convincing proof of the accuracy of the diatomic refractions. Their measurement corresponding with their theoretical value is all the proof we desire of their convexity. Without these possibilities and the formula already just described, all attempts at mathematical demonstration would have been useless. The whole difficulty is avoided by measuring the distance between the object and its image, as the centre of the lenses is unknown. The equivalent lens is substituted. This formula the writer has employed for twenty years with the greatest satisfaction. It was a new departure in *optics*.

Minute, but very perfect, eidolic dots, jet black, may be seen above each spherule of the Peruvian *Actinocyclus*. None of these dots are visible at first by lamp, as the image flame extinguishes them. The dots, however, may be recovered, even then, by most careful manipulation. (The whole floor is crowded with the smallest granules I know.)

As a general effect, the ringed focus gives a pure white disc, which then turns pale sapphire, settling down to a dark red as the focal plane is changed.

In precision of form, glitter of beading, and beauty of arrangement, I may name *Navicula nebulosa* as surpassing every diatom I ever examined. The beading is mostly transverse, and the disc oval, with a strong medium suture. The *Coconeis*, mounted in styrax, exhibits a beautiful flat surface. A very splendid example of a brilliant yet most delicately-beaded diatom is the *Rutilaria radiata* (Oamaru), grotesquely imitating some human eyes (Fig. 3). The true optical effects of the circumferential beading may be indeed described as wonderfully pronounced.

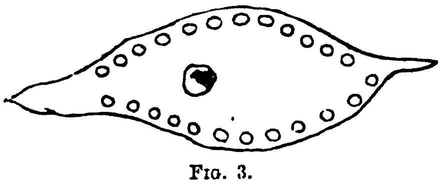
FIG. 3.

Diatomic eclipses deferred till next article.

REVIEWS.

A Text-book of General Astronomy. By CHARLES A. YOUNG, Ph.D., LL.D. Boston, U.S.A., and London: Ginn and Co.

THIS work is by Prof. Young, of Princeton, New Jersey, and is a textbook for the general course in colleges and schools rather than a "popular" treatise on astronomy. It is not intended for beginners, using that term in its generally accepted sense, but is an admirable working book for students who possess an elementary knowledge of algebra, geometry, and trigonometry, and have little time to spare to study the popular treatises and read the romance of the science. The work aims to provide the reader with a clear, accurate, and justly-proportioned statement of astronomical facts, principles, and methods in such a form as to render them easily comprehended by a student possessing an average amount of *nous*. Some portions are printed in smaller type, which may be read when further information is required, but which may be skipped by the student who wishes merely to acquire so much knowledge as will enable him to pass an examination, and at the same time give him a solid groundwork on which to build, should his tastes lead him to study astronomy for pleasure or as a hobby. Prof. Young makes no claim for special originality, because he has utilised the work of others (and acknowledged the help), but his book is not a mere compilation, and it has this special merit, that the answer to almost any astronomical question can be found in its pages, which number more than 500. We have several excellent text-books of astronomy on our shelves, but we can make room for Prof. Young's work, because it is as valuable for reference as it is to the student who wishes to acquire a knowledge of the sublimest of the sciences.

Stellar Evolution and its Relations to Geological Time. By JAMES CROLL, LL.D., F.R.S. London: Edward Stanford.

ANYTHING that Dr. Croll writes is worthy the attention of the student, and even those who will not find themselves able to agree with him in his views of stellar evolution will at least acknowledge that he presents his case in an interesting manner. Every student knows that the sun and the Solar System possess a prodigious amount of energy, which may have been derived from gravitation, but which may possibly have been derived from what Dr. Croll calls stellar evolution. He thinks that great difficulty has been experienced in accounting for the origin of comets upon the nebular hypothesis, and that the attempt to compress the geological history of our globe into the "narrow space" allotted by the physicist is hopeless. Gravitation could not, according to present knowledge, afford a supply of heat sufficient for more than twenty million years; but it is possible that there may be some other source of heat than gravity. The work deals with the subject in three parts—The Impact Theory of Stellar Evolution, Evidence in Support of the Theory from the Age of the Sun's, Heat; and Evidence in Support of the Theory from the Pre-nebular Condition of the Universe. Dr. Croll deals with the various theories and hypotheses which have been advanced, and he says that we have no grounds to conclude that there is anything eternal but God, time, and space. If time and space are subjective, then God alone was uncreated. We have said enough to show the tendency of the work; but we may mention that Dr. Croll promises to consider the matter at greater length in a volume commenced some years ago, on "Determinism, not Force, the Foundation-stone of Evolution."

The Voltaic Accumulator. By EMILE REYNIER. Translated from the French by J. A. BERLY. London: E. and F. N. Spon.

THOSE who wish to have full information about accumulators will find it concisely given in this work by M. Reynier, which Mr. Berly has translated. It is an elementary work explaining in a didactic manner all the practical and scientific advances made with the voltaic accumulator since Planté introduced his secondary battery. M. Reynier has taken a step which renders this work of historical, as well as scientific, value; for, as far as possible, he has given references to the works, inventions, and patents mentioned, and though he acknowledges that some real inventions, not known in France, may have been omitted, it is doubtful whether anything of real value about accumulators will not be found in his pages. Formulæ and other data necessary for making calculations as to the utilisation of secondary currents are given, and there are some pages on the useful applications of a [illegible] Accor[illegible] to M. Reynier, "th [illegible] fields, rendered possible by the use of the voltaic accumulator, will bring an industrial revolution, the social consequences of which can already be perceived." That is to be done apparently by what the author calls "Caption of Natural Forces." We suspect the coals will not be abandoned just yet; but this book will be very useful to those who want to know all about accumulators, including their application to aërial navigation.

The Book of the Lantern. By T. C. HEPWORTH, F.C.S. London: Wyman and Sons.

THIS is a work which may be commended to the attention of all lanternists, as it is a practical guide to the working of the magic-lantern, and contains full directions for making slides. The author has had a good deal of experience, and writes with a full knowledge of his subject, both theoretical and practical. He commences with a chapter on the construction of the lantern, then explains the optical system on which its effects mainly depend, and then goes on to explain the making of oxygen and the management of the limelight. The author was for many years lecturer at the Polytechnic when that institution was the delight of the children, and the title he has adopted for his work is well deserved, for it contains everything that anyone who essays to exhibit with the lantern can desire to have in the shape of print. Of late years the lantern has been greatly improved, and the number of those who use it for the purpose of education or amusement has vastly increased. To those who do not know what can be done with the "magic" lantern we suggest a perusal of Mr. Hepworth's "Book."

The Moulder's Ready Reckoner. By DAVID NEAVE. Aberdeen: The University Press.

This is one of those really useful manuals which appear only at intervals. It is compiled by a practical workman who, from his experience in the "shop"—a generic term—knows what is required, and does what he can to supply it. Noticing an early edition we said that an essentially practical work like Mr. Neave's is sure to be of considerable utility in the foundry; but we notice this, the fourth edition, at greater length than is usually given to reprints, because it has been considerably enlarged, and contains many tables of great use in the foundry. A new table has been added to this edition, containing constants which give the length of chord that will divide any size of a circle into any number of equal parts between 3 and 82. The little book, which fits readily into the jacket pocket, is a veritable vade-mecum for the moulder.

The Watch and Clockmakers' Handbook. By F. J. BRITTEN. London: W. Kent and Co.

THIS is the seventh edition of what is known as "Britten's Handbook," but it contains a good deal of new matter, notably information about clock and watch repairing and cleaning, the repair of musical boxes, and descriptions of new tools, &c. Under the author's careful supervision the work has grown in value, and is now an almost indispensable "handbook" for the watch and clockmaker who wishes to keep himself acquainted with the advances made in connection with his branch of industrial art. We know of no better present for a lad apprenticed to the watch and clock trade; and it would be well if every apprentice would read it and study it thoroughly, for there is a great deal of valuable information connected with the art of the watchmaker—and the trade, too,—to be found within its covers. In these days, no apprentice can afford to neglect any opportunity of learning everything connected with [illegible]; and the fact that this work is in its seventh edition is a proof that it has been appreciated in its earlier forms.

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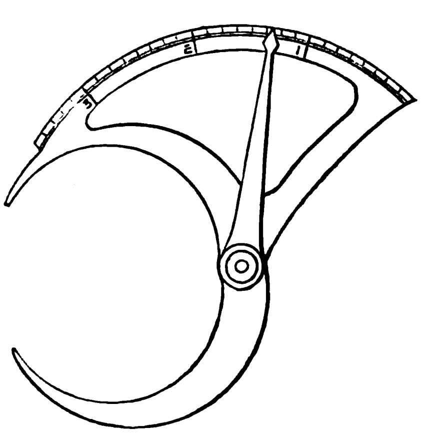
* Here $d = 120$. When $d = 2$in., the miniature is diminished 12,000 times; when $d = 120$, it is diminished 60 times smaller than 12,000 times—i.e., 720,000 times; 15in. object would have (15 ÷ 720,000 =) 1-48000th miniature.

We have also received *Bench Work in Wood*, by W. F. M. Goss (Boston, U.S.A.: Ginn and Co.), a practical treatise on joiner's work, admirably adapted for use in technical schools. The author, we may mention, is Professor of Practical Mechanics in Purdue University, Indiana.——*Firework Making for Amateurs*, by W. H. BROWNE, Ph.D., M.A., L.R.C.P. (London: L. Upcott Gill), is a manual by a well-known professor of the art of firework making, and is so clearly written, and so fully illustrated, that a novice ought by its aid to be able to make almost anything connected with the art of pyrotechny. It contains more than 200 illustrations, a useful index, and the directions are so explicit that one feels tempted to set to work and make some fireworks.——*Force and Energy*, by GRANT ALLEN (London: Longmans) is a treatise which may or may not find many readers. It seems that its origin arose out of Mr. Allen's perusal of certain dynamical treatises by Clerk Maxwell, Tait, Stewart, and Helmholtz, and it is published because Mr. Allen believes his views to be correct. It is a work the student should peruse, even if he fails to agree with the author.——*A Dictionary of Photography*, by E. J. WALL (London: Hazell, Watson, and Viney, Limited), is a useful work, though we scarcely understand "zincography" to be a mere etching process.——*The Chemistry of Photography*, by RAPHAEL MELDOLA, F.R.S. (London: Macmillan and Co.), is one of the "Nature Series," and is a reproduction of the excellent lectures delivered by the professor at the Finsbury Technical College. The photographer who wishes to excel should study this work carefully.——*The Metallurgy of Gold*, by M. EISSLER (London: Crosby Lockwood and Son), is the second edition of a work which we noticed recently; but it has been much enlarged, and now covers the whole field of gold mining and gold refining, including the recent processes adopted with the view of securing, if possible, all the gold in the ore.——*Gleanings in Science*, by GERALD MOLLOY, D.D., D.Sc. (London: Macmillan and Co.), is a series of popular lectures on scientific subjects by the rector of the Catholic University of Ireland, dealing mainly with the theory of heat, with lightning, the storage of energy, electricity, and the glaciers of the Alps. It is a most readable and instructive work.——*Engine-Driving Life*, by MICHAEL REYNOLDS (London: Crosby Lockwood and Son), is the second edition of a work which gives the public some idea of the "stirring adventures and incidents in the lives of locomotive engine-drivers." Mr. Reynolds has added some additional chapters, and we are glad to find that a second edition has been called for, as the more the public learn of the railway driver's life, the sooner will he have all such safeguards as science can provide. No one deserves them more.——*How to Select Wood-working Machinery*, by J. STAFFORD RANSOME (London: William Rider and Son), is a little work that may be useful to those engaged in cutting up and shaping timber. ——*Museums and Art Galleries*, by THOMAS GREENWOOD, F.R.G.S. (London: Simpkin, Marshall and Co.), is an interesting description of what has been done in this country to establish museums and provide buildings in which works of art can be exhibited. Mr. Greenwood says, however, "that it is only the rate-supported museums which are doing really useful work. Museums supported by subscriptions and voluntary donations are in a state of decrepitude and decay." Mr. Greenwood gives some account of what has been done in foreign countries.——*Theoretical Mechanics*, by J. EDWARD TAYLOR, M.A., Lond. (London: Longmans) is a textbook for those reading on the lines of the syllabus of the Science and Art Department, by the headmaster of the Sheffield Science Schools.——*Transmission of Power by Fluid Pressure*, by WILLIAM DONALDSON, M.A., M.Inst.C.E. (London: E. and F. N. Spon), is a technical treatise discussing the question whether air or water is the better medium for transmitting power. Mr. Donaldson agrees with the majority of engineers that water is the most useful.——*How to Make a Dynamo*, by ALFRED CROFTS (London: Crosby Lockwood and Son) is the second edition, revised and enlarged, of a work originally called "The Electric Light, and How Produced." Mr. Crofts' directions for making a dynamo are sufficiently complete to enable any intelligent amateur to construct one of the machines for producing the electric light.——*The Scientific Works of C. William Siemens, Kt., F.R.S.*, edited by G. F. BAMBER, C.E. (London: John Murray), are the collected papers of a distinguished scientific worker, published by his desire. They occupy three volumes, and are divided into "Heat and Metallurgy," "Electricity and Miscellaneous Subjects, "Addresses and Lectures." The papers in each volume are arranged in chronological order, which will facilitate the work of the student.——*Plotting or Graphic Mathematics*, by R. WORMELL, D.Sc., M.A. (London: Waterlow and Sons); and *Graphics, or the Art of Calculation by Drawing Lines*, by ROBERT H. SMITH (London: Longmans), are two works which deal with a subject that has been taken up with energy during recent years. Dr. Wormell's is, to a certain extent, a preliminary work, while that of Prof. Smith is perhaps the most elaborate treatise yet published. The atlas of diagrams forms a separate volume.——*Warren's Table-Book*, by Rev. ISAAC WARREN, M.A. (London: Longmans), is a useful little work outside the school, as it gives the weights and measures used in the British Empire and the metric system.——*Dry Rot in Timber*, by W. H. BIDLAKE, M.A., A.R.I.B.A. (London: B. T. Batsford), is a short treatise which might be studied with advantage by those who desire to build houses which may last beyond the ninety-nine years.——*History of the Transformer*, by F. UPPENBORN (London: E. and F. N. Spon), is a useful little tractate, by the chief of the electro-technical testing station in Munich, which will interest all who study the development of alternating current transformers—that is, all engaged in electric lighting.——*Practical Electrical Measurement*, by J. SWINBURNE (London: H. Alabaster, Gatehouse, and Co.), is a work that will be valued by many electrical engineers, especially as the author has avoided the use of mathematical symbols.—*Electric Bells and all about Them*, by S. R. BOTTONE (London: Whittaker and Co.), is a work the title of which explains all that is needed, especially to our readers who are familiar with the author's painstaking method of description. It is, as he puts it, "a practical book for practical men."——*A Dictionary of Explosives*, by Major J. P. CUNDILL, R.A. (London: Hamilton, Adams, and Co.), is an altogether exceptional work, of the greatest value to those engaged in studying the nature and properties of the numerous explosives now known to modern science. The work really comes from Chatham, and is based on a course of lectures delivered at the School of Military Engineering. It is interleaved with blank pages, on which additions, printed as supplements to the *R.E. Journal*, can be pasted or gummed. The work has been edited by Major Francis J. Day, R.E.——*How to Choose a Pianoforte or American Organ*, by FARLEY NEWMAN (London: F. Pitman), is a little pamphlet which we can recommend to the earnest attention of those about to buy an instrument of the kind referred to. If they pay heed to the admonitions of the writer they will probably not be disappointed with their purchase.——*A Manual of Rules, Tables, and Data for Mechanical Engineers*, by DANIEL KINNEAR CLARK (London: Blackie and Son), is the fourth edition of a work which has made a place for itself in the library of every engineer and all who have to make calculations in connection with works of construction. It is full of useful information, and is one of those books which are always kept "handy for reference."——*An Elementary Treatise on Mechanics*, by Rev. ISAAC WARREN, M.A. (London: Longmans), is a work which will commend itself to teachers, because it contains a large number of "Exercises," and it is therefore also suited to those who cannot avail themselves of class teaching.——*Practical Iron Founding* (London: Whittaker and Co.) is by a writer whose contributions to knowledge are often read by our subscribers, and is intended to give a condensed account of the principles and practice of Iron Founding for the use of the student and the practical man. Some notes on patents which have been taken out for inventions in machine moulding will be specially useful to those interested in that branch of the art.

RICKINSON'S PATENT INDICATING CALIPERS.

THESE calipers are provided with a circular scale and indicator, and may be used without the aid of a rule. They are constructed in two parts—viz., one arm with circular scale in one piece of metal, and one arm and indicator in another piece. These arms are fixed in the ordinary way by means of a pin and washers. When the arms are extended the distance from point to point is given accurately by the indicator on the dial or scale, which is divided into inches and parts of inches. By the use of the indicating calipers it is claimed that the rule is not only dispensed with, but the trouble and annoyance often caused by the rule being out of reach or misplaced are avoided. The dial as illustrated is drawn to a scale of §in. to 1in. The device has been patented by Mr. H. Rickinson, of Islington.



IMPROVEMENTS IN THE WINDING OF CLOCKS.

RATHER a novel idea in connection with the winding of clocks has been patented in this country by Mr. C. Bickford, of Boston, Mass., and Mr. J. Swann, of New York. This invention has for its object to enable the time movement of a clock to be wound by the operation of the spring of the striking movement, and it consists in the combination with the time movement and the striking movement, and their operating springs, of a connection between the springs whereby the rotation of the barrel of the striking movement, during the operation of the striking movement and the unwinding of its spring, is caused to wind the spring of the time movement; the latter being therefore wound at frequent intervals and kept in a nearly uniform state of tension—an obvious advantage. Fig. 1 represents a front elevation of a clock movement embodying the invention. Fig. 2 represents a

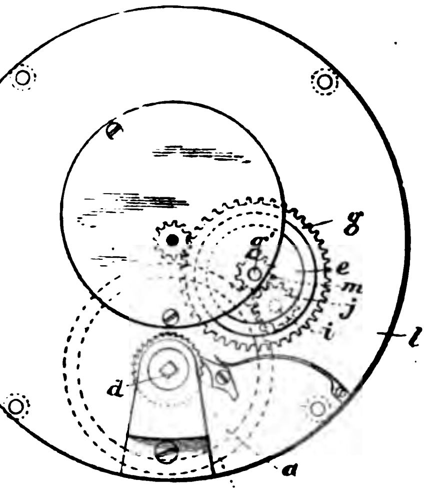


Fig 1

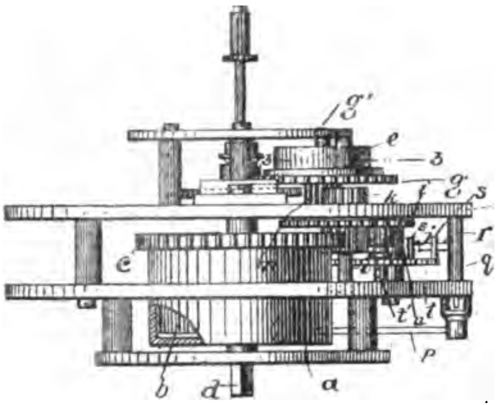


Fig 2

side elevation of the same, the dial being removed in both figures. Fig. 3 represents a section on line 3, 3, Fig. 2. In the drawings *a* represents the barrel which contains the impelling spring (*b*) of the striking movement of a clock, and is rotated by the spring when the striking mechanism is in operation, as in any spring-driven striking movement, the barrel *a* having a gear *c* formed on or attached to it, which gear forms a part of the usual striking movement; *d* represents the usual winding post or arbor, which supports the striking spring and its barrel, and is operated as usual by a key to wind up the striking spring; *e* represents the barrel containing the going or time movement spring *f*. The barrel *e* has formed on or attached to it a gear, *g*, which forms a part of the time train, the latter being organised in the usual or any suitable manner. The arbor g^1, which supports the going spring *f*, and takes the place of the usual winding post, whereby the going spring is wound by a key applied thereto, is not formed to receive a key, but is connected by suitable gearing with the barrel *a* of the striking movement, so that at each operation of the striking movement the rotation of the barrel *a* caused by such operation will rotate the arbor g^1 in the direction required to wind the going spring.

Any arrangement of gearing whereby this result will be effected may be adopted without departing from the spirit of the invention. The patentees show the arbor *i* having the pinion *j*, that engages with the gear *c* on the winding barrel, extended through the plate *l* of the supporting frame, and provided with another pinion *k*, which meshes with a pinion *m* on the arbor g^1 of the going spring. It will be seen that by this arrangement each operation of the striking movement is caused to partially wind the going spring, so that the latter is partially wound at least once each hour, and twice each hour in case the striking movement strikes the half-hours.

The chief advantages of this improvement may be stated as follows:—The going spring is kept at a nearly uniform strength or tension, instead of varying from a condition of strong tension to one of weak tension, as is the case with springs which are wound at long intervals, as in ordinary eight-day or even twenty-four-hour clocks. A comparatively light, and therefore compact, going spring can be employed, requiring for its winding but little expenditure of power from the striking-movement spring, and occupying but little room. The going spring will necessarily be wound more during the latter part of each period of twelve hours, beginning at 1 o'clock, than during the earlier part of that period; but this variation will not affect more than two coils of the spring—that is to say, the spring will only have two more coils under tension when at its highest state of tension than when at the lowest state. In an ordinary clock movement, which is wound by a key at intervals of eight days or thereabouts, this difference usually involves as many as eight coils of the spring. To guard against over-winding of the going-spring its outer end may be attached to a band or shoe, *o*, in frictional contact with the inner surface of the barrel *e*, and adapted to slip thereon when the spring is entirely wound; the pressure of the shoe in the barrel being reduced by the entire winding of the spring, so that the shoe slips on the barrel. *p* represents the hammer of the striking movement, the same being arranged to strike a gong or a spiral wire (not shown). This hammer is attached to a rocking arbor, *q*, which has an arm, *r*, projecting into the path of a series of pins, *s*, which are affixed to a wheel, *t*, which is affixed to an arbor, t^1, having a pinion, *u*, meshing with the gear wheel i^1 on the arbor *i*. The rotation of the arbor *i*, by the striking spring *b*, is imparted to the arbor *t*, and the pins *s* of the latter act on the arm *r*, and alternately raise and release the hammer in a manner well known. All the operative parts of the striking movement are not shown, as the invention does not relate to the construction thereof, but may be used with any suitable striking movement.

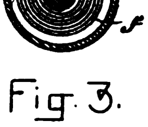


Fig. 3.

THE ANALYSIS OF IRON AND STEEL.—III.*

By An Analyst and Assayer.

Colorimetric Determination of Combined Carbon.

WHEN iron or steel is dissolved in nitric acid free from chlorine, the resulting solution is colourless, or, at the most, of a greenish tint. If, however, combined carbon be present, the solution will be of a brown colour, varying in depth of tint in proportion to the amount contained in the metal. This property of combined carbon renders the determination of the same both easy and rapid, as by simply comparing the depth of the colouration of a solution containing an unknown amount of combined carbon with that of a standard solution, obtained under precisely similar conditions, containing a known amount, the quantity contained in the former may be arrived at. Upon this principle Eggertz's colorimetric test is founded. Although simple and rapid of execution, the value of this method as a means of accurately determining the combined carbon is very limited, as it fails to furnish anything like reliable results with steels that have been hardened or contain over 0·75 per cent. combined carbon. As is evident, the test necessitates the employment of "standard" steels in which the combined carbon has been carefully determined by combustion, and it is absolutely necessary that these be of the same manufacture and contain as nearly as possible a like amount of combined carbon as the specimens being examined. Apropos of standards, we may remark that in our experience the employment of burnt sugar, coffee, &c., as such, have proved far from satisfactory.

For the analysis, 0·20 gramme of the sample is weighed out into a test tube, about 6in. long, ½in. diameter, and a similar weight of the standard steel into a like tube. Five cubic centimètres of nitric acid, sp.gr. 1·20, free from chlorine, is then added to each tube, and when all action is at an end the tubes placed in a vessel containing water maintained at boiling temperature and allowed to remain there for 15 minutes. When this period has expired the tubes are simultaneously withdrawn, the crust adhering to the sides being dissolved by causing the solution to flow over it, and cooled by placing in a beaker of cold water. The solution of the standard is then decanted without loss into a graduated tube closed at one end, of 100 cubic centimètres capacity, divided into one-tenth; the test tube rinsed out with the smallest possible quantity of cold water, the washings added to the main bulk of the solution, which is then diluted with cold water until the volume occupied in cubic centimètres is a power of the carbon contained in the steel. Thus, a standard solution containing 0·40 per cent. of combined carbon would be diluted to a volume measuring five cubic centimètres, that is the eighth power. After dilution, the solution is mixed by closing the open end of the tube with the thumb and inverting several times. The solution of the steel under examination is now transferred to a tube of a like graduation, bore, and capacity as the standard, the last portions rinsed in with the smallest quantity of cold water possible, and the liquid mixed without *dilution*. If, upon comparing the tints of the two solutions by holding the tubes side by side before a window, with a piece of white unglazed paper behind them, it is found that the steel be darker than the standard, the former is diluted with cold water,—added in small quantities at the time, the solution mixed with each fresh addition,—until equality of tints is obtained. The volume in cubic centimètres occupied by the solution when this is attained, multiplied by the power to which the standard was diluted, will equal the combined carbon contained in the sample.

Sometimes the solution of the "standard" is darker than the sample under examination. When such is the case, the volume of the standard is doubled, and upon the obtainment of equality of tints only half the volume occupied by the solution of the sample taken.

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Sulphur.

Of the various methods employed for the determination of this constituent, the one in which the sulphur is converted into sulphuric acid, with subsequent precipitation as barium sulphate ($BaSO_4$), is by far the most accurate.

The analysis is performed on two or four grammes, according to the amount of sulphur supposed to be present. Place this quantity in a porcelain dish, dissolve in 60 cubic centimètres of nitro-hydrochloric acid, and take the resulting solution to complete dryness. Heat the dry residue strongly, dissolve in hydrochloric acid, again take to dryness, remoisten with hydrochloric acid, and evaporate until a crust commences to form upon the surface of the solution, which dissolve in a few drops of hydrochloric acid. By thus repeatedly evaporating with hydrochloric acid, the nitric acid is expelled, and the presence of an excess of acid avoided; two very necessary conditions for the obtainment of accurate results, the former because the presence of nitric acid or nitrates would result in the precipitation of barium nitrate along with the barium sulphate; and the latter on account of barium sulphate being soluble in acid solutions of ferric chloride. After dilution, filter off the silica and wash filter and contents with dilute hydrochloric acid and water. Make up the filtrate, contained in a large beaker, with water to a volume* measuring half a litre, add ten cubic centimètres of a solution of barium chloride—dissolve one part of the crystals in ten of water—thoroughly mix the liquids, cover the mouth of the beaker, and allow to stand at rest in a moderately warm place. After the lapse of 24 hours, siphon off, without disturbing the precipitate, as much as possible of the clear supernatant liquid, and pass the remainder, together with the precipitate, on to a Swedish filter-paper, which, together with contents, wash three or four times with a dilute solution of hydrochloric acid—one of acid to twenty of water—and subsequently thoroughly with hot water. Finally, transfer filter-paper and contents to a crucible, ignite at a strong heat, and weigh the resulting barium sulphate, $BaSO_4$, which contains 13·37 of sulphur.

Phosphorus.

The method generally employed for the determination of this element is that known as the molybdate process, in which the phosphorus is converted into phosphoric acid, and subsequently precipitated as ammonium-phospho-molybdate by means of a solution of ammonium molybdate.

Preparation of Ammonium Molybdate Solution.—Dissolve 60gr. of the crystals in water, make up to a volume measuring a litre, add 60 cubic centimètres of ammonia, ·88 sp.gr., allow to stand for two or three days, and decant from any precipitate formed.

For analysis two or four grammes of the sample, according to the amount of phosphorus presumably present, are dissolved in 60 cubic centimètres of nitro-hydrochloric acid, the solution taken to dryness,† and the silica separated as previously described. To the filtrate, which contains the phosphoric acid, remaining after the separation of the silica, add 100 cubic centimètres of nitric acid, sp.gr. 1·42, and evaporate to a syrupy condition, which operation repeat three or four times, by which means the hydrochloric acid is expelled. When this is attained, nitric acid is added to the syrupy mass in sufficient quantity to cause it to flow freely (the volume of the solution should not exceed 50 cubic centimètres), 50 cubic centimètres of the molybdate solution is added, the containing vessel well shaken and allowed to stand at rest in a warm place (at a temperature of 50° C.), during which time a yellow precipitate of ammonium-phospho-molybdate will come down. After the lapse of ten minutes, determine, by smell, whether the solution is acid or ammoniacal, and, if the former, add ammonia sp.gr. ·88 in small quantities at a time, well agitating, and allowing to stand at rest for at least five minutes after each fresh addition until it is only slightly so; while if ammoniacal, add nitric acid sp.gr. 1·42 until slightly acid. When the right degree of acidity has been obtained, allow the solution to stand at rest until the precipitate has completely settled and the supernatant liquid is clear, when filter through a tared Swedish filter paper, employing a dilute solution of nitric acid—one part acid to ten water—to throw on the precipitate. Wash filter and contents some half-dozen times with the dilute acid, remove to the water oven, dry, and reweigh to determine the phospho-molybdate, which contains 1·63 per cent. of phosphorus.

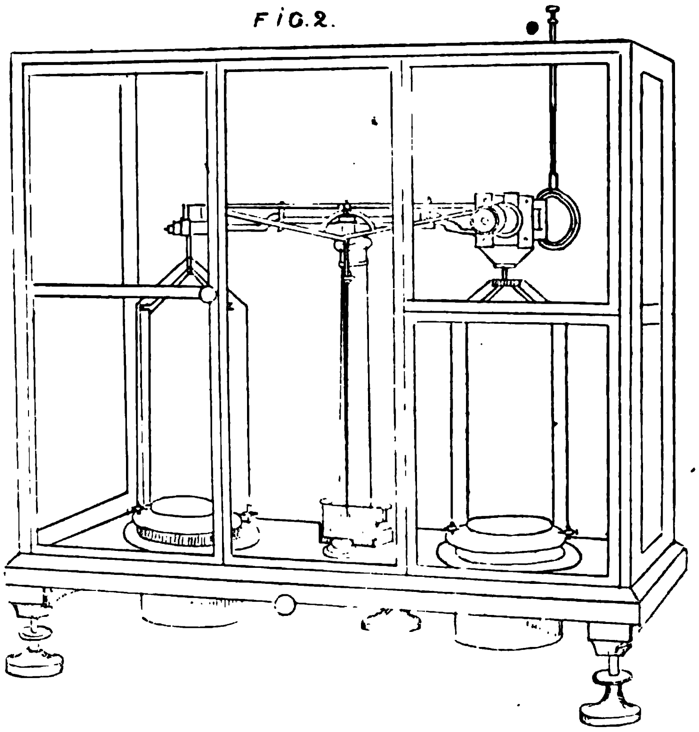
The successful precipitation of phosphorus depends upon the freedom of the solution from hydrochloric acid, and especially upon the obtainment of the *right degree of acidity*. What the right degree of acidity is cannot be very well defined; it is, however, as it were, two or three degrees beyond neutrality, so that while the amount of acid present is sufficient to prevent the precipitation of ammonium molybdate, it is insufficient to prevent the incomplete precipitation of the phosphorus. Experience alone will enable the operator to determine this point.

Should arsenic be contained in the iron or steel, a portion of it will be precipitated as arsenico-ammonium-molybdate, along with the phosphorus. For its removal, the dry residue obtained on evaporating the nitro-hydrochloric acid solution of the metal to complete dryness is dissolved in hydrochloric acid, a hydrochloric acid solution containing one gramme of pure iron added, the whole taken to dryness, redissolved in hydrochloric acid, and again taken to dryness, which operation is repeated several times. Finally the silica is removed, and the phosphorus determined in the filtrate by the method above described.

(*To be continued.*)

A NEW BALANCE.

FIG. 2.



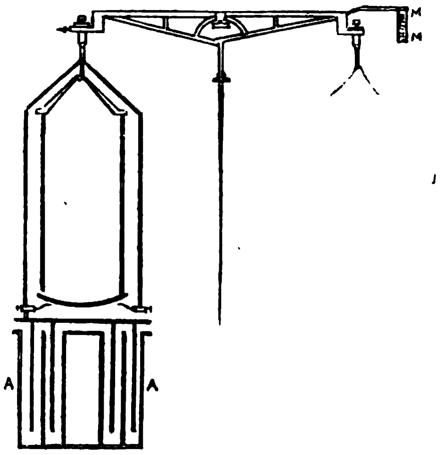
A NEW chemical balance has recently been devised, its aim being to increase the rapidity of weighings that may be necessary in scientific laboratories. Fig. 1 gives a vertical section of the instrument. Fig. 2 shows the general view. A micrometer, *m m*, is fixed to one of the extremities of the beam, and is divided into a large number of divisions. To facilitate the reading, a microscope is so arranged and focussed that the divisions on the micrometer are magnified. This microscope is fitted with a network of parallel cross wires.

The weighing is commenced in the ordinary way, by putting on a series of weights; but instead of ascertaining the exact weight of any given substance by successive trials, the operation is finished by referring to the micrometer. Thus suppose the weight has been found approximately within a difference of, say, 0·2grm., the beam is then allowed to bend beneath this difference in weight between the charge on the weighing pan and that of the weight pan, and then the micrometer is examined through the microscope. The divisions of the micrometer which correspond to the cross-wires of the microscope vary with the inclination of the beam, and this gives an estimation of the difference of charge in the two pans which is true to the tenth of a milligramme.

The operation of weighing is thus much facilitated, and a result can be obtained as delicate and accurate as any that can be got by the usual method of *trial*.

An indispensable part of this apparatus is the cylinder A A which contains air which acts as a buffer. This tends to arrest the oscillation and thus allows the beam to be brought almost immediately into a position of equilibrium.

FIG. 1



M. P. Curie, to whom the invention of this instrument is due, tried various ways of arresting the oscillation; for instance, by making A A reservoirs containing liquid, and by arranging magnets beneath the scales; but he found that the simplest and most practical method is the one described, in which air serves as a buffer and brings about the equilibrium of the beam.

The "air buffers" consist of several concentric cylinders, two of which are attached to each balance pan, and so take part in their movement; the others are attached to the base and open upwards. They differ but little in diameter, and they work one within the other, but without touching. These cylinders may be designated the upper and the lower systems. When the beam is inclined the upper system of cylinders penetrates more or less into the lower system. The air is unable to cir culate instantly by the long and tortuous path which it is obliged to follow between the cylinders, and certain variations of pressure result which last a sufficiently long time to produce a sort of "break" action which tends to arrest the oscillation.

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* This solution must be *distinctly acid*, but free from excess.

† To insure complete oxidation of the phosphorus to phosphoric acid, the dry mass must be strongly heated.

The movements of the balance are *aperiodic*, and with a difference of weights on the pans there are two or three rapid oscillations and then equilibrium is established.

The micrometer is made by a photographic process. It carries figures and lines, which are distant $\frac{1}{20}$ to $\frac{1}{30}$ of a millimètre. The micrometer is rectilinear, the divisions are equidistant, and the reading made with the cross wires of the microscope, is proportional to the tangent of the angle of inclination of the beam. This tangent is exactly proportional to the difference of the weights.

The sensibility of this balance is independent of the charge placed in the pans. In an ordinary balance capable of weighing to $\frac{1}{10}$ of a milligramme, the distance between the axis of suspension and the centre of gravity of the beam is usually $\frac{3}{10}$ of a millimètre, whereas when the same balance is fitted up in the manner described, this distance is 2 millimètres. The advantage then is obvious.

In addition to these advantages, there is that which especially claims the attention of busy men; the movements of the balance are very rapid, the duration of oscillation being nearly proportional to the square root of the distance between the axis of suspension and the centre of gravity.

ON PURIFICATION OF AIR BY OZONE, WITH AN ACCOUNT OF A NEW METHOD.

By B. W. Richardson, M.D.[*]

DURING the time when I was engaged in my preliminary studies,—for I never admit to this day of being anything less than a medical student,—the substance called ozone became the topic of much conversation and speculation. I cannot say that ozone was a discovery of that date . . . . but it was not until the time, or about the time, of which I have spoken, 1846-9, that these discovered but unexplained phenomena received proper recognition. The distinguished physicist Schönbein first, if I may so say, isolated the substance which yielded the phenomena, and gave to it the name, by which it has since generally been known, of ozone, which means to emit an odour, a name, I have always thought, not particularly happy, but which has become practically so fully recognised and understood that it would be wrong now to disturb it. Schönbein made ozone by the action of the electric spark on oxygen. He collected it, he tested its chemical properties, he announced it to be oxygen in a modified form, and he traced its action as an active oxidiser of various substances, and especially of organic substances even when they were in a state of decomposition; but Schönbein went further than this. He argued that ozone was a natural part of the atmosphere, and that in places where there was no decomposition—that is to say, in places away from great towns—ozone was present. On the high tower of a cathedral in a big city he discovered ozone; in the city, at the foot of the tower, he found no ozone at the same time. He argued, therefore, that the ozone above was used up in purifying the town below, and so suggested quite a new explanation of the purification of air. The subject was very soon taken up by English observers, and I remember well a lecture upon it by Michael Faraday, in which that illustrious philosopher, confirming Schönbein, stated that he had discovered ozone freely on the Brighton Downs, and had found the evidence of it diminishing as he approached Brighton, until it was lost altogether in the town itself. Such was the beginning of our knowledge of ozone, the precise nature of which has not yet been completely made out. At the present time it is held to be oxygen condensed. To use a chemical phrase, the molecule of oxygen, which in the ordinary state is composed of two atoms, is condensed in ozone as three atoms. By the electric spark discharged in dry oxygen as much as 15 per cent. may, under proper conditions, be turned into ozone. Recently a very singular hypothesis has been broached in regard to the blue colour of the firmament and ozone. It has been observed that when a tube is filled with ozone the light transmitted through it is of a blue colour, from which fact it is assumed that the blue colour of the sky is due to the presence of this body in the higher atmospheric strata. The hypothesis is in entire accord with the suggestion of Prof. Dove, to which Moffatt always paid the greatest respect—viz., that the source of ozone for the whole of the planet is equatorial, and that the point of development of ozone is where the terrestrial atmosphere raised to its highest altitude, at the equator, expands out north and south in opposite directions towards the two poles, to return to the equator over the earth as the trade winds. It is necessary for all who would understand the applications of ozone for any purpose, whether for bleaching purposes or pure chemical purposes, or for medical or sanitary purposes, to understand these preliminary facts concerning it, facts which bring me to the particular point to which I wish to refer to-day. In my essay describing the model city, Hygeiopolis, it was suggested that in every town there should be a building like a gashouse, in which ozone should be made and stored, and from which it should be dispensed to every street or house at pleasure. This suggestion was made as the final result of observations which had been going on since I first began to work at the subject in 1852. It occurred to me from the moment when I first made ozone by Schönbein's method, that the value of it in a hygienic point of view was incalculable. To my then young and enthusiastic mind it seemed that in ozone we had a means of stopping all putrefaction, of destroying all infectious substances, and of actually commanding and destroying the causes which produce the great spreading diseases; and, although increase of years and greater experience have toned down the enthusiasm, I still believe that here one of the most useful fields for investigation remains almost unexplored. In my first experiments I subjected decomposing blood to ozone, and found that the products of decomposition were instantly destroyed, and that the fluid was rendered odourless and sweet. I discovered that the red corpuscles of fresh blood decomposed ozone, and that coagulated blood underwent a degree of solution through its action. I put dead birds and pieces of animal substances that had undergone extreme decomposition into atmospheres containing ozone, and observed the rapidity with which the products of decomposition were neutralised and rendered harmless. I employed ozone medicinally, by having it inhaled by persons who were suffering from fœtor of the breath, and with remarkable success, and I began to employ it, and have employed it ever since (that is to say, for thirty-seven years), for purposes of disinfection and deodorisation, in close rooms, closets, and the like. I should have used it much more largely but for one circumstance—viz., the almost impracticable difficulty of making it with sufficient ease and in sufficient quantities to meet the necessities of sanitary practice. We are often obstructed in this way. We know of something exceedingly useful, but we cannot utilise it. This was the case with ozone. I hope now that difficulty is overcome. If it is, we shall start from this day on a new era in regard to ozone as an instrument of sanitation. Ozone was originally made by charging dry oxygen or common dry air with electricity from sparks or points. Afterwards Faraday showed that it could be made by holding a warm glass rod in vapour of ether. Again he showed that it could be made by passing air over bright phosphorus half immersed in water. Then Siemens modified the electric process by inventing his well-known ozone tube, which consists of a wide glass tube coated with tinfoil on its outside, and holding within it a smaller glass tube coated with tinfoil on its surface. When a current of dry air or oxygen was passed in current between these two tubes, and the electric spark from a Rhumkorff coil was discharged by the terminal wires connected with the tinfoil surfaces, ozone was freely produced, and this was no doubt the best method, for by means of a double-acting hand-bellows currents of ozone could be driven over very freely. One of these tubes with hand-bellows attached, which I have had in use for twenty-four years, is before the meeting, and answers as well as ever. The practical difficulty lies in the requirement of a battery, a large coil, and a separate bellows as well as the tube. My dear and most distinguished friend, the late Prof. Polli, of Milan, tried to overcome the difficulties arising from the use of the coil by making ozone chemically—namely, by the decomposition of permanganate of potash with strong sulphuric acid. He placed the permanganate in glass vessels, moistened it gradually with the acid, and then allowed the ozone, which is formed, to diffuse into the air. In this way he endeavoured, as I had done, to purify the air of rooms, especially those vitiated by the breaths of many people. When he visited me, not very long before his death, he was enthusiastic as to the success that must attend the utilisation of ozone for purification, and when I expressed a practical doubt, he rallied me by saying I must not desert my own child. At the theatre La Scala, on the occasion of an unusually full attendance, Polli collected the condensible part of the exhaled organic matter by means of a large glass bell filled with ice and placed over the circular opening in the roof, which corresponds with the large central light. The deposit on this ball was liquid, and had a mouldy smell; was for some few days limpid, but then became very thick, and had a nauseous odour. When mixed with a solution of one part of glucose to four parts of water, and kept at a temperature of from 20° to 24° C., this liquid underwent a slow fermentation, with the formation, on the superficies, of green must. During the same period of time, and placed under the same conditions, a similar glucose solution underwent no change whatever. By the use of his ozone bottles Polli believed that he had supplied a means most suitable for directly destroying in the air miasmatic principles, without otherwise interfering with the respiratory functions. The ozonised air had neither a powerful nor an offensive smell, and it might be easily and economically made. The smell of ozone was scarcely perceptible, and was far less disagreeable than chlorine, bromine, and iodine, while it was more efficacious than either of these; if, therefore, its application as a purifier of a vitiated air succeeded, it would probably supply all the exigencies of defective ventilation in crowded atmospheres. In confined places vessels might be placed containing mixtures of permanganate of potash or soda and acid in proper quantities and of which the duration of the action was known; or sulphuric acid could be dropped upon the permanganate. This idea of applying ozone was no doubt very ingenious, and in the bottles before us on the table, which have been prepared in Hastings by Mr. Rossiter, we see it in operation. The disadvantages of the plan are that manipulation with strong sulphuric acid is never an agreeable or safe process, and that the ozone evolved cannot be on a large scale without considerable trouble. In 1875 Dr. Lender published a process for the production of ozone. In this process he used equal parts of manganese, permanganate of potash, and oxalic acid. When this mixture is placed in contact with water ozone is quickly generated. For a room of medium size two spoonfuls of this powder, placed in a dish and occasionally diluted with water, would be sufficient. As the ozone is developed, it disinfects the surrounding air without producing cough. Lender's process is very useful when ozone is wanted on a limited scale. We have some of it here prepared by Mr. Rossiter, and it answers exceedingly well; but it would be impossible to generate sufficient ozone by this plan for the large application that would be required should it come into general use. The process deserves to be remembered, and the physician may find it valuable as a means by which ozone may be medically applied to wounds, or by inhalation when there are fœtid exhalations from the mouth or nostrils.

A New Method.

For the past ten or fifteen years the manufacture of ozone, for the reasons related above, has remained in abeyance, and it is to a new mode, which will, I trust, mark another stage of advancement, that I now wish to direct attention. Some years since, Mr. Wimshurst, a most able electrician, invented the electrical machine which goes by his name. The machine, as will be seen from the specimen of it on the table, looks something like the old electrical machine, but differs in that there is no friction, and that the plates of glass, with their metal sectors, separated a little distance from each other, revolve, when the handle of the machine is turned, in opposite directions. The machine, when it is in good working order (and it is very easily kept in good working order), produces electricity abundantly, and in working it I observed that ozone was so freely generated that more than once the air of my laboratory became charged with ozone to an oppressive degree. The fact led me to use this machine for the production of ozone on a large scale, in the following way: From the terminals of the machine two wires are carried and are conducted, by their terminals, to an ozone generator formed somewhat after the manner of Siemens', but with this difference, that the discharge is made through a series of fine points within the cylinders. The machine is placed on a table with the ozone generator at the back of it, and can be so arranged that, with the turning of the handle which works the machine, a blast of air is carried through the generator. Thus by one action electricity is generated, sparks are discharged in the ozone generator, air is driven through, and ozone is delivered over freely. If it be wished to use pure oxygen instead of common air, nothing more is required than to use compressed oxygen and to allow a gentle current to pass through the ozone generator in place of air. For this purpose Brin's compressed oxygen is the purest and best, but for ordinary service atmospheric air is sufficient.

PRACTICAL DETAILS OF BLACKSMITHING.[*]

IT is sometimes very convenient to have a hand press for bending iron in the blacksmith shop, even if there is plenty of steam or water power be had, for when the operator has the moving power in his hand, it is so completely under his control that he can observe its action as it performs its work, and if it is not producing the desired results he can stop its motion while he readjusts to the proper position the piece submitted to its pressure, and again proceed until the required form has been produced. This press is of that class of tools that are so convenient that, when they are once introduced, many things come to be done with them which never would have suggested their use if they did not stand so handily in the way.

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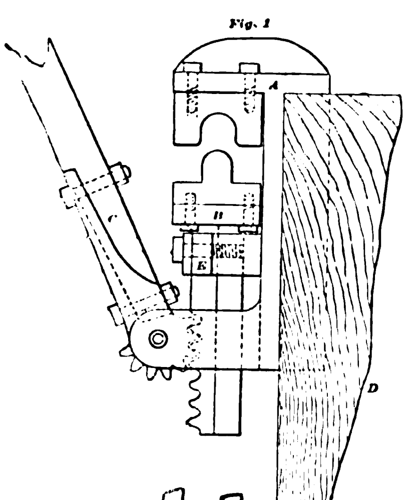
[*] Paper read in Section C—Domestic Health—at the Hastings Health Congress on Friday, May 3rd, 1889. Extracted from the *Asclepiad*.

[*] By B. F. Spalding, in *American Machinist*.

The form of hand bending press shown in Fig. 1 has nothing remarkable to recommend it, except that it is entirely destitute of all sorts of frippery, and is a very practical, common-sense machine. It was probably devised by a man who never knew he was a good mechanic, but did know that he was in a hurry for its work. It is not in the market for sale; every man makes his own. I have seen a number of copies and improvements, but for a machine that, like an old-fashioned Singer tailoring machine, works as well when it is all worn out as when it is new, I will take the old original, which I will now describe. In the circle in which it is known it is appreciated, and to widen this circle is to extend its use. It consists of the frame A, the ram B, the lever C, and the post D. Only part of the post is shown. It should be 1ft. square, and 8ft. long; 3½ft. should be very firmly set in the ground; it will then stand out about the right height to make the machine easily handled, and give a good chance to look into the dies, when placing the pieces which are to be formed.

Fig. 1



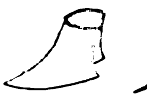


Fig. 2

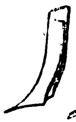


Fig. 3

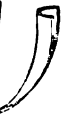


Fig. 4

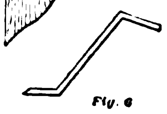


Fig. 6

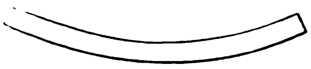


Fig. 5

The frame forms a kind of a clamp. The pattern is made of 1¼in. stuff, except the fulcrum arms, which are 2in., and the ram guide box, which is 3in. thick. The throat is 7in. deep, and the width of the frame gives a die seat 8in. long. The rib on the backside is let into the post. That on the top is of the same thickness (1¼in.), giving 3¼in. on each side of it in the head for space in which to drill bolt holes, through which bolts may be put for different lengths of dies. The method of attaching the dies is shown in the figure.

They are generally of cast iron, and are easily fixed in their proper position if the patterns are well made. Nothing more is necessary, after they come from the foundry, but to put them in their destined places after they have been fitted to receive a piece which is placed between them—and is such as they are intended to make—and scribed through such of the holes in the head as strike them in the best position. Then all that remains is to drill and tap the holes thus laid out, and when the dies are wanted for use there will be nothing to do but to put in the bolts and tighten them up. There will be no trouble about setting them.

If more than one of these hand presses is to be used in the shop, a template should be made of the holes in the head, so that they may be duplicated on each. Then all dies will fit all presses. There has been much trouble and petty annoyance arising in some shops through not observing this precaution, thus making it necessary to always have the jobs done on the presses the dies were originally fitted to, when, in many instances, it would have been much more convenient to have done them at another.

The ram head should also be drilled to correspond with the main head, and then dies can be used either above or below, as circumstances may dictate. The stem of the ram is 3in. square, set on diagonally to the head. It is guided by V grooves in the box and cap, through which it passes in square section; but at the point where the rack commences it squares out full 4in. wide at the front for the rack teeth, leaving it still angular on the back side, which is kept back into a V groove between the fulcrum arms by the action of the lever pinion teeth.

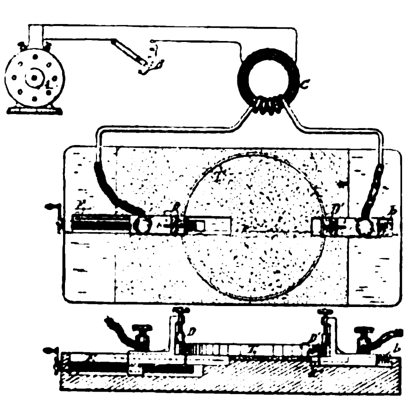
The end of the lever which communicates motion to the rack is made of cast iron 4in. thick, and this is patterned in such a manner, back of the pinion, as to afford a strong seat for a wooden handle, 3in. square in its largest cross section. The handle is fitted into the casting, and rounded down at the other end to give a good hand-hold. It is 3ft. or 4ft. long, giving a purchase of 12 or 16 to 1. With some accumulation of energy in the swing of the lever, a fair-sized man can easily give a pressure equal to a ton. This suffices for a large class of work.

Figs. 3 and 4 represent hoe points, such as are used for ploughing the furrows for seeding with grain drills. These are largely bent on this style of machine, of steel 2½in. by $\frac{3}{16}$in. Fig. 2 shows a form of point made of a 5in. by ⅝in., which offered so much resistance to throwing out the point, in consequence of the depth from the point to the heel and the width of the material that had to be bent to form the concave in its profile, that it could not be bent on this machine at less than three heats, and not satisfactorily at all. When dies are made for a light drop, it was shaped with great facility, being gauged from the point, and also from the bolt hole, indicated on the illustration, which, having been gauged from the point itself when it was punched, was always at a certain distance from it, and gave definite fixed points to work from—a very essential thing in the reduplication of parts.

With this machine, pieces shaped as in Fig. 5 are easily formed of iron 1¼in. by $\frac{3}{16}$in., and, like Fig. 6, of iron 2in. by ⅜in. It can also be used as a welding machine, taking the place of an oliver, for welding rings, eye-bolts, or anything of that description, which it is expedient to have welded between shaping dies. For this purpose it is necessary to set it lower down, so that it will not bring the dies any higher than an anvil. It should be so set that the lever can be seized in the right hand, and the dies so made that the work will enter at the angle at which a man in this position would naturally present it with his left-hand.

EXPANDING HOOPS AND TIRES BY ELECTRIC HEATING.

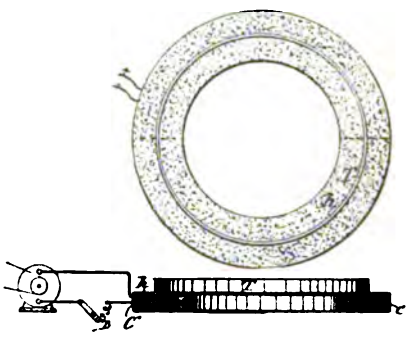
THE method of expanding hoops and tires which has been practised from time immemorial is too well known to need any description; but the method has always been open to the objection that it did not heat the tire uniformly. In more modern practice gas furnaces have been used for the purpose; but even these do not always insure perfectly uniform heating, and are, besides, very wasteful of fuel. In order to obtain perfectly uniform heating and consequent expansion, Mr. Mark W. Dewey, of Syracuse, N.Y., has devised a simple method, in which the heating effect of the electric current is employed to good advantage. The apparatus by which this is accomplished is shown in the accompanying illustrations, Figs. 1 and 2, which show the same in plan and section respectively. As will be seen, a converter, B, has its primary connected to a source of alternating current, which can be regulated by means of a rheostat. The terminals of the secondary coil are connected by flexible low-resistance conductors with adjustable clamps, D and D′, of good conducting material. These clamps are attached to the tire, and are adapted to hold it so as to make good electric contact with the same at two points equidistantly apart in the circumference of the tire, so that the resistance of the tire will be equally divided between the two clamps to form two paths for the currents. The object of thus equally distributing the clamps on the hoop or tire is to heat the same uniformly throughout its circumference, for if the clamps were applied to the tire so that a short portion of the same was between the clamps on one side and a long portion on the other side, and if the tire were of a uniform size in cross-section throughout, a greater part of the current would pass through the short portion on account of its small resistance compared to the long portion, and, consequently, it would heat the short portion more than the long portion in proportion to the difference of resistance in the two portions of the tire. If a small difference of resistance exists between the two portions, however, the difference of heat in the two parts may be nearly imperceptible and immaterial. The tire rests upon a table of non-conducting material.



Figs. 1 and 2.

The operation of the apparatus is almost self-evident. The heavy currents generated in the secondary of the converter being led to the tire, it passes through both branches of the same, heating it uniformly up to the desired temperature, when the current is shut off by the switch.

Another apparatus designed for the same purpose is that shown in plan and section, respectively, in Figs. 3 and 4. Here, it will be noticed, the primary coil C′ of the transformer is made as large as the tire, or large enough to form a bed to support various sizes of tires. Suitable insulating and heat non-conducting material, *h*, is interposed between the coil C′ and tire T, which latter itself form the secondary coil. This insulation is employed for the purpose of preventing the heat of the tire from burning the insulation around the wire of the coil C′. As the tire alone forms the secondary circuit, the heating current circulates only in the tire, and the other parts forming the secondary circuit in the other apparatuses are dispensed with, and the apparatus is thus greatly simplified.—*Electrical World* (N.Y.)



Figs. 3 and 4.

VENETIAN GLASS.*

YOU are doubtless aware that Venetian glass is not actually manufactured in Venice proper, but at Murano. Venice being the most important and best-known city, has always lent her name to the art. It is said that the reason Murano was chosen as the seat of the art of glass-blowing was on account of its peculiar geological position, which has no rival in Europe, and is only partially equalled by Reichenau in Bohemia. The bed of the sea which washes the shore of Murano is composed in great part of quartz or silica, materials which are brought thence from the Alps by torrents. These materials or sand form one of the principal ingredients needful for the manufacture of Venetian glass. I may mention that some time ago the Minister of Public Works, on the request of the Chamber of Commerce of Venice, prohibited the use of this sand for any other purpose, and also prohibited its exportation. There must be something peculiar in the natural position of Murano, as is proved by the fact that when the demand for the glass increased almost beyond the capabilities of the restricted space at command, the Muranese did not think it advisable to extend their furnaces and works to the neighbouring islands. Not only is this restriction attributable to the natural position of Murano, but also to the personal peculiarities, in some measure, of the artists themselves.

They commenced their works naturally with the simplest forms used in daily life; afterwards, when they found a demand for something richer, more elaborate and complicated in design, they worked on step by step in their profession, discarding all use of moulds and contrivances for making easier and quicker their labours, intent only on perfecting their art works, and making every piece a real work of art, of which they are and always were extremely proud. So much do they identify themselves with their works, that there are certain forms and designs which are quite traditional. These have been handed down for generations from father to son, and are known by the family name of the artist producing them.

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* Abstracted from a paper read before the Society of Arts by Dr. Giulio Salviati.

It would seem, from the variety and immense numbers of tints and shades, that a knowledge of chemistry would be needed in the formation of the base of this manufacture. Such, however, is not the case, as a reflection on the ignorance of this science 200 or 300 years ago will prove. This was about the time when Murano began to be renowned for her splendid productions, a renown which has been more or less maintained until the present day.

The artists had neither the time, nor the means, nor desire, to occupy themselves in chemical studies; but continual experiments and practice on certain traditional lines, together with patience and determination to succeed, are and have been the chief moving powers in their works.

Under the name of "Venetian glass" is comprised not only the elegant vases and goblets and ornamental objects, but also chandeliers, candelabra, mirrors, table glass, and roundels of sheet glass for windows, &c., for which Venice was famous. There are a number of names used to express the various kinds of glass, thus:—The "ritorto," a kind of stripe of different colours on a plain ground; the "fiamma," a mixture of many different colours, so named from its appearance of flames; the "retticello," which represents delicate lace patterns; the "avventurina," looking like brilliant gold; the "festoncino," having the appearance of threads; the "chalcedony," looking, as its name signifies, like some stone or marble, &c. These various compositions all require different treatment, many needing several days in preparation.

The tools used by the artists are few, and very simple: a hollow, long tube of iron for blowing; a large pair of shears for cutting (similar to those used by tailors), a few other instruments for measuring, and a stamp with a strawberry-shaped die, these compose all the instruments used in the production of all the articles, even in a *tour de force*, which is the term used to express the most complicated designs. The production of a vase or other article is obtained in this way:—The end of the blowing-rod is dipped into a pot containing molten glass, and a portion of it accumulated on the end. It is essential that the quantity which adheres to the rod should be accurately guessed for the size of the vase or other object which it is intended to produce, be it a small wine glass or a large tazza. If the quantity taken up is too small, the article produced will not be of sufficient size, and naturally if too much is taken, the article produced will exceed the required dimensions. This lump of liquid glass is then rolled on a table by giving a few turns to the blowing-rod; it is then blown by the artist slightly, then reheated in the furnace. This process is repeated each time the article takes a more definite shape, until after repeated heating and blowing, the lump of glass is blown into a vase, cup, or other article. During the whole operation the artist remains in front of the furnace, as the material must be kept in a liquid condition until the right form and size are obtained. Having thus made the body of the object, the artist now proceeds to form the foot or stand. In this he is assisted by another artist of an inferior grade, who has prepared meanwhile a piece of the necessary material on a blowpipe, and who has blown it hollow. This he keeps in a liquid state, and in order to prevent it from dropping off his pipe he has to continually turn it round and round. The right moment must be watched, and then the two parts are joined; a twist, a pull, and a little dexterous manipulation, and the stem is framed. The article is again placed in the furnace; meanwhile the maestro, or chief artist, takes up a small portion of another coloured material; then, taking the article from the furnace, he proceeds to ornament it with strawberries, flowers, leaves, or other devices; between each operation the article is introduced to the furnace to keep it soft; of course, it has to be carefully held in shape. It is astounding to see the numerous variety of decorations which the artists produce for the embellishment of the objects. There are serpents, dragons, flowers, leaves, handles, &c., nothing is too complicated or simple, one and all are modelled by these instruments. Some vases require the attention of four artists at the same time, and require from one to two hours of uninterrupted labour. During this time they are placed in and out of the furnace thirty or forty times. While they are in the furnace they have to be kept in position by a special artisan called a "forcellante," whose duty it is to keep the article turned round and round, and who must watch that it does not drop or any way lose its form; for this purpose he uses a long, fork-like instrument, this he has to do standing in front of the mouth of the furnace until the article is sufficiently cooled to retain its shape without assistance; then by slow degrees it is introduced further and further into the cooler part of the furnace where it remains cooling until the following morning. The painter and sculptor know how difficult their art is, and how much practice they must go through before they can draw a model accurately. How much more difficult, then, must it be for an artist to have to mould his subjects from the pliant and semi-liquid glass, and to be obliged to work at such a speed as to prevent the glass from cooling too much for manipulation.

This general process of blowing is applicable to self-colours, such as opal, ruby, acqua marina, &c.; but when the object to be produced is to be made of the richer and more complicated wares, such as the reticillo, ritorto, filagree, &c., then the material requires a separate preparation, which process (according to the material required) takes from one to three days. These are prepared in long strips callen "canna," and when covered with crystal and ready are placed side by side on a kind of shovel, which is put into the furnace; as they melt they adhere to each other, and the workman with a piece of half-melted glass on the end of his rod presses on the ends, then with a dexterous twist he winds them all up into the form of a cylinder, the end of which is fixed to the handle that is to control them during subsequent operations. When thus ready, the artist dips the end of his blowpipe, charged with the cylinder of prepared strips or canna, into a pot or ordinary clear glass, which is to protect the delicate lace work or the sensitive aventurina. He then proceeds to roll them on the marver or little iron table, and when by heating, rolling and blowing, they form a compact body, he proceeds to cut off a piece of the required size, taking care that the strips are all evenly joined. The vitreous mass thus obtained is then treated by the artist in the manner I have already described to you, and he proceeds to fashion his jug, vase, glass, tazza, or other object. The pattern which was thus imprisoned in the small strips is now by blowing fully developed.

If no twisted movement has been given during the operation, the lines of lace-work or other work remain straight; if, on the other hand, a different movement has been given during the process, the lines will have a twisted effect, as is often seen in Venetian glass. The filagree is prepared by minute thread-like strips inclosed between two sheets of crystal glass; the threads are sometimes crossed, and then minute air-bubbles are imprisoned between the two sheets of glass, having a very beautiful effect when completed.

The "fiamma" is prepared thus:—Upon a hollowed and rolled lump of material are laid strips of avventurina and other colours which are to form the "flames," which are wound spirally round; they are then heated, and whilst in the oven, and before the fusion has proceeded very far, a sharp-edged piece of iron is drawn across them several times, so that there are ridges both ways on the mass, which gradually amalgamates into one piece. On coming out of the fire, the object is subjected to extra twisting beyond that necessary to give it its proper form.

The "millefiore" is a lengthy process. First there are strips made of a certain pattern accordimg to the taste of the artist; these strips are encased in clear glass cut up into lozenge-shaped pieces, then laid on a surface of any coloured glass desired to form the groundwork of the contemplated article; the whole is then heated and blown, developing as it proceeds, the pattern contained in the small lozenges on a clear or coloured ground, producing a lovely effect. By this process all kinds of designs can be produced, animals, insects, and even portraits, distributed all over the vase, jug, or other form. A portrait is formed by the artist taking several strips of canna of the requisite tints, and putting them together in a similar way by which a mosaic portrait is made: this is, as may be imagined, a very delicate and difficult operation. When thus arranged they are covered with a thin coat of crystal, which serves the double purpose of keeping them in place and of preserving them; the mass thus prepared is then inserted into the furnace, and when it commences to melt, two artists, each having an iron tube with a piece of molten crystal on the end, take hold of the mass, one at each side; they move very quietly in opposite directions, which has the effect of elongating the round strip, which is stretched longer and longer until it presents a long thin round strip, which has been kept firmly in place by the coating of clear glass, and which preserves perfectly the portrait all through. This strip of prepared canna is then cut into very thin lozenges and used the same way as in the previous preparation, being used to ornament plates, jugs, goblets, &c.

The avventurina is a metal preparation produced by the fusion of various component parts; this is a material used to give the exquisite brilliancy and lustre so much admired in Venetian glass; it is a very difficult and tedious process, and exceedingly uncertain in its results. This process is one of the chief secrets of Venetian glass, and is only known to one or two of the maestri. It is said the name "avventurina" is derived from adventure, on account of its always uncertain results. The use of a little more or less heat than is absolutely necessary, or some other cause (mostly inexplicable to the most experienced artist himself), will cause the whole mass to be a failure after three or four days' labour. Instead of being the brilliant avventurina the artist expected, he finds, on opening the oven, a mass of a composition of a dull brick-like colour.

The avventurina is used not only in the glass-blowing, but also in the jewellery when it is cut and polished. When used in glass-blowing, a great amount of care must be exercised, and it must be protected by a covering of crystal, otherwise all the sparkling effect would be lost.

The fires used in blowing Venetian glass are made of wood, coal being useless on account of its generating too much smoke and gas, which prevent the delicate ornaments used in decorating the various objects from adhering. Ornaments and vases made by coal or gas alone would soon separate into their various parts.

The artists are from their entrance allowed a certain time daily for study, during which they design and create new shapes and colours. In this, of course, some are more skilful than others. They work together in the greatest possible harmony, each one aiding the other to develop and perfect any new idea, and the interest with which they all anxiously await the moment when a new shaped vase or a new combination of colour is to be withdrawn from the oven is surprising. There seems no personal jealousy, everyone is equally as interested, from the youngest boy to the oldest man. They perfectly understand the capabilities of each one among them, and when the vase, or tazza, or other object is to be made, each artist immediately prepares for his individual part; thus, should the object required be of unusual dimensions, it is at once undertaken by those men who have the strongest lungs for blowing; again, should it be an exceptionally fragile and delicate vase, it is undertaken by the artists known to have the lightest hands; the most difficult forms, such as griffins, dolphins, birds, &c., being the special work of certain artists only. I do not think it easy to find such harmony as exists between artists employed at Murano. I can say that I never heard an angry word among them, and all mutually help one another; they are more happy when at work than when having holidays. These they are obliged to take during the end of July or August, when the furnaces are allowed to go out. The temperature being excessive, it is found impossible during this period for the men to work, so this opportunity is taken advantage of to build new furnaces.

There is one dreadful circumstance which they must all face, and this is blindness. It is unhappily the fact that nearly always, after many years of work, and when they are between forty and fifty years of age, they begin to lose their sight, and after a little while they can see no longer. There is no means of preventing this; it is caused not only by the excessive heat, but also by the glare of the continual flames. Many things have been tried, and several kinds of protection for the eyes, but without avail.

Fortunately, when the dreadful event occurs, they have not the additional suffering of want to face, for while at work their wages are very high, often surpassing those of their magistrate, and their mode of life simple. They thus save large sums, and their declining years, if passed in darkness, are at any rate of ease and comfort in other respects.

I will now conclude my paper by simply stating that it is now over 25 years since this beautiful art of Venetian glass-blowing was revived by my father, and that it has continually progressed in form and colours, the always increasing demand for it, not only in this country, but in France, Germany, America, and indeed all parts of the globe where people are cultivated and appreciate works of art. Its cost, as you can understand, now that I have told you how each piece is made, is naturally greater than that of those glass articles which are moulded; but then its beauty is equivalent to its value.

A MAGNET FOR EXPERIMENTATION.*

THE annexed engravings represent a large magnet which is well adapted for experimental work. With a current from six medium-sized bichromate battery cells it is capable of sustaining about one thousand pounds. It is provided with a switch, so that it may readily be adapted to a light or a heavy current by combining the several coils in series or in parallel. It is made separable, to permit of using the coils detached from the core.

For the construction of the magnet 18lb. of No. 14 double-covered magnet wire are required, also two well annealed cylindrical bars of soft iron, 8in. long and 1¼in. in diameter for the core, a flat, soft iron bar 2½in. wide, 8in. long, and ⅝in. thick for the yoke, a bar of the same kind 7in. long for the armature, two double wooden spools 4in. in diameter and $7\frac{3}{4}$in. long, with flanges $1\frac{1}{16}$in. wide and $\frac{7}{16}$in. thick.

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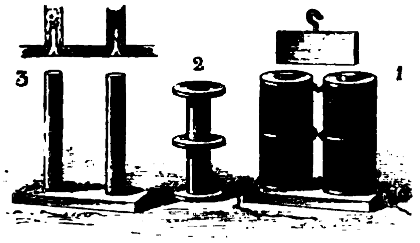
* By Geo. M. Hopkins, in the Scientific American.

The walls of the spools are $\frac{1}{16}$in. thick. Each space in each spool is filled with the No. 14 magnet wire. There are two ways of winding the wire. According to one method a hole is drilled obliquely downward in the flange, and one end of the wire is passed from within outward through the hole, and the spool is wound in the same manner as a spool of thread, the wires at the end of the.coil being tied together with a stout thread to prevent unwinding. Each section of each spool is filled in the same manner.

Although this is the quickest way to wind the magnet, it is not the best way, as the inner end of the coil is liable to be broken off, when the entire coil must be rewound to secure a new connection with the inner end. The correct way to wind the wire is to take a sufficient length and wind it from opposite ends on two bobbins. Wind the wire once over the spool from one of the bobbins, then wind from the ends of the coil thus formed towards the the middle, first with wire from one bobbin, then from the other bobbin; then wind from the middle back each way toward the ends in the same way, then again towards the centre, and so on.



F . 1.—Magnet for Experimentation.

By this method both terminals of the coil are made to come out on the outer layer.

Fig. 1 of the illustration shows the completed magnet and its armature. Fig. 2 is a detail view of the spool. Fig. 3 shows the cores and yoke, both in perspective and section, the sectional view exhibiting the method of fastening the cores to the yoke by means of screws. Fig. 4 shows the magnet mounted on a wooden base provided with a plug switch for connecting the coils in parallel or in series. Fig. 5 is an enlarged view of the switch, and Fig. 6 shows one of the plugs by which the connections are made.

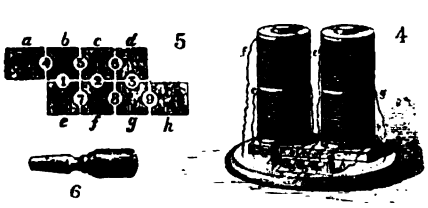


Fig. 2.—Magnet and Switch.

The switch is formed of brass blocks, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, arranged in two series as shown in Fig. 5. The blocks *a*, *h*, are provided with binding posts for receiving the battery-wires. The blocks are provided with semicircular notches forming the plug holes 1, 2, 3, 4, 5, 6, 7, 8, 9.

The block *a* is connected with the lower terminal of the lower left-hand coil, and the block *e* is connected with the upper terminal of the same coil. The block *b* is connected with the lower terminal of the upper left-hand coil, and the block *f* is connected with the upper terminal of the same coil. The block *h* is connected with the lower terminal of the lower right-hand coil, and the block *d* is connected with the upper terminal of the same coil. The block *g* is connected with the lower terminal of the upper right-hand coil, and the block *c* is connected with the upper terminal of the same coil. When the holes, 1, 2, and 3 are plugged, the current goes in series through all the coils. By plugging the holes, 4, 7, 2, 6, and 9, the current goes through the coils two in parallel and two in series, reducing the resistance to a quarter the original amount. By plugging the holes, 4, 5, 6, and 7, 8, 9, the current goes through all the coils in parallel, and the resistance is reduced to $\frac{1}{16}$ the original amount.

The polar extremities of the magnet are drilled axially and tapped to receive screws by which are attached extension pieces for diamagnetic experiments.

To retain the spools on the cores when the magnet is in an inverted position, a thin brass ring is screwed on the end of each core. The armature is provided with a hook for receiving a rope or chain, and the yoke has a threaded hole at the centre for securing the eye for suspending the magnet.

UTILISATION OF ELECTRICITY IN INDUSTRIAL PURSUITS.

An interesting example of the utilisation of electricity in mining operations is given by the New York correspondent of the *Electrician*.

The owners of the celebrated Comstock Lode at Virginia City have for a long time felt that the exigencies of their operations demanded not only more power, but power at such a cost as would enable them to work their enormous quantities of low-grade ore at a profit. They have, at heavy expenditure, carried water from streams in the Sierra Nevada Mountains, 30 miles off, but the supply has never been sufficient, and the working of the mine has been frequently suspended in consequence. A perfect and remarkable solution of their difficulties, however, has just been effected. The stamp mill of the Nevada Mill and Mining Company has a water-power at the level of the mill, supplied from a reservoir at the side of the mountain, and, finding this water-power inadequate for their operations, the company compared notes with the Comstock people. The matter was referred to the Brush Electric Company, through its agents, the California Electric Light Company, of San Francisco, and the speedy result was a proposition to collect the waste water from the surface wheel at the mill, convey it in pipes to the shaft of the Chollar mine, which is close to the stamp mill, and thence down the shaft, until a sufficient head should be obtained to produce the power required. This was a bold scheme, but it was pronounced practicable, and work was begun last winter. At the 1,650-foot level of the Chollar mine a chamber 50ft. long, 25ft. wide, and 12ft. high was excavated out of the solid porphyry, in which the dynamo-electric generators were placed. From the waste-surface tank two wrought-iron pipes, one 10in. and one 8in. in diameter, are led to the subterranean chamber. At the bottom of the shaft these two pipes are united into a single one 14in. in diameter, from which six 6in. pipes run to the nozzles of the water-wheels provided to drive the large Brush dynamos. Of these there are six, which are mounted on a heavy cast-iron base, and are provided with an extended shaft and outer bearing. On each armature shaft, and between two bearings, a Pelton water-wheel is mounted, inclosed in a water-tight cover. The generators are each of 130H.P. capacity, and are compound-wound for constant current. Their electrical curve is as near perfection as possible, and they require no regulator. The current is of constant strength under all conditions of load. One of the most remarkable points about this plant, however, is the head of water at the underground chamber, which is 1,650ft. Never before has such an enormous pressure been used for the purpose. The "Pelton" water-wheels, which were selected as the best adapted to the special conditions, are provided with an ingenious wedge-shaped partition, by which the stream of water is divided and sweeps out through the curved sides in such a way as to produce a reactionary effect in addition to the impact, and the water is all thrown down and out of the way of the wheel. The six wheels, which are made of phosphor bronze, are each 40in. in diameter, and weigh 220lb., and they drive the generators at a speed of 900 revolutions per minute. The machines are arranged in two parallel rows of three, and work with such perfect smoothness that of the 800H.P. generated there is no evidence save the motion of the swiftly revolving armatures. Thirty-six Swan incandescent lamps, operated in multiple series from one of the generators, illuminate the chamber, and there are several of the same lamps in the incline. Each generator circuit has a Brush dead-beat ammeter, and a Brush voltmeter capable of measuring up to 3,000 volts is also provided. Any generator can be thrown on to any one of the outgoing circuits by a switchboard in the dynamo-room, to which the generator circuits are led. As the circuits of copper wire ascend, one to each generator, they pass through a shower of spray, but the insulation is so excellent that no sign of a leak has yet been seen. The wires are carried above ground to the electric motor room at the Nevada Mill, the length of each circuit being a little more than a mile. The six motors in the motor-room are of the regular Brush constant-current type, each of 80H.P. capacity, and arranged in a single row parallel with the main driving shaft, to which they are belted. The surface wheel, which is also connected to this shaft, uses the water in the first instance and furnishes part of the power to drive the main shaft. The waste water is then carried down the Chollar shaft to the underground chamber, where it drives the dynamo which generates the electric current and energises the electric motors above ground, which in turn furnish additional power to the main shaft. A more complete triumph of adaptation it would be hard to find. Each motor has its own independent circuit fed from one of the generators, and its speed is regulated by the well-known Brush regulator. All or any number of the motors work perfectly in a battery together or with the water-wheel, and they run at a speed of 850 revolutions per minute. An ammeter for each motor indicates at all times the current flowing in each circuit. Some idea of the saving effected by this plant to the mine-owners may be formed from the fact that the surface wheel alone requires 312 miner's inches of water to develop power sufficient to drive 40 of the 60 stamps with which the mill is equipped. As a matter of fact, this amount of water is seldom available. Two of the electric motors, working in addition to the surface wheel, will perform the same work with but 72 miner's inches of water, thus effecting a saving of about 77 per cent. The net commercial efficiency of the plant is about 70 per cent. The waste water from the 1,650ft. level of the Chollar mine is now, I may add, piped into the Sutro tunnel, and it is seriously proposed to use this water a third time at a lower level for other work by duplicating the electrical machinery.

SCIENTIFIC NEWS.

Another small planet, being No. 284, was discovered by M. Charlois, of Nice, on May 29.

In the report of the Astronomer Royal to the Board of Visitors of Greenwich Observatory we note that a small electric hand lamp (with secondary battery) has been substituted for the wax taper formerly used for reading thermometers of the horizontal and vertical force-magnets, and has been tound very convenient as well as much safer.

The death is announced, at the age of 79, of Mr. John Frederick la Trobe Bateman, one of the most distinguished engineers of the day. He supplied Glasgow with water from Loch Katrine, and was the author of a scheme for supplying London from the Bala Lake in Wales. He was engaged at the time of his death in the construction of docks and gasworks at Buenos Ayres, and in the scheme for supplying Minorca with water.

The death is announced of Mr. K. Miller, well known some five-and-twenty years ago in Cambridge as a brilliant mathematician, and subsequently Professor of Mathematics at the Naval College at Greenwich.

The death is announced as occurring at Mayfield, Watford, Herts, on the 27th ult., of Dr. George Owen Rees, M.D., F.R.C.P., F.R.S., physician extraordinary to the Queen. Dr. Owen Rees, who took his M.D. degree at Glasgow in 1837, became a Fellow of the Royal College of Physicians of London in 1844, in which he occupied the post of Senior Censor in 1863. He was consulting physician to Guy's Hospital, Queen Charlotte's Lying-in Hospital, and physician to Pentonville Prison, and was chosen to deliver at different dates the Gulstonian lectures, the Lettsomian lectures, the Harveian oration, and the Croonian lectures. He was also the author of a number of works dealing with different forms of renal disease.

Prof. David Boyes Smith, who was appointed two or three years ago to succed Dr. Maclean as Professor of Military Medicine in the Army Medical School, Netley, died on June 3. He was the author of many papers and works on sanitary subjects.

Indian entomology has sustained a heavy loss by the sudden death of Mr. Otto Möller, of Tukvar, near Darjeeling. Mr. Möller, who kept a staff of twenty Lepcha collectors constantly at work in Sikkim, Bhutan, and parts of Thibet, had obtained specimens of many new species.

The annual meeting of the Royal Society for the election of Fellows was held at the society's rooms in Burlington House on Thursday, last week, when the following gentlemen were elected:—John Aitken, Edward Ballard, M.D., Alfred Barnard Basset, M.A., Horace T. Brown, F.C.S., Latimer Clark, C.E., Prof. David Douglas Cunningham, M.B., Lazarus Fletcher, M.A., William Botting Hemsley, A.L.S., Charles Thomas Hudson, LL.D., Prof. Thomas M'Kenny Hughes, M.A., Edward B. Poulton, M.A., Prof. William Johnson Sollas, D.Sc., Charles Todd, M.A., Herbert Tomlinson, B.A., Prof. Gerald F. Yeo, M.D.

At the annual general meeting of the Institution of Civil Engineers, Sir John Coode was elected president in succession to Sir George Bruce; and it was announced that the duration of the office would henceforth be for two years, instead of for one year.

In the *Asclepiad* for the second quarter of 1889, Dr. B. W. Richardson gives a memoir with portrait of John Freind, M.D., F.R.S., the medical historian. In the notes entitled "Opuscula Practica," Dr. Richardson refers to the use of the graphophone in medicine, to poisoning by the smoke of tobacco, and amongst other matters touches on vibration in cycling and on its prevention.

Prof. Judd has contributed to the June number of the *Geological Magazine* a suggestive article on Metamorphism, in which he proposes the convenient term "statical metamorphism" to indicate the changes produced in rocks which have been subjected to great pressure but have not yielded, so that no movement has been effected. It thus forms a correlative term to Rosenbusch's "dynamical metamorphism," which is applied to the phenomena resulting from the operation of mechanical forces that have caused actual movement in a rock-mass, as best seen in districts where the rocks have been sheared.

The ladies' conversazione at the Royal Society will be held on Wednesday, June 19; and the conversazione of the Society of Arts on Friday, June 28, the latter, as usual, at the South Kensington Museum.

Prof. Herdman, of Liverpool, describing some of the hailstones which fell there on June 2, says that many were spherical or ellipsoidal in outline, some were mammillated, and some were evidently compound, being formed of several hailstones partially fused together—one, the outline of which he traced, shows evidence of being formed by the junction of at least eight spheres. Specimens measured by himself and Mr. F. Archer ranged from ⅞in. to 1¾in. in diameter, made up of concentric layers alternately clear and snow-white. Mr. I. C. Thompson, writing at the same time, says that the hailstones were of remarkable forms and structure, some being round and thick with flat surfaces, and composed of a number of concentric layers, both transparent and opaque. Others were large, jagged and angular, while some resembled broken pieces of ice. As they dissolved in the conical-shaped watch glasses a deposit fell to the centre, which a rough microscopical examination showed to be mainly composed of a dark coloured amorphous inorganic substance, and minute stone particles. Interspersed with them he noticed small pieces of vegetable tissue, having the appearance of parts of cryptogamic spore-cases, and amongst them were numbers of very minute oblong bead-like bodies about 1-55th of an inch in length, each having a dark patch at the apices. Under a ⅛in. objective these bodies were found to have a rough knobby surface, the dark ends being curled up extensions, and were similar in character to the forms known as belonging to the spores of some of the lower cryptogamia, especially the lichens, to which they evidently belong, although, after careful search, Mr. Thompson is unable to refer them to any known British species. This would seem to be proof that microscopic bodies float at a great height in our atmosphere.

At a recent meeting of the Royal Society of Edinburgh, Prof. T. R. Fraser made some further remarks on Strophanthus Hispidus, in the course of which he said that, by means of ether and alcohol, he had extracted the active principle—a glucoside to which he gives the name strophanthin. From that he has separated a crystalline substance so intensely poisonous that a millionth fraction of a grain is sufficient to have a distinct effect on the heart of a rabbit. This crystalline material Prof. Fraser terms "strophanthidin," which he first obtained by the action of acetate of lead on the liquid extract, which was afterwards treated with sulphuretted hydrogen. That method was not found to be satisfactory, so a second method was devised, in which the extract was first treated with tannin, then with oxide of lead, alcohol, and carbonic acid gas. Prof. Fraser pointed out that in all his experiments he found that the presence in the extract of any of the stronger inorganic acids, even in the cold, set up an action that resulted in the throwing down of a copper precipitate on the addition of Fehling's solution. In the opinion of those most competent to judge, strophanthus is one of the most valuable additions to the Pharmacopœia made for many years.

According to the *Athenæum*, a curious discovery has just been made in the Botanic Garden, Oxford. Dr. Selmar Schönland, the sub-curator of the Herbarium, has found in a corner bundles containing a collection of Italian plants, well preserved, with indications of the names of the plants and the localities whence they were taken, by Gregorius à Reggio (Calabria), a Capucin, who collected them in 1605. Nothing is known of this Gregorius, who must have been a good botanist, and no trace has yet been found of the person who brought the collection to Oxford. Another bundle contains the mosses brought by Sir John Franklin. It would appear from this statement that there is at last someone at Oxford who will find out what there is in the Botanic Garden.

At a recent meeting of the Physical Society a paper was read "On a Water Spray Influence Machine," by Mr. George Fuller. The apparatus is made up of four similar sections, each consisting of a nozzle, a metal ring, and a metal dish or receiver, arranged about a vertical axis. Pressure water issues from perforations $\frac{1}{100}$in. in diameter in the nozzles, and passes through the rings into the insulated receiver below. The rings are placed at such a distance below the nozzles as to be about the point where the streams break into spray, and the receivers empty themselves automatically. Calling the consecutive sections 1, 2, 3, 4, respectively, the rings of 1 and 3 are connected to the receiver of 4, and those of 2 and 4 to the receiver of 1. The discharge points are connected with the receivers 2 and 3, and a rapid succession of sparks passes when the water is turned on. Prof. S. P. Thompson inquired whether the length of the spark was limited by leakage along the glass rods or by the spray passing between the receivers, and in reply Mr. Fuller said he thought the former leakage the more important.

The spread of cancer in a small commune of Normandy (St. Sylvestre de Courcelles) attracted the attention of Dr. Arnaudet, as the disease has attained to 15 per cent. of the total mortality. The cases were principally males, and as a rule the cancer was located in the stomach: hence Dr. Arnaudet thinks cancer is contagious, and is propagated by water; for although the sufferers were not water-drinkers, they drank cider, which is diluted with the pond-water of the district. There are few waters which are really safe to drink, unless previously boiled.

At the General Hospital, Vienna, Prof. Drasche has been trying saccharin, with the result, it is stated, that the substance does not exercise any noxious influence.

At the Royal Institution last Friday, Dr. Archibald Geikie discoursed on "Researches into the Origin and Age of the Highlands of Scotland and the West of Ireland." The detail work of the Geological Survey has so added to our knowledge that the problem has been much discussed in the last seven or eight years in the light of the new facts ascertained. The lecturer, after describing at some length the character of the rocks, drew especial attention to a diagram showing the yellow zone between the Cambrian and the base of the Silurian. The Cambrians, he said, had everywhere been worn down before the deposition of this zone commenced; and this denudation, therefore, pointed to a long interval of time between the Cambrian and Silurian. A point of still greater interest was this, that it had been recently found that large tracts which had been such a puzzle were really composed out of Archæan, Cambrian, and Silurian; but they were several times repeated. There was a general easterly dip, and going from west to east, as in the Sutherlandshire section, there was found above the Silurian a repetition of Archæan, Cambrian, and Silurian, and this was again repeated. The explanation accepted was that there had been great thrusts, which had forced parts of these formations up over other parts of themselves, and again this has been repeated further east. One great question has been, Is it possible to anywhere find the base of the Archæan? Within the last few weeks this question has been solved by finding rocks below it in the Island of Iona. One of the fossil collectors of the Survey has been sent down there, and the solution of the question whether these were fossiliferous rocks or not is awaited with deep interest.

It is said that some conductors are now being laid underground insulated in the following manner: The bare wires are placed in glass tubes, which are protected by a layer of cement, outside which again is an iron pipe. The method is said to be very cheap, to give a high degree of insulation, and to be impervious to water.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE PAPAL OBSERVATORY—SATURN'S RINGS—VENUS—A VULCAN-IC ERUPTION — TELESCOPIC APERTURE — A SIMPLE LAY — CENTRIFUGAL "FORCE" AS EXERCISED ON THE MOON—EASTER IN 1827—THE STAFF OF OUR NATIONAL OBSERVATORY—THE CANALS (?) OF MARS—MERCURY AND VENUS—FLAT FOR NEWTONIAN TELESCOPE—SPECTRA OF URANUS AND SATURN.

[30026.]—I cannot conceive that the Pope can be acting under the advice of any competent astronomer, in deciding to build an astronomical observatory in a town, surmounting rooms used for residential purposes! Stability is the "*sine quâ non*" with every kind of astronomical instrument, and the more massive the foundation on which it rests, and the nearer to the ground it is situated, *cæteris paribus*, the more efficiently it will perform. Cock it up at a great height, and you convert it into an inverted pendulum—a device expressly employed to detect otherwise insensible vibrations.

May I remind "W. G. P." (letter 29979 p. [illegible]) that what Schröter, Harding, Schwabe, Schmidt, Bond, Secchi, and de Vico (of whom, by the bye, Webb says that his "observations are not always satisfactory") saw, was in no sense such a spot on Saturn's rings as that which has given rise to so much discussion; but little specks, or knots of brightness, perceptible when the ring system was seen edgeways; and having their origin probably in actual differences of thickness. I presume that your correspondent is familiar with what Pierce, Clerk-Maxwell, and Proctor have written on the question of the structure or material of the rings?

Of course, as Mr. Dixon (letter 29980, p. 281) has seen Venus as a crescent with the naked eye, I believe it; but I must say, quite candidly, that I should not have believed it had I seen it myself. How far the impression of a twinkling image, some 13° or 14° high, in a bright twilight sky, would be likely to resolve itself into such a form, I leave others to decide. Meanwhile, I have just been making an instructive experiment. I struck with compasses, and subsequently cut out, a crescent of white paper, precisely 1in. in diameter, and 0·07in. in its thickest part (thus representing the actual phase of Venus on April [illegible]), and mounted it on a black disc. Attaching this to a gate-post, I measured off a distance of 296·[illegible]ft., at which, of course, my 1in. crescent subtended an angle of 57·6", as did that of Venus at the date referred to. I am myself shortsighted, but I got a lady of exceptional keenness of vision to retire until, knowing that it was a crescent she was viewing, and familiar with its aspect and position, she failed to perceive it. She ceased to see it as a *crescent* at 119ft.; or when its diameter subtended an angle of some 2′ 22″. This, to me, is very significant indeed. My mimic Venus was placed in brilliant sunshine. Would it be worth Mr. Dixon's while to repeat so simple an experiment?

I regret sincerely that I seem to have unwittingly trodden on the toes of Prof. Swift, as would appear from letter 29982 on p. 281. I know, of course, how Le Verrier concluded, from the motion of the perihelion of Mercury's orbit, that *something* must exist within that orbit to cause it; the action of the known planets being insufficient to do so. But this "something" may just as well be meteoric matter as an aggregation into any[illegible] like a planet or planets, properly so-called. Of course, I am familiar with the whole story of the [illegible] which Messrs. Watson and Swift believed [illegible] made in 1878; of Prof. Watson's mist[illegible] ζ Cancri for one of these bodies, and mixing up with another; and of Prof. Swift's two stars (pr[illegible] ably, as Proctor says, 25 Cancri and an unnam[illegible] one of the 7th magnitude) observed with a teles[illegible] fastened to a 10ft. pole, swaying in one direct[illegible] and sticking in the other! But we on this side the Atlantic are very far indeed from being co[illegible] vinced that any intra-Mercurial planets whatev[illegible] were perceived on that occasion; and I for one cannot admit any obligation to prove a negative. At the same time, I regret (no one more so) Mr. Swift's ill-luck on the occasion of the eclipse of January 1st in the present year. I read the telegram, and weakly imagined that "failed to observe" meant was unsuccessful in observing. There were no details given.

"Omicron" (letter 29983, p. 282) may observe the phenomena of Jupiter's satellites with a really good 3in. object-glass; but by no means with a cheap one of that aperture. Saturn requires 3½in. at least to be at all fairly seen, and 4in. and upwards will exhibit his leading features better still.

Here is a solution of the hen-and-egg problem, by a lady, which I venture to think is even neater than Mr. Perren Maycock's (in reply 68670) on p. 287. 3 half hens lay 3 half eggs in 3 half days ∴ 6 hens (= 12 half hens) lay four times as many, i.e., 12 half eggs in the same time. 7 days = 14 half days; then 3 half days : 14 half days : : 12 half eggs : 56 half eggs, or 28 whole ones.

I fail to grasp exactly what it is that Mr. Hosken (query 68764, p. 290) requires. To begin with, the expression "centrifugal force" is a solecism. The earth revolves round the sun because his attraction deflects her from the straight line in which she would otherwise travel. It is this tendency to travel in a straight line which is so curiously misdescribed as centrifugal force. Certainly this has no effect on the substance of the moon which, instead of being "ductile," is of the very rockiest material; and, whether or no, for all practical purposes, every portion of her globe moves at the same rate round the earth. The effect, then, of what my querist calls centrifugal force in the case of the moon could only have its origin in her own rotation on her axis. Now, it takes her about 27·322 days, or, say, 655·72 hours to complete one such rotation, and as her circumference is very approximately 6795·46 miles, a point on her equator must travel about 10·36 miles an hour; or at about the rate at which many men drive to a railway-station every day of the week. In the case of our own earth, whose equatorial circumference is 24902·13 miles; turning, as she does, on her axis in some 3m. 56s. less than 24 hours of mean time, the rate of rotation of a point on her equator is 1040·43 miles an hour —a velocity sufficient appreciably to affect the figure of her globe, converting it into that of an oblate spheroid, and diminishing the weight of bodies on the equator by about the ·00346 part of that they possess at the poles.

In answer to query 68780, p. 290, Easter Day in 1827 fell on Sunday, April 15.

The "Non possumus" of the Treasury, as a response to any and every appeal for the real advancement of science, has become a byword; but it seems hardly possible that the intimation with which the Astronomer Royal concludes his report to the Visitors of the Royal Observatory can pass unheeded. When we find mere advertising quacks subsidised out of the public funds, it appears monstrous that the work of our National Observatory should be crippled for want of an adequate staff. I hope that the few scientific members in the House and the Admirals will join in putting some pressure on the Government in this really urgent matter.

As Dr. Terby refers to an expression of mine, at the end of letter 30000, on p. 302, let me assure him that I, for one, have not the slightest doubt that he did see something traversing one of the Martial polar spots in 1888; and I may add that in the case of so skilled an observer as he is, and one armed with so fine an instrument, the corroborative testimony of MM. Schiaparelli and Perotin was scarcely needed. But I would humbly venture to point out that it by no means follows that the marvellous network depicted in certain drawings as covering the surface of Mars, has any real existence. In the current number of *L'Astronomie*, M. Flammarion has a most instructive article on this planet, in which he shows by facsimile reproductions of drawings made nearly simultaneously by different observers, how very little dependence is to be placed on the objective reality of any but the most salient Areographical features.

Certainly "Al Fard" (letter 30003, p. 302) ought to see Mercury in bright sunshine with a 6in. reflector, as I have seen it many a time and oft with an achromatic of but little over 4in. of aperture. It is, though, at best, but a little mite of a thing, easily overlooked. As to Venus, as she approaches the earth she of course seems to get both larger and brighter; but, after passing, say, her greatest eastern elongation, as her diameter increases her crescent diminishes, and it is at the point in her orbit—about 40° east of the sun—where this thinning of her crescent balances her increase of diameter that she attains her maximum brilliancy.

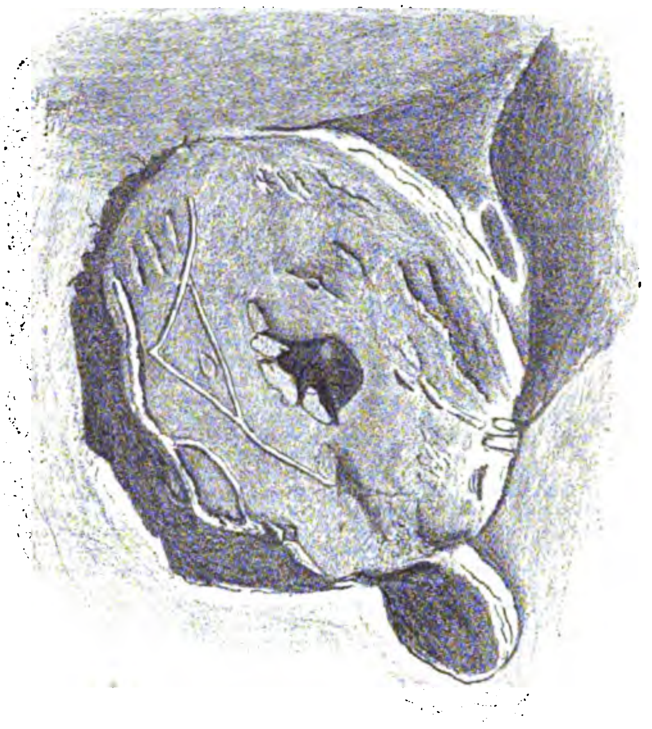
In reply to "Solar Focus" (query 68840, p. 312), I should think that a 3in. flat would answer for all practical purposes on his telescope.

An interesting and important paper by Dr. Huggins was read at the Royal Society on the 6th inst., on "The Photographic Spectra of Uranus and Saturn," in which its gifted author gave the results of his most recent investigations into the chemical constitution of two of the family of giant planets which revolve round the sun outside of the orbit of Mars. It will be remembered by many who read these lines that eighteen years ago Dr. Huggins examined the visible spectrum of Uranus, visually, and detected six absorption bands (one being at F), but the light was too faint with a narrow slit to see the Fraunhofer lines. These observations were entirely confirmed by Vogel in 1872. During the present year Dr. Huggins has succeeded in photographing the spectrum of the planet, and with two hours' exposure obtained a photograph of it from a little above F to beyond N in the ultra-violet. In this all the chief Fraunhofer lines come out. Doubtless this part of the spectrum is solar. No other lines, light or dark, are perceptible, so that special absorption is confined to the visible spectrum. In 1864 Dr. Huggins began his investigation into the visible spectrum of the Saturnian system, read a paper on the photographic spectra, and in the following year photographed the spectrum of Saturn and his rings, finding no other than Fraunhofer lines in it. During the present apparition of Saturn, by a peculiar arrangement of the slit of the spectroscope, Dr. H. has been able to get the spectra of the ring, the ball, and the sky, all distinct and not encroaching on one another; but, as in 1881, he can detect no lines, bright or dark, in the planetary spectra which are not also present in that of the sky. I ought perhaps to add that these photographs have been taken when the sky was sufficiently bright to give a faint spectrum for comparison.

A Fellow of the Royal Astronomical Society.

GASSENDI.

[30027.]—There being some inquiry for sketches of Gassendi, I thought the inclosed, made on April 11 last, may be of interest. Particular attention was paid to the west side of the plain, especially the curious triangle of rills about the little crater. Powers used were 320 and 600 in the 10in. refractor.



Champion-hill, S.E. **Herbert Ingall.**

SATURN, ERRATIC.

[30028.]—A curious omission occurs in my letter (29999). I intended the second part to read thus:—"A little while ago a man assured me that he had often seen Saturn's *ring* with the naked eye!"

June 7. **D. B. L.**

SATURN'S LUMINOUS SPOT.

[30029.]—Astronomers are a most patient folk. Their vocation demands the constant exercise of that most useful virtue. Hence we can all afford to wait until Saturn arrives on the western side of the sun, when, of course, the shadow of the ball will be projected on the western portion of the rings, and should the so-called white spot be then seen immediately following the shadow of the ball, to say the least, an additional reason (which some will think conclusive) will be afforded in support of the contrast and subjective theory. There are three of us who think it quite possible to calculate the probable width and amount of luminosity, making due allowance for the rings being somewhat narrower in appearance. Surely none will say that the luminous space is as long as the width of the ball, plus the width of the shadow! "Everything good comes to those who can wait."

Portland, June 10. **W. R. Waugh.**

JUPITER.

[30030.]—The first of a fresh series of transits of the fourth satellite of Jupiter took place apparently on the night of the 4th inst., egress taking place at about 11h. 20m. The transit could have been only of short duration, and is not predicted in the *Nautical Almanac*. In subsequent transits ingress of No. IV. will probably occur before the time mentioned.

Hendon, June 10. **P. F. Duke.**

THE PLANET MERCURY.

[30031.]—In reply to "Al Fard" (letter 30003), I have often seen Mercury in full sunshine with 3¼ o.g.; but to see the planet by day the neighbouring sky must be free from all trace of cloud. There are times, however, when all the conditions appear most favourable, and yet there seems to be matter of some kind in the neighbourhood of the sun which entirely obliterates the planet. I tried to pick up Mercury on June 4, when in a very favourable position, and apparently clear blue sky, using a very good 5in. o.g., but utterly failed to see any trace of him. I have given a good deal of attention to this planet for some years, and should be glad to have the opinion of practical observers as to what this film of opaque matter is.

Austwick Hall, June 8. **T. R. Clapham.**

SEEING MERCURY IN FULL SUNSHINE.

[30032.]—If "Al Fard" (letter 30003) has access to *Ency. Brit.*, new edition, he will find the theoretical point of greatest brilliancy for an exterior or interior planet is a question of maxima and minima illustrated and explained under article "Infinitesimal Calculus." **W. S.**

VISIBILITY OF VENUS'S CRESCENT BY NAKED EYE.

[30033.]—Surely "H. S." (letter 29998) is in error as to the apparent diameter of Venus. The apparent size of sun is that of a halfpenny, viewed at 120in. or 10ft. Venus being $\frac{1}{30}$ at nearest, makes 300ft. or 100 yards—much less chance than 48 yards.

Liverpool. **W. S.**

[30034.]—Your correspondent "H. S." (letter 29998, p. 301), will find the letter of Mr. Stoddart's, to which I referred on p. 281, in the volume of the *Leisure Hour* for 1853, where it is published under the title of "Planetary Observations in the East." Mr. Stoddart appears to have been an enthusiastic amateur, the possessor of a home-made Newtonian telescope of 5in. aperture, and accustomed to make observations of the heavenly bodies; his naked-eye observations detailed in the letter to Sir J. Herschel seem to have been conducted with great care. As a proof of the remarkable clearness of the atmosphere, he mentions that the snowy peak of Ararat could be seen "just as bright and beautiful when two hundred miles distant as when we stand near its base." He also states that, "were it not for the interference of the moon, we should have seventy-five nights in the three summer months superior for purposes of observation to the very finest nights which favour the astronomer in the New World."

As regards the visibility of the crescent to the naked eye, it is quite certain that, in addition to a keen sight, a perfectly tranquil and clear condition of the atmosphere is absolutely necessary; but given these conditions, and that the glare of the planet's light is subdued by a coloured glass, I do not myself see why we should doubt the possibility of a *few* individual observers being now and again met with who can perceive it. Any statement to that effect should, however, be received with distrust unless accompanied with particulars of the precautions taken to prevent self-deception and the atmospheric conditions prevailing at the time of observation. Like "H. S.," I should like to know where the author of "Celestial Objects" obtained his information from concerning the naked-eye observations of the crescent made in Chile and by Theodore Parker. Mr. Holmes (letter 30001, p. 302) says that he intends to make some experiments bearing on this subject, and intends to report should he find one who can discern the model of the crescent. May I request that he inform the astronomical readers of "Ours" of the results, even if entirely negative, and that he make use of a tinted glass, so that his experiments may be comparable with Mr. Stoddart's observation?

In fifth line from bottom of my letter on p. 281, for the word "on" read "as."

Forest Gate, E., June 10. **B. J. Hopkins.**

VISIBILITY OF LIGHT, &c.—CORONA.

[30035.]—The experiment which "F.R.A.S." reminds us of, May 31, shows that when light passes through a tube by means of two holes on its opposite sides it is invisible to an eye looking down the tube. And it shows more than this—namely, that the illumined æther, which pervades all space, and the atmosphere which lie between the holes are both of them invisible. But here the proof of the negative comes to an end. It has, indeed, been inferred that because the small quantity of æther which lies between the holes is invisible it will, therefore, be always invisible, no matter how highly illumined, or how much of it there may be. This, however, does not follow as a logical consequence by any means; if it did, it would equally show that *illumined atmosphere* is always invisible, which is well known to be not the case, and therefore it would prove *too* much. Atmosphere, when presented to the eye in sufficient quantities, *is* visible, though the small quantity in the tube is not. So may it be with the æther, for anything the experiment shows.

And here we may remark that the question at issue is not whether light in the abstract can be seen or not, but whether there is any concrete substance in nature which is essentially invisible, no matter how highly illumined it may be, or what may be its extent. "F.R.A.S." seems to think that there is just one substance which can never be seen—to wit, the æther; but he bases his opinion upon an experiment which would equally prove that *atmosphere* is always invisible. If experiment is used to prove our case in point, it must be upon a vastly larger scale than the above, and perhaps nothing is more suitable to the purpose than to observe the corona, from the fact that it cannot be confused with atmospheric appearance.

There is another apparent difficulty suggested by "F.R.A.S." He says: "It must be obvious that a homogeneous substance must itself appear homogenous." Certainly; *when it is equally illumined all throughout*, and *only* in this case. The proposition, stated as a *universal* one, is surely contrary to all experience. Thus, a homogeneous screen, when light falls upon it through a prism, or when the image of an object is formed on it by a lens, or simply when shadows fall upon it—in all these cases it is not the light itself, but the screen, which is seen, and it presents every possible variety of appearance according to the way in which it is illumined, though it is homogeneous. Complicated appearances, therefore, are not inconsistent with the object being homogeneous.

Now in the case of the æther, it was observed in my first letter that the illumination is not uniform; it is not the same at all distances from the sun; it is very intense in the immediate neighbourhood, and, therefore, unless our æther is an exception to all other substances, it will be brighter near to the sun.

Again, the sun does not give out light equally from all points; it has dark spots, *faculæ*, &c., and a greater outburst of light near the western limb, say, will cause more or less of a streamer to be seen on the western side, and so to any extent.

In fact, however complicated the appearances may be, the explanation of them is to be sought for in the *complicated nature of the transaction, rather than in that of the substance upon which it acts.*

W. G. Penny.

THE MOON AND THE WEATHER.

[30036.]—Your correspondent Mr. Nicholls has advanced very little in the study of lunar influence if he hopes or imagines he may find any continued relation between the phases of the moon and the weather. All observation made between any given position of the moon and corresponding weather has signally failed, except, perhaps, with regard to her position in extreme northern and southern declination and transit of the Equator. These positions do seem to be followed by some change. Observations made with regard to changes with New and Full or quarters, regardless of the moon's position relatively to the earth, give no results whatever; but in conjunction with extreme declination they appear to point to the moon as the ruling cause—at least, 25 years of observation over a large area of the earth's surface convince me of this fact. The way in which some people talk about the moon's changes would lead us to believe she had a sort of frog-like motion, jumping from place to place, and a corresponding "change" in the weather with each jump, whereas, as everybody knows, her motion in the heavens is gradual, though variable, and the mere fact of her being at her first and second quarter alone, without other important considerations, cannot cause any weather change. I am myself a firm believer in lunar influence, and have the most positive evidence of her influeuce; but it is not based on observations as hitherto made. That observations hitherto made to trace her influence have failed is not to be wondered at, considering the manner in which they have been made. Can we expect to find any change in the weather over any point of the earth's surface precisely when the moon is at any one of her phases without considering her declination, relative position to the earth—that is, her R.A. and declination combined? What is a "change"? The term is vague, and any proof of lunar influence will never be decided by misleading terms that different people can interpret differently. Admitting that the moon does exert an influence on the principal atmospheric currents, chiefly sub-lunar in Tropical zones, and that her influence is propagated into temperate zones, both to the north and south, it would, if great enough, be capable of producing storms (barometric depressions), anticyclones, and through them all sorts of disturbance and change. The sum of all the moon's different changes, distance, declination, relative positions to the earth at such times as New and Full, transit of the Equator, &c., together with a consideration of what effects might be produced by such continual action on the whole mass of the atmosphere as the earth rotates sub-lunar, does yield evidence of her power in producing atmospheric disturbances and their opposites, anticyclones, and both can be predicted with approximate accuracy in both time and place. Barometric observations, however, show no traces of any lunar influence, or, at least, so small that they cannot be considered sufficient as an acting cause; but there are reasons for believing that barometic observations alone will never decide this question. If the moon has any influence, it must be sought for by other means. Again given her power in disturbing atmospheric currents, we should have to find some dynamic laws governing the result of such action, for those already known are not sufficsent for the purposes of prediction. Until some law is discovered which governs the production of anticyclones and depressions, their position on the earth's surface, culmination, and final disappearance, all existing laws will fail to afford any rule for predicting the weather. That such laws are to be deduced from the positions and gradual motion of the moon and sun relatively to their position and motion of the earth I have the most conclusive evidence.

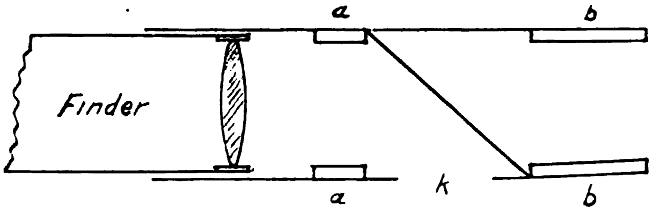
June 8th. **W. L. Brown.**

TELESCOPE FINDER.

[30037.]—No doubt many of your readers have experienced the difficulty of seeing the cross wires of the finder on a dark night. To remedy this I have recently used a slip of clear glass placed at an angle of about 45° on a pasteboard tube, which is provided with a lateral opening at *k*. The tube is slipped over the o.g. of the finder like a dewcap, and when the star is in field the opening *k* is turned towards some source of light (an illuminated window or a distant lantern) until the cross wires are just visible.

Of course, the light of the star passes directly through the clear glass, while that of the lantern is reflected from it into the finder. It is easy work with this contrivance to secure just the minimum of light necessary to illuminate the cross wires. *a a*, *b b*, represent the sections of rings of cork which I use to keep the glass reflector in position.

L. L. G.



COIL PHENOMENA.

[30038.]—Some time back, when writing my article on Coil-making, I promised another one, entitled "Coil Phenomena"; but, owing to much business pressure, I have been unable to see to the experimental data before. The coil the following experiments were made by was one similar to that which I gave instructions for making. It had on it 3lb. No. 36 (B.W.G.) for secondary, and had 8-power regulator, and also water regulator of usual type, 4½ by 1¼in.; and also had suitable connections (by means of suitable switch) for connecting up condenser of 25 sheets, 4in. by 4in.; 50 sheets, 4in. by 4in.; 100 sheets, 4in. by 4in.; and 200 sheets, 4in. by 4in. With this description of the coil and its appendages, I will proceed with the experiments. These were divided into two classes —physiological and general experiments. I will first of all deal with the physiological experiments.

The battery used for these experiments consisted of four pint Bunsen cells. The first subjects that I experimented on with this coil were a young man of eighteen, a young girl of seventeen, and myself. With No. 1 power (representing ¾lb. wire), and water regulator full out, the shock in my case was one of mildness, though a little piercing in the elbows; the chief shock felt was about the shoulder. In the case of the young man, he said that he could hardly feel any shock whatever; whilst, with the young girl, her description of the shock was similar to mine. The shocks were tried with moist and dry conductors, pressed firmly against the skin and held lightly against the skin. From trying these experiments as above, still with the No. 1 power and water regulator, I was able to deduce: that physiological effects caused by the induced electric current are different according to the mode in which the current is transmitted to the organs. Applied by means of moist conductors, it produces contractions of those muscles which are beneath that part of the skin to which the electrodes are directed. If dry handles or electrodes are used, there will be an effect on the sentient nerves of the skin, but not on the contractile power of the muscles, provided that the tension of the current is not very light. With No. 6 power (representing about 2¼lb. wire) the shock, which was really too strong to speak satisfactorily from, as it had to have two more water regulators let into the circuit, which, of course, greatly reduced the current, the effect was, I should say, vice-versâ to the above. If the electrodes were firmly pressed against the skin at a point where a motor nerve was superficial, contractions of all the muscles took place which were animated by that nerve; but if the conductors were not pressed against the skin, the current travelled along the cellular tissue which envelops the nerve, as this cellular tissue is a much better conductor of the current than the nerve itself, and therefore in the latter case it causes no muscular contraction. These effects fully agree with those of Dr. Althaus, given in his treatise, to which I must refer my readers for further information regarding this point. These effects were fully proved with the succeeding currents, except that of the experiment above given, obtained by No. 6 power. I did not confine myself to these subjects alone, but chose others, both old and young, and also some taken from the canine world (but these were taken chiefly to try the effect on the brain, as to have tried them on human beings might have brought me under the notice of the public executioner, as the results further will show). But all the experiments clearly proved to me that they acted differently upon different constitutions: how this is I cannot quite accurately say. I thought at first that the weaker the person was the less shock could he take; but I soon found out that it was quite wrong, as a young and weak and delicate woman of 18 could stand a much greater strength than a robust and healthy man of 28. I have put the matter down to be in some way or other connected with the nervous system. The physiological effects are also determined according to that organ of the body to which it is applied. The same current that causes a flash of light with the eye causes sensation of taste with the mouth, sensation of sound in the ears, and some say a sensation of smell at the nose; but I cannot say that I have ever found this correct. It also, as may be supposed, causes muscular contractions when directed to a motor nerve. Finally (this is an extract from Dr. Althaus's book, which my experiments fully proved) the different states of vitality of the organ at the time the current is applied are of great importance. Thus, a morbid increase of sensibility in a nerve, as we observe in sciatica, tic douloureux, and other forms of neuralgia, may be subdued by electricity. On the other hand, a nerve the vital energy of which is gone or materially diminished, may by the current be restored to its normal condition. I will now, before I give an account of the current on the brain, endeavour to explain the terms "galvanisation" and "Faradisation." Galvanisation really means the application of the continuous current or battery current, chiefly used for deficiency of vision, hemiplegia after the cessation of the pressure on the brain, aphonia, rheumatism, and sciatica. The most celebrated of the earliest treatises on galvanism is "Essai Théorique et Expérimental sur le Galvanisme," Bologne, 1804, by Aldini.

It is not my intention to discuss galvanism, for this has little to do with coils. Faradisation is, though, somewhat more in our line, as this is done by means of the induced current. The first induction apparatus for medical use was constructed by M. Pasii in 1836, and though this induced current that is termed Faradisation is caused really by the magnetic machine, and not induction coil, though, for all that, the current generated is exactly similar to that obtained from the induction coil; this is used for rheumatism, tic douloureux, &c. I will now for a time drop the technical and scientific course, and proceed to deal with the methods for curing the toothache, faceache, rheumatism; but though I give these, I do not mean to state that I thoroughly hold with them, for I cannot say that I am particularly in love with medical electricity at all, though I will own that there has been some cures obtained by means of it, and it is rapidly advancing into favour in England, so I think I will let the matter rest as it stands; but for single cases of toothache, &c., I will say that an electric shock is very good indeed, for I have cured hundreds of cases by means of it. To cure toothache, take one handle (or other suitable electrode), and press it firmly against that side of the face, and hold the other handle in other hand; in some cases it will be necessary to use the tooth electrode, which consists of a silver rod, bent so as to be inserted in the mouth, and touching the hollow of the tooth; but with the first-named method I have generally found a relief. Do not give a strong current; a weaker one is far more suitable. Some people seem to think that you are to give them as strong a shock as you can, and then keep them at that. It is no such thing: a weak current for about five minutes, slowly moving the electrode over the affected part, is of much more service. For neuralgia, one electrode is given, a slight sweeping motion over the affected nerve, holding every now and then the electrode firmly against the part. This generally gives a slight relief in from 5 to 60 minutes, total relief usually quickly following. The other nervous disorders are treated similarly. For earache, I prefer to use an electrode, curved (similar to the tooth electrode) with a rounded blunt point about ¼in. diameter. Some prefer to put in the ear cotton wool, saturated with water, to which a little nitrous ether has been added, and then inserting the electrode in this; but I cannot say that I particularly care about the method. Before I conclude I will say a few words regarding the action of the current on the brain. The first to investigate this was Prof. Weber (article "Muskelbewegung," in Wagner's "Handwörterbuch der Physiologie," Vol. III. part 2). No effect is observed when the electrodes are applied to the hemispheres of the brain or to the cerebellum, not even if they are thrust into the medullary substance; but if you galvanise the tubercula quadrigemina, irregular convulsions are produced, which very much resemble the clonic cramps such as are observed in patients suffering from diseases of the brain, or they resemble reflex movements; in one case of a bitch it produced death (this was with No. 7 power and condenser of 50 sheets, and water regulators both in). Nothing unusual after death was noticed, only that her eyes were dull and open, and a very slight froth abounding at the mouth. If the medulla oblongata be excited (says Prof. Weber) tetanic convulsions are the consequence, which resemble those observed in persons poisoned by strychnia. This might lead to the conclusion that if clonic cramps are observed in patients there is a disease of the brain; whilst there would be a disease of medulla oblongata, or the spinal cord, if tonic cramps were observed. I should state that in my opinion the bitch above named died from stoppage of the heart's action. I tried the same experiment with three other dogs and one cat, and in all cases did I see the same signs, and came to the same conclusions. So, having gone into the physiological effects of the coil, I will now proceed with the general experiments.

General Experiments.—The first thing I shall notice in these are the different kinds of sparks that can be produced from coils. First of all, the primary spark. This is the spark usually seen at the contact breaker. The spark appears as though it were a brilliant star, but when the coil and battery power are great, it has the appearance of a flame. One of the uses of the condenser is to diminish this, as a too excessive sparking here will mean ruin to our contacts (which must in all cases be of platinum). This primary spark, though appearing continuous, is really only intermittent, as no spark occurs at the make, but only at the break. If we wish to obtain a shock or other phenomena from the primary circuit, we must attach two wires with electrodes to the contact-breaker and to the armature.

The secondary spark is produced when two wires are attached to the secondary terminals, and their other ends brought near each other. These sparks are larger in proportion to the quantity of secondary circuit there is (the usual rule being 1lb. No. 36 B.W.G. wire for each 1in. spark. My coil gave 2¾in. spark, owing to other apparatus, as regulator, &c., being attached. These secondary sparks are manifestations of the dynamic condition of the secondary circuit (Dyer). If we attach two wires to the coil, and bring the *point of one to the side* of the other, we shall obtain a spark which, if viewed through a magnifying-glass, will be seen that its ends are dissimilar, one end being more brilliant and of a red colour, and the other end being of a feeble, luminous, violet colour. This can be more clearly seen if the experiment is conducted in a rarefied atmosphere. This spark is termed the elongated dynamic spark. If, instead of as above, we bring *both the ends* of the wire near each other, the spark will be more brighter and of a fine red colour. This is termed the calorific dynamic spark from its heating properties. It is this spark that is most suitable for ignitions and other calorific experiments. If we bring a lighted taper towards any of these sparks, the character of the spark will be much altered, and will likewise be attracted to the flame; the reason for this being that the heated atmosphere surrounding the flame and the particles of carbon in the flame form a better conducting medium than the ordinary atmosphere. If we pass the spark *through* the flame, the spark will assume an egg-like form of intense whiteness; passed through the base of the flame, it travels round the wick and is of a blue colour. If instead of bringing two points together we use one point and a small ball, we shall find that the spark will be divided into a number of branches radiating from the point; by using an electrode of a shield shape instead of a ball, we shall obtain a very slight report as well as the spark. (My readers must not take it for granted that they will always obtain this, as it is at all times rather difficult to obtain, and is governed by circumstances.) If we pass the spark over very finely divided metal (as copper and steel filings rubbed down in a mortar) we shall find that the spark will dash over these, and attain an artificial colour, and even fusing some of the metal (for this experiment and some of the others one of Henley's dischargers will be exceedingly useful). If we pass the spark through oil, we shall likewise obtain an artificial coloured spark (mostly of a greenish hue). By passing it through water we shall find that it will, in most cases, travel round the sides of it, and not through it, the spark will not be of very much different colour, unless a little argentic nitrate, cobalt nitrate, &c., be dissolved in it; in that case there will be an artificial colour given to the spark. If we try to divide the spark (as it were) by bringing a plate of guttapercha between the two points we shall find that the spark will be bent as though it were forced out of the straight line by the pressure of the plate against it. To obtain the disruptive action of the spark on paper, lay a thread of tinfoil (connected to one terminal of the coil) on a sheet of guttapercha, or other insulator, lay the card to be pierced on this, and then attach the other terminal to a brass pin; by bringing this pin down on the card (if the coil is insufficiently powerful, about ½in. or ¾in. being sufficient), we shall be able to pierce the card. This is similar to the experiment usually shown with the Leyden jar. We can also show the decomposition of water by means of the coil; but not at all satisfactory, as it requires the continuous current, and not an alternative one: if we do, we shall find that instead of having hydrogen and oxygen, each in a separate tube of the decomposition apparatus, we shall have a mixture of the gases (explosive) which, by the usual tests, can be proved. It is for this reason that we cannot use the secondary current of a coil for electro-deposition, as for this and the above experiment we want a continuous (battery) current. We can also by means of the calorific spark ignite ether, phosphorus, hydrogen, guncotton, and gunpowder. To show the experiment of the explosion of gas and common air we shall require an electric pistol. This consists of an ordinary wooden pistol-handle upon which is mounted a brass stock; through this (near the handle), and insulated from it by a boss of wood or ebonite, there is a brass pin so adjusted that a spark can be passed between it and the interior of the brass stock. This is filled with gas and air, a good sound cork put in, and when everybody is out of reach of the cork, a spark passed (by means of attaching the stock to one terminal and the pin to the other); the consequence will be that the mixture will explode, and blow out the cork. (Care must be taken in this experiment not to fill the pistol entirely with hydrogen.) Before I proceed to say anything about the vacuum experiments, I will just give the details of galvanic cartridge:—Take a piece of indiarubber tube, about ¼in. dia., and take a piece of silk-covered wire, and fold it back upon itself; twist the ends round to form, as it were, one piece, leaving two ends free to make connection with coil; break or cut the extremity where the end is doubled. This will then give us two wires with a small gap at one end for a spark to pass these wires up about half-way into the indiarubber tube, and then pour into the indiarubber tube (pressing it firmly down on a plate of glass) some melted indiarubber; this is to cement the wires in and form a case (with a little experience this becomes very easy). Then fill the case with a tuft of guncotton (round the sparking points) and little gunpowder, and over this a plug of clay, and over this some more melted indiarubber (be very careful doing this, seeing that there is no chance of the melted rubber finding it way to the gunpowder). This can then be exploded by attaching two wires to the ends of the wire of the cartridge and the terminals of the coil.

I will now, just by way of a finish, describe a few vacuum experiments. If we take a piece of glass tube with two metallic wires nearly touching in it, and likewise the interior of the tube being a vacuum, and then pass a spark through it, we shall then find if we have a perfect vacuum that we can obtain no spark whatever, thus proving that an electric discharge cannot take place in a vacuum; but, of course, in an imperfect one it can. Take a glass globe provided at one end with a stopcock and a rod surmounted with a brass ball, at the other end with a brass cap and stuffing box, through which passes another brass rod provided with a brass ball (the stuffing box, upon which a little oil should be poured, is for the purpose of allowing the distance between the two brass balls to be regulated, without in the least allowing air to enter or escape). Partially exhaust the globe (by means of an air-pump, or, what I prefer, an exhaustive syringe, price 25s. to 30s.), and then connect up to terminals of coil. Instead of in this instance obtaining a spark, we shall obtain a brilliant stream of light reaching from one brass ball to the other (giving the globe its well-known name of the luminous globe; this experiment is, in my idea, one of the prettiest going). If we thoroughly exhaust the globe and introduce into it vapour of alcohol, naphtha, or other hydrocarbons, we shall obtain, instead of the brilliant stream of light, a series of belts of zones of light. (From what cause this comes it is hard to state, some saying it is only an optical illusion; but, nevertheless, it can be plainly seen). Both of these streams of light, it will be found, are capable of being attracted by any outside conductor presented to the globe. Take a brass rod, and hold it to the outside of the globe; we shall find that the current will divert from its path and flow to that side of the globe where the conductor is. By filling this globe in succession with hydrogen, oxygen, nitrogen, and chlorine we shall find that it gives to the light a characteristic colour, hydrogen white, nitrogen rose, and carbonic acid pale green; with chlorine and oxygen the colour was very hard to discern.

I will now just take a rough and rapid glance at the vacuum tubes. As these are so well known, there is hardly any description needed. The first to construct these was M. Geissler, of Bonn; since then the tubes have been known under the designation of Geissler tubes, Gassiot tubes, vacuum tubes, &c. They usually consist of glass tubes (of different shapes), with two platinum wires passing through their ends or sides, carefully melted in; and they are then filled with the required vapour or gas, and then hermetically sealed. These tubes look very pretty when they are revolved rapidly by one of the many Gassiot tube-revolvers that are in the market. I consider that to show these properly one of these revolvers is needed, likewise it enhances the appearance if, round the tubes and revolver, there is placed a black velvet screen, inclosing them in on all sides but one, and also there is no need to state these experiments show much better in darkness. There are so many shapes of Gassiot tubes now in the market, that to go into details with all would take rather too much space, so I will content myself with just glancing at a few. First of all the motto tubes: These are tubes containing a convoluted tube bent into the words, one of the commonest being "God Save the Queen." The next, the horizontal compound spiral tube, consist of a spiral convoluted tube surrounded by an outer tube containing the liquid or vapour.

Compound vacuum tubes: These are vacuum tubes surrounded by an outer tube containing solutions of various kinds, the most used are sulphate of quinine, alcoholic solution of stramonium, or sometimes æsculine. These solutions being fluorescent greatly add to the beauty of the tubes.

Gassiotti Cascade, one of the most beautiful designs in tubes. The usual form is that of a cylinder of glass slightly enlarged at each end (bulb form). The upper bulb is divided from the rest of the cylinder by a glass partition, in the centre of which is a tube reaching down the other and lower bulb. This, like the other, is separated by a glass partition, having one or more holes through it. On this lower partition is fixed a glass goblet, so arranged that the tube from the upper bulb comes down inside the goblet nearly to the bottom. The platinum wires are fixed one in each bulb. The goblets are made of uranium glass, so that they glow with a beautiful green light. When this tube is connected to the coil the spark enters the upper globe and diffuses itself there. Then it passes down the centre tube, and emerges from its end to the bottom of the goblet, rises from here up the inside of the goblet, streaming down the outside through the hole in the bottom partition into the lower bulb, and finally out by the other platinum electrode. It is really very hard, indeed, to explain in writing the beautiful appearance of this tube.

It must be thoroughly understood, then, from this short description of the tubes, that they are very fragile things, and require to be handled carefully. I should like to press this on my reader's mind (who has made up his mind to try them), as I have smashed many valuable ones by being a little careless. I shall be most happy and pleased to answer any queries regarding coils or their phenomena.

F. W. Mason, Consulting Electrician.

A PIANO (?) FOR EVERYBODY.

[30039.]—REFERRING to letter 30014, if wire gongs are to be used at all, why not use these and nothing else? As a mixture of steel strings and wire, gongs would produce an intolerable break in the tone at the juncture of one with the other, besides involving much mechanical difficulty by having two soundboards made upon different principles. But an instrument made of gongs is quite another matter from a pianoforte. The piano is not an instrument to reduce in size to any great extent.

I consider the American organ, with one good set of reeds and a knee swell, a far more suitable subject. It could be put into a pine case of very reasonable dimensions, and when the reeds are well voiced, a very pleasing little instrument is the result, and could be made at much less expense than a piano. The principle of the American organ renders its tone beautifully delicate, and utterly unlike the nasal harshness of the usual small harmonium. Of course, the style of the music played would have to be different; but, still, inhabitants of cottages, I think, would get on far better with the deliberate organ touch, than the more brilliant pianoforte style of execution.

No doubt Mr. Nettleton is quite right when he says that "the tone and quality" (presumably of tone) "of a musical instrument does not depend upon the magnitude of its soundboard"; but the quality or tone of a pianoforte very largely does. He instances the violin, but the violin has four catgut strings pressing down upon its soundboard, shaped very convex on its front face; a small five-octave piano would have, if bichord 122 steel and copper-covered strings, and an almost flat soundboard.

The curves and also the sound-holes of violins, without doubt, affect its tone; but the pianoforte maker is handicapped for room, and therefore his instrument is a theoretically faulty one.

As to the zither tone bearing comparison with that of a well-made piano, I must beg to differ; both in power and quality, I should say comparison with the banjo far more appropriate. **Vandal.**

ESTIMATION OF SO_2.

[30040.]—THE estimation of SO_2 contained in a given sample of H_2SO_3 is of importance. The present pharmacopœial method is a little troublesome, and I would suggest the discharge of colour from a standard solution of $KMnO_4$ by H_2So_3 as an indication of the strength of the acid in question. In practice I find this method answer admirably. The reaction occurring may possibly be the following:—

$$2KMnO_4 + 5H_2SO_3 = K_2SO_4 + 2MnSO_4 + 2H_2SO_4 + 3H_2O.$$

I am not aware this method has been previously reported. **Frederick Davis.**

June 7.

LITHANODE.

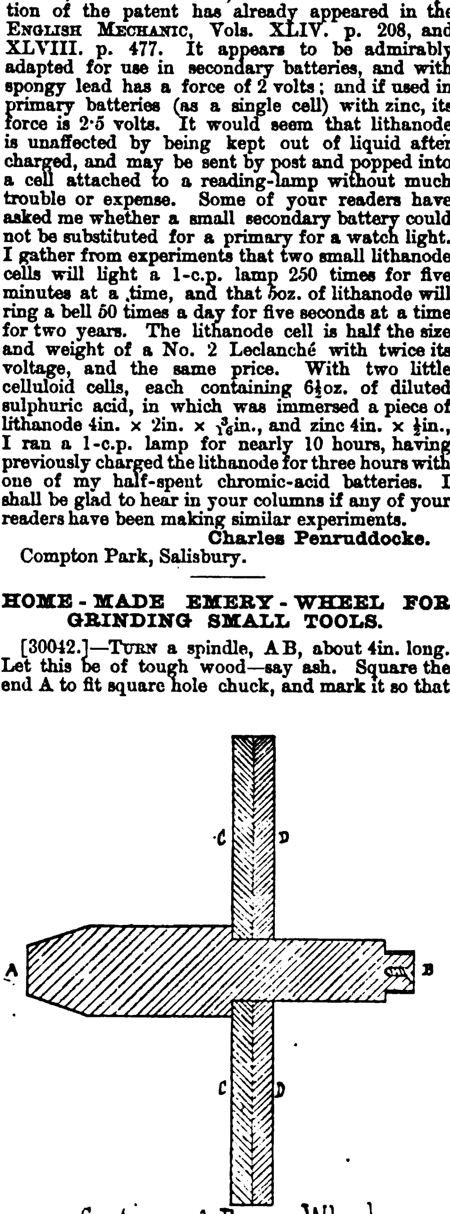
[30041.]—THINKING your readers may be interested in "lithanode," a compound invented and patented by Mr. Desmond Fitzgerald, I venture to draw their attention to it, as samples for testing have been offered to amateurs by Mr. Oswald Swete, electrician, at the instance of the Mining and General Electric Lamp Company, Crown Works, Guildford-street, Lambeth. A description of the patent has already appeared in the ENGLISH MECHANIC, Vols. XLIV. p. 208, and XLVIII. p. 477. It appears to be admirably adapted for use in secondary batteries, and with spongy lead has a force of 2 volts; and if used in primary batteries (as a single cell) with zinc, its force is 2·5 volts. It would seem that lithanode is unaffected by being kept out of liquid after charged, and may be sent by post and popped into a cell attached to a reading-lamp without much trouble or expense. Some of your readers have asked me whether a small secondary battery could not be substituted for a primary for a watch light. I gather from experiments that two small lithanode cells will light a 1-c.p. lamp 250 times for five minutes at a time, and that 5oz. of lithanode will ring a bell 50 times a day for five seconds at a time for two years. The lithanode cell is half the size and weight of a No. 2 Leclanché with twice its voltage, and the same price. With two little celluloid cells, each containing 6¼oz. of diluted sulphuric acid, in which was immersed a piece of lithanode 4in. × 2in. × $\frac{3}{16}$in., and zinc 4in. × ½in., I ran a 1-c.p. lamp for nearly 10 hours, having previously charged the lithanode for three hours with one of my half-spent chromic-acid batteries. I shall be glad to hear in your columns if any of your readers have been making similar experiments.

Charles Penruddocke.

Compton Park, Salisbury.

HOME-MADE EMERY-WHEEL FOR GRINDING SMALL TOOLS.

[30042.]—TURN a spindle, AB, about 4in. long. Let this be of tough wood—say ash. Square the end A to fit square hole chuck, and mark it so that it may always be put in the same way. Fit brass ferrule on B, and for back centre hole screw in an ordinary thick, short screw, drilling centre hole in middle of head, making it deeper than cross-cut. For wheel, take two pieces of deal ⅜in. thick, plane smooth, and glue them together crossgrain. These should be put in a press to dry. When dry, drill a hole in centre and glue to spindle. When this is thoroughly dry, turn up faces CC, DD true and smooth. To make this into an emery-wheel, glue on surfaces C and D some stout calico, seeing that it is glued on smooth. Trim edges when dry, and stand wheel with spindle vertical and faces horizontal. Smear thickly over the upper surface emery in powder before the glue is dry, and allow to stand all night. Repeat this several times, and the result will be an emery-wheel that will be exceedingly useful for grinding small tools. I have had one in work now for some months, and find it more efficacious than I anticipated.



Section of Emery Wheel.

Leytonstone, June 3. **A. P. Wire.**

PERMANGANATE OF POTASH AND DRY CELLS.

[30043.]—I am rather afraid our friend Mr. Mason is just a trifle behindhand in his discovery that permanganate of potash makes a good depolariser when used in a dry cell, inasmuch as I made a few successful experiments in this line myself as far back as November last. I had noticed some time previously that when permanganate was mixed and used as a substitute for the ordinary bichromate solution, it gave a first-rate current, but polarised, if anything, even quicker than the latter usually does. However, as that was, comparatively speaking, of no very vital consequence where a cell is only required to do such intermittent work as bell-ringing, I determined to make up a few so-called dry cells, using the permanganate, of course, in place of the oxide of zinc employed in the Gassner cell. The result appeared so satisfactory that a friend, to whom I communicated the idea, set to work and cast a few zinc cells scarcely half the size of the Gassner, and one of these, though so small in comparison, rang a bell strongly when charged with the permanganate mixture. That cell was made up a day or two before Christmas, and my friend tells me it is still in working order. Should any reader of the "E.M." wish to try his hand at rigging up a cell or two, he can do so cheaply in the following way:—Take a common stoneware jar, such as those sold containing marmalade, and holding about a pint; bend a piece of thin sheet zinc to fit the inside of the jar, allowing it of sufficient depth to stand ¼in. or so above the rim, so as to be able to attach a wire or binding-screw to make the necessary connection. Well amalgamate this, but do not put any silver on the part standing above the jar, as it makes thin zinc so rotten. Then have ready a fairish sized carbon plate, or, better still, half a dozen round ¼in. carbon rods. If the latter be used, let one be 2in. or 3in. longer than the others, so that a wire can be given two or more turns tightly round the projecting ends to make the other connection. The shorter lengths are then firmly bound in a cluster round the lower end of the longer one, a piece of string being used for that purpose. Now take a saturated solution of salammoniac and about three-parts fill the jar wish it. Add an ounce of permanganate, and having well mixed the solution, stir in sufficient plaster of Paris to make it of a thin, creamy consistence. The zinc cylinder should then be immediately pressed down into the mixture, and the carbons likewise quickly placed in position in the centre, the whole being allowed to stand some little time to set and cool, for the mixing seems to have a tendency to create some degree of heat. When set, run a thin layer of melted paraffin wax over the top to prevent evaporation. The cell is then ready for use. Of course, a thick cylinder of zinc would be the orthodox thing, but it's not always easy to obtain such, whereas any novice can bend a piece of the thin stuff, and it is surprising how long it lasts when well amalgamated.

Another simple plan I have adopted, and which I consider quite equal, so far as mere current is concerned, to the Leclanché or Gassner cell, is to take a pair of small agglomerate blocks, and bind them firmly to a carbon plate with string as though for an ordinary wet cell, and having placed them in the centre of the zinc cylinder, a mixture of plaster and salammoniac only is run in, and when set is sealed over as before with the paraffin wax. I find, however, it is rather an essential point that in mixing these dry-cell arrangements the mixture should be used as thin as possible, without, of course, going so far as to destroy the actual setting capacity of the plaster, for, if too dry and solid, it makes a lot of difference to the current. I notice Mr. Allsopp is rather enthusiastic over the Gassner cell, but if he would try this arrangement I think he would like it, as it gives a good current, and can be put together at a cheaper rate than that at which a Gassner can be bought. On the other hand, our universal friend, Mr. Bottone, does not seem particularly enraptured with the dry-cell business. Undoubtedly they are very useful for special purposes, but, speaking generally, I hardly think they look like cutting the venerable Leclanché out—at any rate, not just yet. It seems to me one of their very best openings is as medical cells, for their portability for this special purpose is quite a boon to those who have to make frequent use of such apparatus.

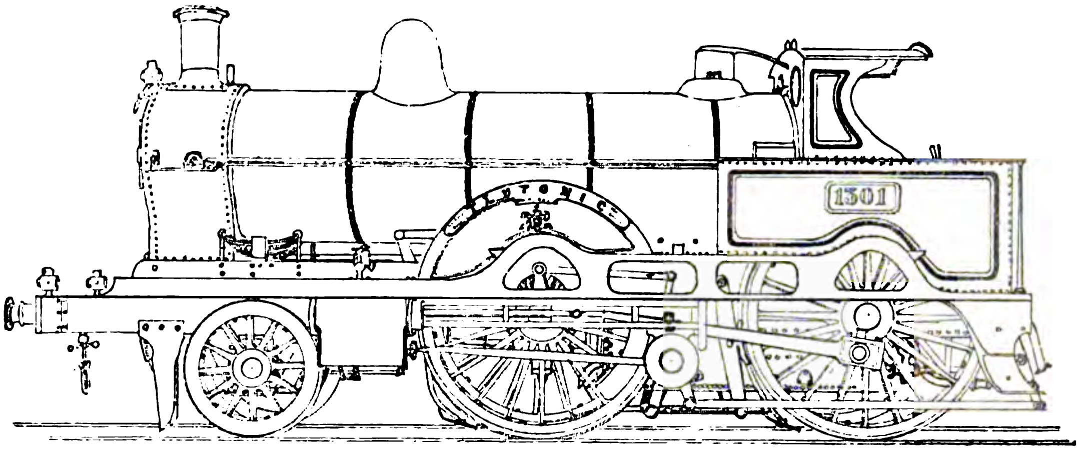
As regard Mr. Mason's idea respecting the permanganate regenerating his used-up cell, I think the term is hardly a correct one to use, seeing that when the permanganate was run through the cell it simply became active again by virtue of a new depolariser being added to it, and not because the old spent oxide of zinc was in any way reoxidised—at least, such is my humble opinion.

Respecting the making of these cells, would some one kindly give an opinion as to whether the use of the zinc cylinder, when cast and used as the containing vessel, would be in any way an infringement of the Gassner patent? I mean, of course, in case of selling such.

Victoria-street, Gloucester. **W. J. Gardner.**

THE NEW COMPOUND.

[30044.]—HEREWITH I send a sketch of the new compound on the N.W.R., thinking that it may interest engineering readers. Particulars were given in the issue of May 31st, to which readers must refer. On the whole, the design is similar to the Dreadnought class, with the exceptions that the boiler is mounted higher, the wheels are larger, the drivers being 10in. bigger, the sand-blast has been added, and improvements in the valve-gear made. Of course, these alterations necessitate other minor ones. The Teutonic, the only one yet running, seems to give great satisfaction, hauling loads of eighteen carriages between Crewe and Euston at



very high speeds. I believe seven more like her to be on order.

I regret that out of fifty or so locos. at the Paris Exhibition England is only represented by four, and one of these for a foreign line. They are Mr. Stroudley's front-couple, Mr. Stirling's S.E. bogie, a loco. by Neilson and Co., and last, but not least, the Midland single. I should like to have seen one of the new N.W. compounds as well as a G.N. 8ft., G.E. 7ft. 4-couple, S.W. front-couple, 7ft. Caledonian single, and a N.E. compound. Then we should have had a show worthy of the native land of the locomotive. Still, we need not be ashamed of the specimens sent. May they "take the cake," to use a small vulgarism. **Vandal.**

LOCOMOTIVES.

[30045.]—The recent interesting letters on this subject have revived an old but sleeping query in my cranium. It is this:

All the locomotives and models of these which were made or used by Trevithick had, as far as I know, the old "tappet" motion for working the slide-valves. This is also true of old "Puffing Billy" from Wylam, now in South Kensington Museum, and of a similar engine from the same colliery, called "Wylam Dilly," in the Edinburgh Museum. What I am curious to know is, who replaced the old "tappet" gear in locomotives by the "loose eccentric," and who was the ingenious inventor of this latter very useful contrivance?

It has often struck me how silent or indifferen most writers on the steam-engine appear in respect to such interesting details, considering that all true students are desirous of watching the growth of each separate part from its inception to the latest development.

Willesden, June 8. **Semaphore.**

[30046.]—Before this interesting subject is dropped I should like to ask the following question. If I understand rightly, the valve gear of the very early locomotives consisted of a single and separate loose eccentric for each cylinder, the slides being reversed by two levers upon the foot-plate, which levers were in motion during the running of the engine, the connection between the eccentric rods and valves requiring to be severed while reversing. Dempsey, in a little work published in 1857, alludes to a method "formerly much adopted," which, I presume, was an improvement. In this the two eccentrics are described as fixed to each other at right angles, but loose on the centre of the cranked axle, so that they might be shifted along to catch into gear with either the "forward" or "backward" driver as desired, the shifting being effected by a *third* lever upon the foot-plate. I should be glad to know when this modification was introduced. **T. C. G.**

HAYDON CUTTER-BAR AND THE WIRE GUN.

[30047.]—As an old engineer, who at one time of his life understood the use of tools, I am sometimes puzzled, as well as amused, at the contentions to which you afford so much space in your interesting and valuable serial, but by none more so than by those relating to the Haydon cutter-bar—e.g., in to-day's issue, at p. 303, I cannot but agree with the writer, from what I have seen and heard, that it is "unquestionably a thoroughly good and reliable lathe tool"; but I must also acknowledge that, apart from ordinary mechanical principles, I "have not the remotest idea of the principles which the inventor embodies in his design." The mystery here is so great that it makes one wish for a "Clerk-Maxwell" to elucidate these principles by their proper formulæ, so that they may be tested by the "theory of least squares," and so made clear to everybody.

The Wire Gun.—May I ask what was the extent of the "Jubilee shot from this gun at Shoeburyness," see page 313, which has beaten the marvellous American foot-ton rifled cannon by 11·8 miles (?)! "Queen Anne's pocket pistol," on the ramparts of Dover Castle, said one hundred years ago: "Sponge me well, and keep me clean, and I'll carry a ball to Calais Green." This surely would beat them both.

June 7. **Antiquus Eng.**

CUTTER-BARS.

[30048.]—Referring to letter 30009 on p. 303, I can quite understand why several of my friends prefer any other cutter-bar to Haydon's. The reason lies simply in the fact that they do not know how to go about the grinding of the cutters to produce satisfactory edges, and I think I may assert that I have never seen exposed for sale in any London shop one that was not ground entirely wrong. If I were to adopt another, I should still, for grinding the cutters, use just the same arrangement as I now do for Haydon's—viz., simply a flat wooden block of the correct height, and firmly attached to the frame of the grindstone for giving the slope of 4° away from the perpendicular for the front facets of the tool, and on this block the stock of the tool is simply laid and held, thus enabling one to grind the front facets of any tool exactly, without using any gauge at all. What is disliked for the most part in respect of Haydon's bar is the necessity for grinding the upper face of the cutter—that is to say, the one that gives the angle of "escape," down which the shavings have to slide on leaving the work after separation.

In many of the cutter-bars that are differently arranged the object seems to be to make one of what may not improperly be called the self-faces of the steel take the place that would certainly be much better filled by a properly-ground facet, and hence seems to spring the preference for the "other" cutter-bars. A face (the upper one) is already given and provided by the arrangement of the holder itself, and those who use it grind and modify the front and under sides or facets to suit. But, in the opinion of Prof. Willis (sorry to say the *late*), and of Haydon, and of myself, this is just beginning at the wrong end. Our [glad to be in good company] idea is to shape the underneath sides first, and, lastly, to shape the top facet according to the requirements of the case. Steel is not exactly what it used to be, and the old saw of "forge thick and grind thin" *may* have had all the tooth taken out of it; but its teaching may be pretty safely followed in even these days, when anything that suited my grandfather won't do for *me*.

I think I am right in saying that the makers of other cutter-bars do, as a rule, supply the cutters ready ground as regards the upper surface; but, at the same time, this upper surface would bear tilting upwards to a much greater angle to produce the best effect on wrought iron. And it would usually be found that on the occasion of a tool requiring grinding, instead of the whole stuff for reproducing a fine point being taken away entirely from the front and under facets, the irresistible prompting to get a point as soon as possible takes the form of a slight touch on the grindstone of the upper surface of the cutter, which ought not to be meddled with at all.

As to my saying of Haydon's bar that "I would not be without it on any account," I must wish to be understood that if I had a forge at my command, as Fred Carre has, and as I myself had some 15 years ago, before the N.W. Railway Company thought fit to duplicate Primrose Hill Tunnel and turned me out of my house, I rather think I should go back to solid tools for plain turning. I use these regularly for external work; for inside work I have a considerable variety of cutter-bars for boring and screw-cutting, &c. **J. K. P.**

ORGAN MATTERS.

[30049.]—I have to thank Mr. Audsley for his kindness in replying to my recent letter. As I live 300 miles away from the City, and shall not be South this year, it is impossible for me to accept his kind invitation to inspect his organ.

My organ will be erected in a drawing-room, 24ft. by 13ft. by 11ft. 3in. high. I shall erect it at one end of the room, and having plenty of room to spare shall make the two swell boxes of sufficient size to give plenty of speaking room to the stops Mr. Audsley may specify. Wind pressure, 2¼in. Feeders and reservoir placed in a room behind the drawing-room. Feeders worked by hydraulic engine. The organ is intended for the performance of strict organ compositions of a solo character, and also will be used with piano and violin occasionally, but not with any other instruments. I shall be glad if this information will now enable Mr. Audsley to give me the specification, which will be greatly valued by

George Landell.

[30050.]—"Tacett" has given very full details of the keys of his old Organ; but, strange to relate, the very dimensions I wanted have not been furnished. I, perhaps, was not explicit enough; but what I asked for were the *lengths* of the black and white keys with which the fingers are concerned in playing—namely, the portions exposed. "Tacett," however, does give the total length of the ivory on the naturals as 5¼in., and from this I presume the length of the ivory exposed is about 4¾in., or, at most, 5in. Such a length points to a date of about the middle of the 18th century. We know that previous to the work of Snetzler the keys of the organs built in England were very short, seldom exceeding 4¼in. in the naturals, and 2⅜in. in the sharps. Snetzler introduced longer and more convenient keys, and his practice was followed by subsequent builders. It is very probable that the instrument acquired by "Tacett" is a Snetzler or a Green, built between the years 1750 and 1796. It may, however, be the work of either of the Englands, who worked at the same period.

The Stopped Diapason has evidently been an addition to the original scheme; the method of its insertion amply proves this. In the original Organ the stop-handle labelled *Tacett* cut off all stops save the Open Diapason. It is probable this was thrown out of action when the Stopped Diapason was blocked out at the back of the windchest, as described. **G. A. Audsley.**

[30051.]—Allow me to thank Mr. Robinson and "Uranium" for the valuable practical information given in these columns. A few hints on making a soundboard or bellows are of far more value than the long-winded articles on tone-colour, swell-boxes, &c.

Having travelled the world a bit, I have had my faith in theorists very much shaken. When in London, I saw an organ built by a most prolific writer on "theoretical" organ building: it was a dismal failure. I was always taught never to mitre a pipe at right angles. I lately saw an organ built in Switzerland with the bass pipes mitred right over in two cuts, and the down part glued to and touching the body; the tone was excellent. There was no case, and the pipes were grooved to an extent I never saw before to produce a design, but the speech was quite prompt. The bellows had no inverted ribs, and besides being weighted, had a spring which came into operation when the bellows were half-full; the wind was quite steady.

Foreign organs are, as a rule, cheap and nasty—celluloid for keys, crockery stop knobs, spruce for pipes, felt for leather; but they look well, the littlest mostly having a burnished tin front.

There is a cheap foreign organ, put up about three years ago. The inside is rough from the saw, and daubed over with what looks like tar. It is pneumatic action, and when playing soft you can hear the escape of wind all over the place. What Mr. Robinson says about the duffers in the trade is quite true, and some of them have been in the trade for years.

I saw an organ by a 30 years' builder: the job had 34 stops and 3 manuals; the bellows rose only 8in.

Another job I saw by a big London builder—if the tuner rested his knee on the soundboard while tuning, it would spring and cipher, it was so weak.

At one church some fool has lined the "inside" of the swell with soft felt. Talk about a resonant box! A London builder, who has plenty of work, told me that he never put mixtures, if he could help it, "because if you come to look at it you know they are *discords*."

Foreign builders are far ahead of us in the making and voicing of wooden pipes; their flutes have mostly circular mouths, with an artificial lip, the tone splendid.

Can "Uranium" (whom I have missed lately) or Mr. Robinson tell me how to make a soundboard without using a caul? **Dias, Amateur.**

CHURCH CHIMING CLOCK.

[30052.]—Mr. Maddison (letter 29994) describes and shows photos under above number of a church clock made by him, and states that he does not think the arrangement of the parts of clock admit of improvement. I cannot agree with his views, for the clock is built on lines of an obsolete pattern that was in vogue some 60 years ago, and I am sorry Mr. Maddison did not examine some modern clocks before making the one he describes; if he had, it would have been made very differently I have no doubt, and would have been more interesting to readers, as it would have been an example of the work of to-day, and not of that done a great many years ago. The maintaining power described is a very poor one; it should have been attached to the main wheel of clock, and be self-acting. The method employed for winding up the clock by one of the pinions of the train is bad. If a winding-pinion was necessary (which I doubt, if the clock was made properly, however small the space for winder might be), the front of barrel should have been fitted with a toothed-wheel gearing into a pinion carrying a winding-square; this could not interfere with the working of the train, whereas Mr. Maddison's method is very likely to when the clock has been working for some years.

The escapement cannot be seen from photo, so I cannot understand the principle; but undoubtedly the Graham's dead-beat escapement for simplicity, safety, and accuracy, is unrivalled for small church clocks (not large ones). With regard to the striking train, the length of fall for weight is not given, but assuming it to be of the ordinary length, the hammer-lever should have been lifted from a cam containing, say, 30 teeth, attached to the main wheel (the reason is obvious). I am afraid I have written at too great a length, but trust that my remarks may be of some use to Mr. Maddison, should he make any more clocks of a similar type.

T. W. Buggins.

SAFETY BICYCLES.

[30053.]—As Mr. Walton ventures a few remarks, I may perhaps be permitted to give my observations. I can entirely concur with him in his opinions.

I have noticed (1) that machines with the weight nearly central between the wheels, there is a tendency of the driving wheel to skid on muddy hills. (2) When the handles come very far back, one cannot turn a sharp corner without the possibility of a spill from his thigh getting jammed against the bar. Raising the handles gets over this difficulty, but makes it impossible to climb a hill. (3) Lurching and side-slipping (of front wheel) are more noticeable when the steering centre is in direct line with the point of contact of the wheel with the road, and the wheel, if it gets into a rut, does not come out again so readily as when the line of centre is rather in advance of the point of contact. Wheels with curved forks seem to get knocked out of their course by every little pebble. (4) The more weight there is on the driving-wheel, the less liability there is to slip sideways, but the greater the vibration on bad roads and the exertion in hill climbing. (5) Machines that are very light cost a fortune in repairs, unless always run on very good roads; and they do not often go easier than others that are 12lb. or 14lb. heavier.

A. F. Shakespear.

Luttichaustrasse 14, Dresden, June 8.

EXTRAORDINARY METEOR.

[30054.]—The remarkable object described by Mr. David Booth, of Leeds (letter 30004, p. 302), was, no doubt, the meteor seen here on May 29th, at 10h. 20¼m. p.m., local mean time, which agrees with the time he mentions, adding the difference of Belfast to Greenwich mean time.

I regret I did not see the meteor myself until it nearly had finished its course; but I wrote to a local newspaper (the *Northern Whig*), describing what I saw, for the purpose of getting some definite data, so as to determine its path; but, unfortunately, my letter elicited no response, although the meteor was seen by many in this neighbourhood.

The gentleman mentioned in my letter (below) saw its disappearance apparently between his position, which lay about 2¼ miles N.E. of mine (my residence lying in the southern suburbs), so that the course of the meteor probably terminated somewhere over the east of Belfast, which lies 190 to 200 miles W.N.W. of Leeds as the crow flies.

The following is the copy of letter above-mentioned:—"Last night (May 29), about twenty minutes past ten o'clock, when looking towards the west, where the sky was free from clouds, and in consequence of the bright twilight everything around could be seen pretty distinctly for a considerable distance from where I was at Windsor Park-avenue, I was startled by a bright flash lighting up the houses behind me towards the south-east, and on turning quickly round to ascertain the cause, I observed over the roofs of the houses a burst of light. As the meteor moved slowly downwards towards the north-west I saw its final outburst as it passed to the north of the terrace of houses close to where I was standing, and it disappeared like a shower of rockets near the bright star Alpha Cygni. When I first turned round the light appeared near the first-magnitude star Vega; but the meteor had probably travelled some distance in its course before I became aware of its presence by the vivid illumination of surrounding objects. I was informed to-day by a friend who had been walking in Victoria Park that on his looking towards the south he observed a flash of light, at first bluish; but as the meteor moved very slowly from S.E. to N.W. the streak of light became more brilliant, being of a ruddy tinge near the middle of its course, and finally disappeared before reaching his more northern position. It would be desirable to learn whether this splendid object has been seen at any considerable distance from here, and its position, with reference to any prominent stars in the line of sight, from where it was first observed until its final disappearance, with a rough estimate of the duration of its visibility, as its motion appears to have been comparatively slow."

Belfast, June 10. **I. W. Ward.**

SOME LITTLE-KNOWN PLANTS OF THE FLORA MEDICA.

[30055.]—Lauraceæ: L. Camphora, yielding the camphor of the druggist from a small evergreen tree of great beauty. Camphor is not mentioned by the ancient writers; it was introduced into Europe about six centuries ago, but was previously known to the Arabs. Half a century ago there was a beautiful specimen of this tree growing at Malmaison, over 20ft. high by 6in. in diameter. I have seen one of the same size in the Botanical Gardens of N.W. India. The camphor of commerce is obtained by cutting the wood into billets, then boiling them in iron vessels covered with earthenware heads filled with straw. The camphor volatilises, and concretes in the straw. This is the usual process followed in Japan, Sumatra, Borneo, and Malacca. To purify the product, it is introduced into a subliming vessel, with one-fiftieth its weight of quicklime, to retain some oil with which it is contaminated, heat being gently applied by a sand bath. Camphor is insoluble in water; soluble in alcohol, ether, fixed and volatile oils, and several acids; readily volatile, and very inflammable.

There are many camphoraceous plants: in Spain the drug has been obtained from several of the large order Labitæ. It has also been prepared artificially by passing a current of muriatic acid gas through turpentine; this last variety, however, has not been used in medicine to my knowledge.

The camphor tree of China attains a timber size, to judge of the chests made of its wood. I have possessed some of these imperishable trunks—receptacles alike proof to insect pests and the germs of contagion. They have risen in price greatly since I first obtained them. The last was sent to me direct from Hong Kong, and I am told that improvident waste of the trees, without any forestry laws, has led to this scarcity.

In the European practice of medicine camphor has long sustained its reputation as a valuable stimulant, especially in typhoid fevers—given in larger doses for other diseases, it proves narcotic, and it frequently gives great relief as an external application when applied in ointments and liniments. "Raspail," the celebrated heterodox practitioner—called the "Camphor Doctor"—administered it largely. His Liqueur hygienique contains much of it, and everybody bought this pleasant household cordial, guaranteed to prevent many common ailments and save doctors' bills. His little book on simple treatment is well worth perusal, and, I think, has been translated into English. I always found this cordial a pleasant and harmless stomachic, digestive, and laxative. Camphor in excess is a poison. I have known fatal and dangerous results from a habit of chewing it. Not long ago a young married lady of my acquaintance, who had acquired this fancy, became suddenly and alarmingly ill. She was frightened, and told her medical adviser, who was astonished at her folly, and attended her for some time to effect a cure! Syncope, through enfeeblement of the heart's action, is the general result of over-doses. Camphor is a valuable sedative in the more severe derangements of "teething" met with in Tropical climates. In combination, I found it lower the temperature of the body, produce long and refreshing sleep, and restore the urinary function when long suspended (a grain or two of camphor, no more). I have always been a believer in its antiseptic and prophylactic qualities.

In my youth I was an ardent votary of taxidermy, but in those very slow days of India, any specimens sent me were sure to be decomposed on arrival. I happened to make the acquaintance of a skilful anatomist, and he performed a very interesting experiment for my benefit; he got a freshly-killed "blue chatterer," then, preparing a quantity of camphorated spirit by dissolving some lumps in pure alcohol, he injected the bird at vent and beak with an ear syringe, about one ounce, I think it was; the subject remained perfectly sweet, and fit to stuff for a whole week. Nowadays we have numerous chemical liquids to attain the same end of temporary preservation.

Camphor possesses well-established anaphrodisiac virtues. I was once much amused and edified by a Gallic mariner, who had been boasting of his ship for some time with a *confrère* of the profession that he and his crew were models of continence. "We all take camphor regularly." I had noticed Raspail's books and medicines during my voyage as a passenger.

The natives of India have a proverb about "friendship"—"Camphor and peppercorns are inseparable," alluding to the custom of always keeping them and selling them together; and I think, from my own observation, that those pungent grains do arrest evaporation. In all parts of the world I have found camphor placed in airtight boxes most effectually excluded the devourers of fur and feather. I have now a large tin case; its contents are hairy materials and gaudy plumage, collected over 30 years ago for flymaking. They are as sound as when placed there, the camphor having been occasionally renewed.

Camphor is much used in India by firework-makers, and in the manufacture of that beautiful transparent varnish, made from the resin of the copal, like "vateria," without such addition to the alcohol, it will not dissolve the above; and I believe this is the case with other substances. **Eos.**

USEFUL AND SCIENTIFIC NOTES.

The Largest Elephant ever Killed in India.—The *Madras Mail* reports that some time last year a solitary male elephant, which had killed two men and was a source of terror to the neighbourhood, was pursued and killed in a talook of the South Arcot district. On hearing of this, an official of the Central Museum of Madras repaired to the place to secure the skeleton, but did not reach it until after the body had been buried. Orders were then given to exhume the bones and send them to Madras. This was done, and the skeleton on being mounted was found to be 10ft. 6in. high. The principal authority on the subject, Mr. Sanderson, in "Thirteen Years among the Wild Beasts of India," says that out of hundreds of elephants measured in the flesh he never found one to exceed 9ft. 10in., or 8in. less than the Madras skeleton. The tusks are 6ft. along the curve, and weigh 50lb. each.

A Phenomenon in Cheap Literature.—Beecham, the well-known proprietor of "Beecham's Pills," emboldened by the success attained by the annual he published last Christmas, has just issued "The Beecham Illustrated Holiday Number," which is the most extraordinary pennyworth we have yet seen. Comprised in 100 pages we find twelve complete tales by such well-known authors as James Payn, G. R. Sims, Hawley Smart, James Greenwood, Sir Gilbert Campbell, Bart., Geo. Manville Fenn, Philip May, Howard Paul, &c., each story having been written expressly for this work. Three months' free insurance is guaranteed to each purchaser of every copy. The book is well printed and in clear type, and is just what a holiday number should be. Published by F. J. Lambert and Co., 18, Bouverie-street, London, E.C.

Coppering Iron.—It is stated in the *Metallarbeiter* that iron can be coppered by dipping it into melted copper, the surface of which is protected by a melted layer of cryolite and phosphoric acid, the articles to be thus treated being heated to the same temperature as the melted copper. Another process consists in dipping the articles into a melted mixture of one part of chloride or fluoride of copper, five or six parts of cryolite, and a little chloride of barium. If the article, when immersed, is connected with the negative pole of a battery, the process is hastened. A third method consists in dipping the articles in a solution of oxalate of copper and bicarbonate of soda, dissolved in 10 or 15 parts of water, acidified with organic acid.

REPLIES TO QUERIES.

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⁎ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[66883.]—**Problem in Arithmetic.**—I have just got my last volume back from the binders, and I see in my reply, on page 522, to "Analyst's" query, there are a few errors. 1st. The number of the query is wrong, 3 having been printed instead of 8. 2nd. The crosses over 86 and 84 have been transposed. 3rd. The cross over 104 (at a height = 11) is omitted. The figure in the text is wrong, and does not agree with the description. The two lower lines should be horizontal and parallel.

Glatton.

[67717.]—**Smoke-Pipe.**—"Technical" (May 10) thinks I gained my information as to this problem from Warn's "Sheet Metal Workers' Instructor"; but I could not gain from that book information that is not there. What I do learn from Warn's solution is that, given the axes of an ellipse, if you form a rectangle (L, A, M, N, Fig. 4, p. 221), which has for two of its sides half the major axis, L A, and half the minor axis (A M), join the extremities (L M) of these half-axes, and from the angle (N) formed by the other two sides draw a line perpendicular to the diagonal, and produce it to cut the major and minor axes (at *c* and *b*), you have in these points centres from which you can draw on the diagonal by arcs a quarter of the ellipse (L, *a*, M). This is what Warn teaches me; but the teaching is illusive, as the workman who has smoke-pipe to fit will very soon find out. I will pass this by, however, because in dealing with problems practically, we have constantly to accept approximations; not but that the results obtained by Warn's above mode of ellipse drawing are often such as by no stretch of language could have this term applied to them. Far more serious is it that Warn's treatment of the problem is false in principle. Let A, B, C, Fig. 1, be a part circular-section of the smaller cylinder, the diameter A C being in the plane (X, say) of central vertical section of the larger cylinder. Now, the semicircle A B C being divided into equal parts in the points 1, 2, 3, 4, 5, the perpendicular distances of these points from A C, that is from the plane X, remain the same, whatever may be the angle the smaller cylinder makes with the larger. Not so by Warn; for his ellipse method makes the distances of the above division points vary with the inclination of the smaller cylinder, as the quarter ellipses, whilst standing upon a constant semi-minor axis, vary in their semi-major axes according to this inclination. If Warn's method were correct, then, taking two quarter ellipses standing upon A M (Fig. 2, and see also Fig. 4, p. 221), dividing one of them into three equal parts (as Warn instructs), in the points *d* and *e*, drawing lines from *d* and *e* perpendicular to A M, and producing these lines to cut the other quarter ellipse, this should be divided in the points *d'* and *e'* into three equal parts, which manifestly it would not be. Starting wrong, Warn gets a wrong shape for the hole in the larger cylinder, as well as for the junction end of the smaller. In small pipes this may not be important, but with large cylinders it would be very serious. This error of principle in Warn's method will be part of the copyright that "Technical" carefully, but unbefittingly, cautions me, appertains to Warn's book. The three points that Millis gets (*b*, *c*, and *d*, Fig. 1, p. 115), are absolutely true, and lead to true results. As "Technical," so to speak, challenges me, I think it but just to say that inaccuracy is rather characteristic of Warn's book, and that, besides accuracy and system in Millis's, I get, and a boon it is indeed, short radius methods for those problems in which in practice centres are out of bounds.

Aliquando.

Fig. 1

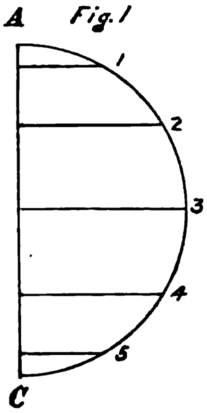
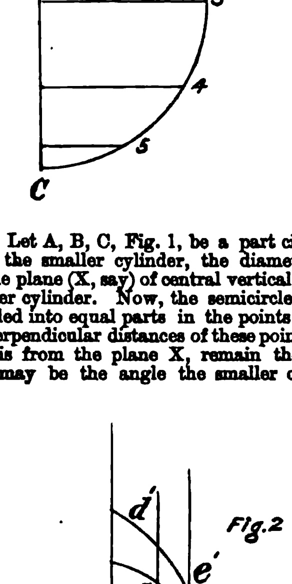


Fig. 2



[67995.]—**Ivory.**—I am afraid "Nun. Dor." is behind times, because more than eighteen months ago I was shown some celluloid dressing-combs, beautifully grained to imitate ivory, at 2s. 6d. each, and if he cares to advertise his address, I will tell him where to get them now.

Vooght.

[68104.]—**Catering.**—Will "Phos. Bron." kindly explain *how* the liquid flows from the discharging vessel to the measuring reservoir, which is already filled with air? Perhaps there is some arrangement for allowing the air to escape not shown, but without which the so-called measuring tap is useless.

Upton Manor. W. J. Woodward.

[68164.]—**Lever Bicycle (U.Q.)**—You may lessen the trouble by carrying the connecting-rod down to fork extensions; but machines with the lever on the crank-pin never go well. The back wheel must be pretty big.

A. F. Shakespear.
Lüttichaustr. 14, Dresden.

[68210.]—**Electrical Query (U.Q.)**—If the point to which Q units are brought up has already a potential value, this will be constantly acting on the Q units (attracting or repelling, as the case may be). It is thus clear that the work done is Q V ergs, provided that the potential at the point is not raised or lowered by the approach of the charge. When the point has originally zero potential, the approach of Q will gradually give it a potential which finally reaches value V. Consequently, the average potential is $\frac{V}{2}$; whence, work done $= \frac{QV}{2}$ ergs. In the case of the Leyden jars, if inner coating of first jar is at V potential, the outer coating of second jar, being connected with earth, must have zero potential. Therefore, total potential difference between inner coating of first jar and outer coating of second jar is only V. Consequently, potential difference between inner and outer coat of either jar, presuming them to be alike, must be only ½ V.

W. Perren Maycock.

[68237.]—**Electro-Magnets (U.Q.)**—Let one end of each magnet be joined to a common terminal leading to one pole of dynamo. The other pole is connected to a mercury trough in which the free ends of magnets may be inserted at will, and in any combination. To make trough, get a piece of 1in. teak, 1ft. by 2in. Down the middle cut out a trough about ¾in. deep by ½in. wide. Boil in paraffin wax. Screw down on bench or stand. Staple down dynamo wire, leading it in at one end of trough. Fill trough with mercury. The ends of magnet wires should be so bent as to keep their place when inserted in trough.

W. Perren Maycock.

[68353.]—**Electro-plating on Ferns, &c.**—The difference between the amount of copper and silver necessary for "experimenting" is so small that one might reasonably try the silver, I think—especially as it is not lost. Possibly Dr. F. L. James will reply himself; but here is a précis of the method given in his article in No. 908. The object to be silvered, after being thoroughly cleaned, is immersed for two or three minutes in a saturated solution of gallic acid in distilled water. It is then dipped in a solution of 20gr. of crystallised nitrate of silver in 1,000gr. of distilled water. This operation is repeated two or three times, moving the object from one bath to another until it has acquired a silvery appearance. Rinse in distilled water and place on bibulous paper. Make up a reducing solution of grape sugar, or honey, 5 parts; quicklime, 2 parts; tartaric acid, 2 parts; distilled water, 650 parts. Dissolve and filter. Make up a silvering solution by dissolving 20 parts of nitrate of silver in 650 parts of distilled water and add liquor ammoniæ drop by drop, stirring with a glass rod until the brown precipitate which will be produced is nearly redissolved. Mix equal parts of the reducing and silvering solutions in a guttapercha or japanned dish; stir thoroughly and filter. Then immerse the previously prepared articles, and the deposition of the silver will commence in a few minutes and continue until the solution is exhausted. That is the simple process. To plate with the battery proceed in any of the well-known methods described hundreds of times in these columns.

Nun. Dor.

[68403.]—**Chromic Acid Battery.**—To Mr. W. Perren-Maycock.—Mr. Maycock, in his answer to this query, raises a reference to the new paper, *Work*, by Messrs. Cassell and Co., I fancy, and says that it seems to be going from bad to worse. I am sorry to have to differ from him there, for I believe the paper to be a practical and useful one. He also is, I think, a bit hard on the article on the Bunsen Battery. I myself considered it a good and practical one (Mr. Maycock must not think through this that I was the author of it, because I was not, nor am I in any way acquainted with him); but as I before stated, I do not think Mr. Maycock is justified in his sweeping condemnation of *Work* and its contents. I write this because I am myself on the staff of its writers (which, by the way, Mr. Maycock might like to know number among its members men of known ability and worth), and so it stands to reason I take a great interest in the publication. It may be stated that it is a bit dry to all but the true workman, and perhaps it is on this ground that Mr. Maycock condemns it.

F. W. Mason.

[68437.]—**Blowpipe (U.Q.)**—Cheaper to buy than to make.

A. F. Shakespeare.
Lüttichaustr. 14, Dresden.

[68479.]—**Routing Machine.**—The superfluous zinc is usually cut away by means of a saw, and the hollows are cleared out by a sort of rose bit.

M.

[68481.]—**Division Plate for 9in. Lathe.**—Methods of making division plates have been given to my knowledge in many back numbers, and I fancy I have seen some letters, &c., on the subject recently.

M. S.

[68486.]—**Soldering Fluid.**—The querist should have mentioned the page on which he found the soldering fluid containing lactic acid. As he quotes the recipe it looks like a "joke."

J. M. T.

[68491.]—**Screw Threads.**—I don't think the American standard threads are the same; but as to tools going in free of duty, if they have been used, they do not charge anything on them. But there must not be enough to stock a second-hand shop.

C. H.

[68515.]—**Sensitive Plants.**—There is the Mimosa sensitiva and M. pudica, also Oxalis sensitiva and some others, with Æschynomene Americana, Cassia nictitans. What part of the yellow Berberis moves, and which Mimulus, as there are several—the common monkey flower and the musk, for instance?

S.

[68519.]—**Scalding by Hot Tea.**—There is no "scientific reason" for the statement that tea made with water which has "not quite boiled" scalds more than tea made with water that did boil, for the simple reason that it is not a fact. As soon as water begins to boil, paradoxical as it may seem, it begins to cool, because the vapour of the water absorbs so many of the heat units in the conversion of the liquid into the vaporous stage. Perhaps that is the origin of the statement.

B. C. M.

[68526.]—**Int. B.Sc. Lond.**—If "Engineer" cannot refer to back volumes, which he can certainly refer to if resident in London, I would suggest the advisability of procuring the University *Calendar*, and ascertaining from that what is required of him.

Q.

[68534.]—**Telephone Connections.**—Diagrams of all sorts of arrangements of telephones have been given, and if "A. R. H." cannot find "anything suitable" in the last 16 volumes, I am afraid he will have to do his own inventing.

N. D. C.

[68545.]—**Keyless Watches.**—There are several methods of preventing the bow of a keyless watch being wrenched off, the most obvious of which is to attach it to a collar round the stem; but an ingenious plan was illustrated on p. 233, which the querist has no doubt seen.

T. J. L.

[68549.]—**Steam Pressure and Plate Glass.**—If this "Twenty Years' Reader" will state the size of the basin and the thickness of the glass, he may get an answer. His twenty years' reading seems to have been wasted, for a more careless query could not well be put.

C. T.

[68552.]—**Maxima and Minima.**—In reply to "A. M.," it is rarely necessary in geometrical problems of this kind to carry the process beyond the second differential co-efficient. However, this is the third:—

$$\frac{d^3s}{dx^3} = \frac{9\sqrt{2x}}{\sqrt{(1-x^2)^5}} + \frac{15\sqrt{2x^3}}{\sqrt{(1-x^2)^7}} - \frac{1}{(1-x^2)^2} - \frac{2+10x^2}{(1-x^2)^3} - \frac{12x^2(1+x^2)}{(1-x^2)^4}$$

Putting $x = \frac{1}{3}\sqrt{3}$, we find $\frac{d^3s}{dx^3} = -10\frac{1}{8}$. This, the first diff. co-eff. that does not vanish, is of an *odd* order (not *even* order, as stated by "A. M."), and there is no max. or min. indicated, but a point of contrary flexure. The curve expressed by the equation for the area (see p. 264) consists of two infinite branches; but in the problem x is always positive, and cannot exceed $\frac{1}{3}\sqrt{6}$ (the diagonal position), so that only part of the curve is included. The vertical position is a maximum in the problem, and the diagonal position a minimum; but these simply represent the extremities of the *part* of the curve referred to, and cannot be found by the usual process of differentiating. If the value $x = \frac{1}{2}\sqrt{3}$ gave a maximum, there would also be a minimum between that and the vertical position, or at least, *one* smaller value of x would give a smaller area than $\frac{3}{4}\sqrt{3}$, the area of the regular hexagon. Can "A. M." give any such smaller value of x, or in any way further elucidate this very interesting problem? W. J. A.

[68557.]—**Carbon Rods, &c.**—The article on p. 300 comes opportunely as an answer to the query on p. 206; but it should be noted that it is not possible to make useful carbon rods and plates without proper plant. High pressures are required, and if the plant has to be procured for obtaining them, it would be cheaper to buy such plates and rods as are wanted. If the querist wishes to enter upon the manufacture as a business, I would suggest that he should go about it in the usual way.
TIMMY.

[68604.]—**Ellipse.**—Both replies to this query are only approximations. It is well known that it is impossible accurately to construct an ellipse by means of arcs of circles, as the curvature continually changes, and the position of the centres would have to change in the same manner. For practical purposes the "string and pencil" process, with which the querist is acquainted, is the best to adopt, taking care not to stretch the string more in one part of the curve than in another. W. J. A.

[68611.]—**Land and Engineering Surveyor.**—I think you will find that instruments used by an engineer or mechanic are admitted to the United States free of duty. But this you can easily find out by addressing the U.S. Minister at London. As to prospects of employment on the Pacific slope, they are fairly good, although not as good as one might imagine. In these days of cheap railroads, one part of this great country can no sooner become short of any particular talent than it speedily has an influx from the sections of country where it is more abundant. Thus there is no crying demand for engineers on the Pacific slope, although in this, as well as in all other professions, there is plenty of room at the top; and an engineer possessing more than average ability, accuracy, and briskness, will have no difficulty in finding employment. But it takes all these to win.
Mandan, Dakota, U.S.A. R. M. TUTTLE.

[68660.]—**Electrical Repairs.**—I thank Mr. Mason for his explanation. At first sight the cell thus saturated with permanganate solution would appear to act as a sort of dry chromic battery; though it is quite possible that there may be some reaction between the permanganate and the original constituents. I would ask some of our chemists to throw a little light on the subject of the chemical action of the Gassner cell. We have—

$$Zn + (HCl_1 + CaSO_4 + OH_2 + ZnSO_4) + C,$$

as the constituents, so far as I have been able to ascertain. W. PERREN MAYCOCK, A.I.E.E.

[68699.]—**Copper Sulphate Deposition.**—On the face of it, the proposition I myself made is absurd. It would be wholly uneconomical, and I am sorry I did not give more attention to the query before committing myself. "H. B. F." places the matter in the true light. W. PERREN MAYCOCK.

[68699.]—**Copper Sulphate Deposition.**—To MR. F. W. MASON.—The abbreviations given refer to the maker's (Messrs. Siemens Bros. and Co., Woolwich) marks of the machine. I fancy Mr. W. Perren-Maycock will find full particulars of the machine in the *Electrical Trades Directory*.
F. W. MASON.

[68711.]—**Great Western Locomotives.**—The hiss, hiss, at every revolution is not peculiar to the above locos. It is caused by the exhaust over-pressure from the pump of vacuum brake.
VOOGHT.

[68714.]—**To Mr. F. W. Mason.**—It is no wonder, then, that "Amateur's" battery current runs down. I thought there was something wrong at first. I know the battery current does run down, but not so excessive as I took for granted "Amateur's" was. The whole fault lies in the non-amalgamation of the zinc plates. "Amateur" had better amalgamate them at once, and then I have not the least doubt that he will have an improvement, for by preventing polarisation of the plate he will be adding materially to the effect of the battery. You can either amalgamate them by dipping the zincs (well cleaned) into sulphuric acid, and then rubbing them well, with a piece of rag tied on a stick, with sulphuric acid and mercury, when the mercury will adhere to the zinc and form a smooth silvery surface of mercury. The process that I myself prefer to this is to take the well-cleaned zincs, dip them into a solution of common salt, and then into a solution of mercuric chloride, $HgCl_2$ (corrosive sublimate), when a lovely mercury surface will be obtained. F. W. MASON.

[68729.]—**Electric-Bell Fixing.**—An electric bell requires $\frac{1}{5}$ ampère to work it (average); therefore, 24 bells in parallel would require 4·8 ampères. Does Mr. Mason mean to say that a current of 4·8 ampères can be maintained by 12 Leclanché cells *in series?* The thing is absurd.
W. PERREN MAYCOCK, A.I.E.E.

[68737.]—**Kitten and Parasites.**—A lady friend tells me that a wash of water and saltpetre will set kitten and carpets all right. C. C.

[68743.]—**Large Tree.**—The bark of the large tree exhibited some years ago at the Crystal Palace was that of the Sequoia gigantea, a species forming a connecting link between the true pine and the cedar. They are found in detached groups in several parts of N. California, as, for instance, in the counties of Mariposa and Calaveras. They grow to a height of 300ft. I measured the circumference of one of these immense trunks in the Mariposa grove in 1870, and found it to be nearly 100ft. at the base, 70ft. 6in. at a height of 8ft. from the ground. A full account of these trees is given in Lawson's "Pinetum," Edinburgh.
Clapham. T. R.

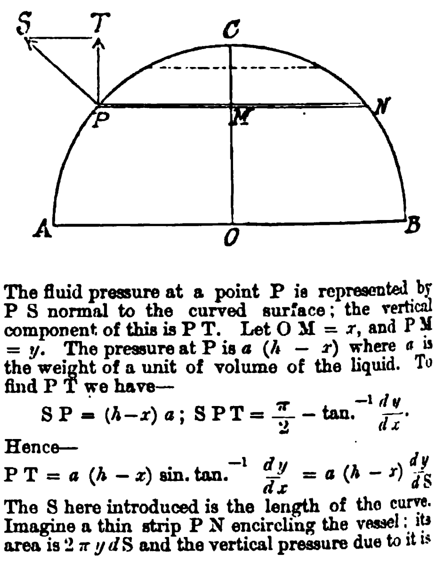
[68743.]—**Large Tree.**—Wellingtonia gigantea was, I believe, the name by which the large tree, represented by its bark only (as the tree itself was too large for transport) in the Exhibition of 1851 was known. It was a specimen of a gigantic species of Eucalyptus. It was cut down in California, and was 14ft. in diameter. A plank of that width would have been sent to the Exhibition, but saws could not be obtained long enough to cut that depth; but two cross-sections were cut from the stem of one of these trees. The larger section, taken at 4ft. from the ground, was 6ft. in diameter, the smaller section, taken at 134ft. (just below the first branch), was nearly 3ft. in diameter. In England we had, about the year 1800, some oak trees remarkable for their diameter—the Fairlop oak, in a glade of Hainhault Forest, Essex, about a mile from Barkingside. The tradition of the country traces it about half-way up the Christian era. In 1800 it was still a noble tree, though suffering greatly from age. About a yard from the ground its rough fluted stem was 36ft. in circumference. Fairlop Fair was held annually under its branches on July 2nd, and no booth was allowed to be erected beyond the extent of its boughs. Another oak tree, known as Damory's oak, stood a little earlier near Blandford, in Dorsetshire, and was probably in its prime about 600 years ago. At the ground its circumference was 68ft.; at 17ft. from the ground its diameter was 4yds., or 12ft., which, taken as a circle, would be equal to a circumference of about 41ft. As the trunk decayed it became hollow, forming a cavity 15ft. wide and 17ft. high. About the year 1743 some of its branches were 75ft. high, and extended 72ft. In 1755 it was sold for firewood for £15. Another wonderful oak tree is, or was, about the year 1800, known as "The Three Brethren Oak Tree," being the largest of three remarkable trees in Whinfield Forest, in the county of Westmoreland, then, and possibly still, the property of the Earls of Thanet. In 1800 it was known to have stood nearly 270 years. The circumference is 14 yards, or 42ft., and nearly the same to the height of 15ft. from the root. There is some uncertainty about the height it attained in its prime, as the top and most of the principal branches have been off for many years, but is supposed to have been 60ft. high in solid timber. On the north-east side is a large entrance, cut and broken out, in the form of a doorway, where people either walked in or rode in on horseback, the space admitting of the horse and rider to turn about at pleasure within the tree. It also formed a shelter for the deer in the park. As this account began with reference to the Exhibition of 1851, it may be opportune, and perhaps interesting to some of my fellow subscribers to the ENGLISH MECHANIC, to mention, as the Eiffel Tower is now an accomplished fact, that a proposal was made in 1852 for the conversion of the 1851 Exhibition building into a prospect tower 1,000ft. high. The design, of which I have an engraving, was by Mr. C. Burton, architect, who stated in his description of it that Messrs. Fox and Henderson, the constructors of the 1851 Exhibition building, "expressed their conviction that the project could be carried out." From this it seems that the Parisian tower is not quite a novel idea. WINDER.

[68745.]—**Tempering Watch Drills.**—Why does not "Young Watch and Clock Maker," if he means to advance himself, take some lessons in drilling from a practical watchmaker? In boring through brass it is best to drill the hole somewhat smaller than required, and afterwards to enlarge it with a broach. Holes broached open in this manner are not only neat in appearance, but are also much more exactly the required size. Besides the cutting broaches, there are also round broaches for enlarging holes by compression. These broaches, as they are made tapering very gradually and regularly, would serve as superior wedges for hair-springs. A WATCHMAKER.

[68754.] — **Aneroid.** — "Henri's" barometer seems to be one called Bourdon's; it is founded on this: A tube of thin brass is flattened and bent in the direction of the smaller diameter to the shape of a horseshoe. If the two ends are closed and a pressure applied from within, the two ends have a tendency to widen the distance between them. If the air is exhausted and pressure applied from the outside, the two ends tend to approach each other, which property is taken advantage of by fixing one end and allowing the other end to move freely: this movement can be rendered more visible by levers The first property is used to make a steam-gauge or any gas-pressure gauge. C. C.

[68760.] — **Hydrostatics.** — "Ignotus" must have read my question rather hurriedly. "T. C., Bristol," instead of asking, has replied to the question. Also, I do not see where the "error" comes in. The query was put in paradoxical form, with the idea of making it more amusing, and there is nothing to imply ignorance of the laws of pressure of fluids in any one submitting such a problem to his fellow-readers. My object was to find what our mathematical readers could give in the way of a short and accurate method of explaining the subject, and "J. R. C." and "W. J. A." have evidently understood the question in this light. The question divested of all circumlocution, amounts to this—Given a hollow vessel of any form, convex side up, with flat base, to show that when filled with liquid the upward pressure is equal to the weight of the liquid which would be contained between the convex surface and the circumscribing cylinder. If the vessel is of regular form, the upward pressure can easily be calculated by the calculus, and I rather expected to see this done.
Bath. M.I.C.E.

[68760.]—**Hydrostatics.**—With regard to this question, it may be observed that equilbrium such as "M.I.C.E." mentions will obviously exist, whatever be the form of the containing vessel, conical, spherical, or otherwise. Suppose A B the base, and A C a curve of any form revolving about the axis O C. Take O for the origin, and let the vessel be filled to any height h above O.



The fluid pressure at a point P is represented by P S normal to the curved surface; the vertical component of this is P T. Let O M = x, and P M = y. The pressure at P is $a\ (h - x)$ where a is the weight of a unit of volume of the liquid. To find P T we have—

$$SP = (h-x)\,a;\ SPT = \frac{\pi}{2} - \tan.^{-1}\frac{dy}{dx}.$$

Hence—

$$PT = a\ (h - x)\ \sin.\tan.^{-1}\ \frac{dy}{dx} = a\ (h - x)\frac{dy}{dS}$$

The S here introduced is the length of the curve. Imagine a thin strip P N encircling the vessel: its area is $2\pi y\,dS$ and the vertical pressure due to it is

$$a\ (h - x)\ \frac{dy}{dS} \times 2\ \pi\ y\ d\ S$$
$$= 2\ a\ \pi\ (h - x)\ y\,d\,y.$$

Therefore, if U denote the aggregate of all such pressures as P T over the wet surface—

$$U = 2\,a\,\pi\int_0^h (h - x)\ y\frac{dy}{dx}dx.$$

This can be integrated by parts—

$$\int (h - x)\ y\frac{dy}{dx}dx = (h - x)\,y^2$$
$$-\int (h - x)\ y\ \frac{dy}{dx}dx + \int y^2\ dx;$$
$$\therefore\quad 2\int (h - x)\ y\frac{dy}{dx}dx = (h - x)\ y^2 + \int y^2\,dx$$

The transformation of the integral can now be effected—

$$U = a\,\pi\int_0^h y^2\,d\,x - a\,\pi\,h\,r^2;$$
$$U + a\,\pi\,h\,r^2 = a\ v.$$

v is the volume of the liquid, for we recognise the integral to be the formula for the volume of a solid of revolution; $a\ \pi\ h\ r^2$ is, of course, the fluid pressure on base. The final result may be stated in words: The algebraical sum of the fluid pressures on base and the vertical components of the pressures on curved sides is equal to the weight of the liquid, or the weight of the block of ice in "M.I.C.E.'s" example. In my figure it is obvious that the negative sign must be given to U since these components act in an upward direction, and the pressure on the base is downward. If the vessel increased in size from the base upwards, the positive sign would apply, for all the pressures would be downwards. If we were to hold a cone, as in "M.I.C.E.'s" case, in contact with a plane surface, then, supposing the cone had no bottom, a force u would have to be exerted by the hand to prevent the cone from rising bodily off the plane.

Portsmouth. A. M.

[68760.]—**Hydrostatics.**—This seems to me a very ingenious but simple question. The secret is the difference between pressure and weight. Water could not exist in a conical form unless it were bounded by the glass or cone which receives the pressure on its sides, having a component in a vertical direction upwards, which component is equal to the weight of the liquid which would be vertically over the sides, if the liquid stood at the same level outside and inside the vessel. Thus the resultant pressure downward caused by the liquid is found by subtracting the upward pressure on the sides from the downward pressure on base, and is, as in other cases, equal to the weight of fluid in the vessel; whereas the ice exists in a solid form on $a\,b\,c$ of its cohesive powers answering to the sides of the conical vessel. Pressure is proportioned to depth, and acts on an immersed body in every direction, upward as well as downward, so that weight is only altered by volume. If a cone of water, as "M.I.C.E." says, is represented in pressure at base by $\pi r^2 b$, so also would the pressure on the base of a cylinder of water be $\pi r^2 b$; but the cylinder of water would weigh more than the cone.

HERMES, C.E.

[68766.]—**Persian Cat.**—Before acting on F. W. Mason's advice, consult one of the Materia medicas of homœopathy as to what is the causative poisonous action of *Cantharides* (Spanish fly) on the human subject. Poor puss would certainly have many a severe "quarter of an hour," to use a familiar French phrase, if the prescription were put to the practical test.

THE LYDNEY DISPENSER.

[68780.]—**Easter in 1827.**—The late Prof. Dr. Gauss, of Göttingen, gave the following simple rule as applicable to the 19th century. 1. Divide the given year number by the three numbers 19, 4, and 7 respectively, and call remainders a, b, and c. 2. Multiply remainder a with the number 19, add to the product the number 23, and divide sum by 30, calling the remainder d. 3. Multiply remainder b by 2, the remainder c by 4, and the remainder d by 6. 4. Add these three products together plus the number 4, and divide the sum by 7, the remainder call e. 5. On adding the two last remainders d and e to March 22, Easter day is found. Example:—

1. 1827 : 19 = 96, remainder a = 3.
   1827 : 4 = 456, remainder b = 3.
   1827 : 7 = 261, remainder c = 0.
2. a3 × 19 = 57 + 23 = 80 : 30 = 2, remainder d = 20.
3. b3 × 2 = 6, c0 × 4 = 0, d20 × 6 = 120.
4. 6 + 0 + 120 = 126 + 4 = 130 : 7 = 18, remainder e = 4.
5. d20 + e4 = 24 + 22 March = 46 days.

Deducting the 31 days of March remains 15 days, or Easter fell on April 15 in the year 1827. It can never fall earlier than March 22, nor later than April 25. In this century it fell only once on March 22—viz., in 1818; and in like manner only once on April 25—viz., in 1886. MARIENBERG.

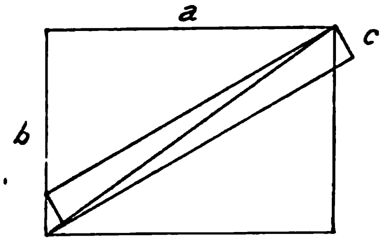
[68795.]—**Gravity Problem.**—By the second law of motion, the pressure on the track remains exactly the same, whether the body be at rest or be travelling slow or fast. If speed could relieve the track from pressure, we might have railways without bridges.

LATRIS.

[68795.]—**Gravity Problem.**—I should imagine that this case is the same as that of a satellite revolving around the earth close to the surface, for if the pressure on track is *nil* the friction vanishes also. Consider a body of mass m revolving in a circular orbit at a distance r from the centre of force—that is, the c.g. of the earth. The attraction of the earth would, at a distance equal to its radius from the c.g., produce an acceleration g in the body corresponding to a centrifugal force mg; but a body of mass m revolving in a circle of radius r with a velocity v has a centrifugal force $\frac{mv^2}{r}$. Hence $mg = \frac{mv^2}{r}$, whence $v = \sqrt{rg}$. In the present case $r = 4{,}000 \times 5{,}280$ = earth's radius, and $g = 32$, roughly, which makes $v = 3{,}200\sqrt{66}$ feet per second. With this velocity the satellite would just revolve without touching or flying off from the earth; but were the velocity greater, it would recede to a greater distance and revolve in an elliptic orbit. The periodic time would be $\frac{8{,}000 \times 5{,}280 \times \pi}{3{,}200\sqrt{66} \times 60 \times 60}$ hours $= \frac{\pi\sqrt{66}}{18}$, or about 1·4156 hours.

Portsmouth, June 8. A. M.

[68796.] — **Mensuration Problem.** — A. W. Lambert will understand the reasoning by aid of sketch herewith. If a be length of the field, b the width of ditto, then length of diagonal is $\sqrt{a^2 + b^2}$. This is also the length of diagonal of the road. If



c be width of road and l its length, then we have $l = \sqrt{a^2 + b^2 - c^2}$, whence area of road $x = c \, . \sqrt{a^2 + b^2 - c^2}$. The area of the remaining portion is, of course, 6,000 − x square feet. The querist will remember that c is $\frac{1}{12}$ foot.

Liverpool. J. C. Q.

[68804.]—**Geology.**—Yes; London Geological Field Class. Hon. Sec., R. H. Bentley, 31, Adolphus-road, Brownswood Park, South Hornsey.

E. A. M.

[68806.]—**Polish.**—With emery wheels, used with soap-and-water.

Bristol. T. C.

[68808.]—**Cement for Boiler.**—Try a cement sold by the Purimachos Cement Co., of Bristol. It has all the qualities of a good Portland cement, and will stand red heat for any length of time. I have used it instead of "fire lumps" for back of grate and boiler bridges.

Birmingham. HALL.

[68808.] — **Cement for Boiler.** — Experience being the best teacher, I think I can put "Cement" in the way of making up the space between his kitchen oven and boiler, and the stone jambs so as to stand. Mortar is of no use, neither is cement, without a backing to press it against, as the iron is thin, and, with the hollow space behind, it cannot be made a tight, firm job. A few years ago I was in the same difficulty—there was a space of from $\frac{3}{16}$ to $\frac{1}{4}$in. to fill up. The man who fixed it put in mortar, which came off the first time the oven was heated. I got strips of thin tin-plate, about $\frac{3}{4}$ or $\frac{5}{8}$in. broad, and worked them into a "flat" with a curve and long bend, the flat part resting on the face of the iron and the curved part to be sprung into the opening. This forms a backing for the cement. I then got some "Scotch" cement at the ironmongers. What the nature of it is I know not, or whether generally kept for sale. It is in the form of a pink powder. This requires to be well kneaded and worked on a warm plate (iron is best) with as little boiled linseed oil as will suffice to make it the consistence of putty. Plaster this on the joint, pressing it well in, and it will set with the heat almost as hard as the metal itself, and, if properly done, will stick there.

Summerest-place, Bradford. J. WILSON.

[68809.]—**Reducing Temperature.**—Procure a large porous bottle, such as those made of terra-cotta, and keep the water in it. This materially cools the water, even if kept in a sick-room. Landing window is the best place. Also add vinegar to water; it much assists evaporation.

J. D. H.

[68810.]—**Numismatics.**—A U, A R, Æ, on the coupling lines are to show the material of the coin, representing Aurum, Argentum, Æs: or gold, silver, or copper (bronze), as case may be.

Liverpool, June 10. W. S.

[68810.]—**Numismatics.**—The letters are A R, short for "ante" (front), "retro" (back). Latin was used in all works on science years ago, being a language known by all educated men of every country, consequently no translating was necessary. The initials here mentioned are instances of this custom still remaining. J. D. H.

[68812.]—**Truing Square.**—If a "Young Turner" wants to prove the truth of his squares at any stage of their manufacture, he may set the stock of his square against the planed edge of the surface plate or drawing-board, and rule a fine line close up to the blade and the full length of it; then turn the square over and rule another line—say one-sixteenth from the other. If his square is true, these lines will be parallel. If they are nearer at the stock end than the blade end, it will show that the blade is at a less angle than 90° with the stock; if further, then more than 90°.

Birmingham. HALL.

[68813.]—**Dog-Cart Brake.**—Messrs. Casson (I think this is the name), coachbuilders, Malvern, have a good patent for one; it would meet the querist's needs. The Bristol Waggon Works Company also have another patent, possessing some merit. There is, however, still plenty of latitude for invention on the same lines, a matter that every now and then is, owing to the steep, sharp gradients of the hills flanking the Channel, brought rather forcibly to the notice of

THE LYDNEY DISPENSER.

[68814.]—**Best Shoe for Harness Horses.**—May I repeat what I have said before in these columns and in the daily papers—viz., that the present form of shoe is unnatural and unscientific, and to it may be attributed 99 per cent. of the accidents which occur upon the asphalted streets here in London, and a large number of cases of lameness, &c., constantly met with in horses all over the country? There are two kinds of shoe which have come under my notice, and seem worthy of the consideration of all who own or use horses. First, the "rational shoe," which is an improvement upon the original "Charlies," too well known to need description; and secondly, one invented and kindly shown me by Admiral Selwyn. This latter consists in a band of steel fastened round the outside of the horse's hoofs by small screws, the lower edge of the steel band being level with the bottom of the hoof. Both these forms of shoe allow the frog of the foot to grow naturally, thereby forming a soft pad on which the animal treads, and which entirely prevents his slipping, no matter whether the road be greasy, asphalte, or frosty. The latter patent (Admiral Selwyn's) has to my mind one very great advantage—viz., that it dispenses with the necessity of driving the usual long nails or pins through the sensitive lamina of the horse's feet. I trust that the above somewhat meagre information may be of at least some little use to your correspondent.

HERBERT WILKINS.

[68815.]—**Portable Musical Instrument.**—The English concertina answers "Honduras'" requirements best. It is easily learnt with practice. An instrument called melophone is next best, and has keys like piano; gives rich tone resembling harmonium. J. D. H.

[68816.]—**Indicator.**—By the diagram you appear to be admitting steam up to $\frac{3}{4}$ths of the stroke. I don't see how you can add more power, except by still further taking steam; but then comes in the question of speedy release at the end of the stroke. Your diagram offers, I think, a good field for the services of a condenser.

Birmingham. HALL.

[68816.]—**Indicator.**—The only way you can get more power is by driving faster and gearing down, unless you can raise the pressure. The power is calculated correctly; but the diagrams show that the ports are not opened sufficiently wide, or else the steam is throttled somewhere, and the cut-off valve leaks badly (if, as I understand, the cut-off is at about $\frac{3}{8}$). If you ran faster and had more cushion and a better cut-off, you should get more power from the same steam, which is now being exhausted at about 37lb. The engine is evidently overloaded at its present speed.

Bristol. T. C.

[68819.]—**Magnet.** — Horseshoe soft-iron core $\frac{1}{2}$in. diam.; length of each limb 2in., wound with No. 28 B.W.G.—about $\frac{1}{4}$lb. on each bobbin. Wire should be silk-covered (double). Use three No. 3 Leclanché cells if for intermediate work; but if for continuous I should advise four Daniells.

F. W. MASON.

[68820.]—**Telescope.**—If "G. G. B." can refer to the "E. M.," May 9, 1884, page 209, he will see an observing-chair figured, with description. There is an error in printing in the last paragraph but one, it should be "D 1$\frac{1}{2}$in. thick." There would be no difficulty in putting castors on the three legs of his altazimuth stand. They should be strong brass, the wheels about 1$\frac{1}{2}$in. diam. They will move easily when nicely oiled, but will be rigid enough to require no clamping. They will raise the stand 2in., but before cutting this off the legs, if he wishes to do so, it might be well to try them first on their present length. Calver's larger instruments are often made with a wheel in one of the legs; but I see no objection to the three if it is used only on a floor.

Fordingbridge. T. WESTLAKE.

[68824.]—**Foot Lathe.**—The pulley will do for size; but I much prefer a gut for a foot lathe, as the strap has to be very tight, or else it slips under a heavy cut. Wheel, 20in. to 22in. diam., and 90lb. to 100lb. Suit yourself about another wheel afterwards.

Bristol. T. C.

[68824.]—**Foot Lathe.**—The sizes and widths of the pulleys are not out of proportion for a 7in. foot lathe. I don't consider a flat band at all disadvantageous for a lathe of this size. Your pulley on the crank-shaft should be from 80 to 90lb. weight, in which case you would not require a flywheel. I am afraid you will find a 7in. back-geared lathe will treadle somewhat heavily. I find that my 5in. Britannia wants all the power I can give it at the treadle with a moderate cut "on."

Birmingham. HALL.

[68827.]—**Resistance Box.**—The way I prefer to do this is to screw the brass down to a bit of common wood, and then cut it, then unscrew, and screw into the resistance-box. F. W. MASON.

[68827.]—**Resistance Box.**—First, the castings must be filed and planed up; the plug-holes are then marked off and drilled. Not till after castings are "planted" and ready for cleaning up should they be cut. W. PERREN MAYCOCK.

[68830.]—**Cutting Sheet Iron into Strips.**—A pair of circular cutters, having an adjustable "fence" or guard, is what you want. If you do not make them yourself, you can get everything you want in this direction from W. G. Garnett, Bradford-street; Kendricks, 25 and 26, Rea-street; Linnett and Co., 9, Smithfield-street; Winn and Co., Commercial-street. These are all tinmen's tool-makers, and all of this city.

Birmingham. HALL.

[68834.]—**Mercurial Ointment.**—Mercury and prepared lard, 1lb. each; prepared suet, 1oz. Not so good as lard and lime, and, of course, far more expensive. J. D. H.

[68834.]—**Mercurial Ointment.**—Some years ago I used a large swivel punt-gun for shooting wild fowl on the sea, and always covered the gun with a coat of mercurial ointment before going afloat. I certainly found it the best preservative against rust of any of the nostrums I ever tried.

H. A.

[68834.] — **Mercurial Ointment.** — I do not know of any cheap ointment of this; but you could use the following—it is one that I have heard has been very successful. Mercuric chloride, 2 drachms; oil origanum, 1 drachm; linseed meal, 2oz.; lard, to proper consistence. Dissolve mercuric chloride in little water in mortar, add linseed, rub well down, then add oil, rub down again, and then finally rub down with lard; 1lb. could be made for about 2s., or 2s. 6d. F. W. MASON.

[68836.]—**Bootmaking.**—"Nitram" has purchased a white elephant and does not know what to do with it. Neither "Jack of All Trades" nor anyone else can give instructions in bootmaking by letter. He had better hand over the French calf and English butt to a practical man and see him go through the whole process, and he will soon find out that bootmaking is not so simple an operation as he thinks. E. BARRETT.

[68838.] — **Great Western Broad Gauge Engines.**—The engine "Prometheus" was built at Swindon in 1888. It is a single engine, with 8ft. driving-wheels. This is the largest driving wheel the G.W.R. use; all the broad-gauge singles have this size. The G.W.R. are apparently not giving up making engines of this gauge, as towards the end of 1888 a large batch of 4-c. (leading and driving-wheels coupled) saddle-tanks were turned out at Swindon, which now are used on the Devon and Cornwall lines. I may here mention that the list given by "Gorgon" (on page 286) is not absolutely complete. He has omitted to mention "Pluto," 4-c., tank, Newton Abbott shed, and Saunders, 6-c., tank, Bristol shed. I have noticed both of these engines on the line very recently. In April, "Prince" was being repaired in Newton Abbott Works, so I should hardly think it has ceased to run. It is also a 4-c. tank. I forgot to mention that No. 16 4-c. passenger broad-gauge tender was built at Swindon in 1888, so that it is also comparatively new. W. E. C. B.

[68839.] — **Cleaning and Polishing Marble.**—Use mixture of soft soap, solution of potash, and slaked lime (to form a paste), spread over the marble, leave it for two days, and then wash off with hot water. F. W. MASON.

[68839.]—**Cleaning and Polishing Marble.**—If "Elektron" will refer to Nos. 367, 389, 408, and 2315 in "Enquire Within" (1887 ed.), he will find recipes for cleaning marble. I have tried them all. I like 408 the best. 367 would suit outdoor marble very well, and would perhaps answer in the case of query 68831. The borax recipe (2315, "Enquire Within") is not very active, but is useful for delicate and somewhat soft marble.

Birmingham. HALL.

[68845.]—**Paper Battery Cells.**—If the construction of these was thoroughly seen to, and the paper layers about ⅛in. thick, the cells might answer.

F. W. MASON.

[68845.]—**Paper Battery Cells.**—Yes; but waterproof paper would be the most suitable. Many years ago, during the three years I was studying the actions of electricity on the human body (causative and curative), I required some square cells à la Leclanché, which would be nominal in weight and thickness; accident suggested that these cells would suit if made of the same materials as the shells of silk hats—i.e., canvas and shellac. Messrs. Marsh, hatters, Bristol, made two specimens for me which suited admirably, the dimensions being 6in. long, 2in. and 3in. square respectively. Of course the cells were to be packed in a box, so as to have the sides supported. My experiment with these cells was, however, cut short, owing to a continuous current from a battery of the Silvertown Daniell cell being placed at my service.

THE LYDNEY DISPENSER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last A. F. Shakespear has replied to 68164; W. Perren Maycock, 68210, 68237.

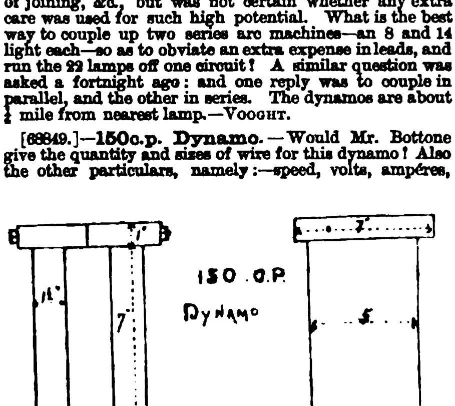
68277. Reflector, p. 121.
68290. B. Pumping Ram, 121.
68301. Hydraulic Pressure Gauges, 121.
68304. Lapping Gold Alberts, &c., 121.
68306. An Unbutton Hook, 121.
68309. Boiler Coating, 122.
68311. Induction Coil, 122.
68312. Saw Setting, 122.

68476. Marine Boiler, p. 204.
68494. Boot Repairing, 205.
68498. Gaiffe's Pocket Medical Chloride of Silver Battery, 205.
68504. Piston Rings, 205.
68514. Albatross Breast, 205.
68525. Movable Stereoscopic Pictures, 206.
68529. Glass Gauge, 206.
68531. Brighton Railway Engines, 206.
68546. Microscope Exhibition, 206.
68551. Ventilation, 206.
68553. Problem, 206.
68554. Railway Accident, 206.

QUERIES.

[68848.]—**Coupling Dynamos.**—To "ENGINEER, GOVAN."—Many thanks for reply. I know usual modes of joining, &c., but was not certain whether any extra care was used for such high potential. What is the best way to couple up two series arc machines—an 8 and 14 light each—so as to obviate an extra expense in leads, and run the 22 lamps off one circuit? A similar question was asked a fortnight ago: and one reply was to couple in parallel, and the other in series. The dynamos are about ¾ mile from nearest lamp.—VOOGHT.

[68849.]—**150c.p. Dynamo.**—Would Mr. Bottone give the quantity and sizes of wire for this dynamo? Also the other particulars, namely:—speed, volts, ampéres, and horse-power wanted. I wanted to wind four coils of wire round F.Ms., and bring the ends to the top, and connect as a series, shunt, or compound. Could this be done with one gauge of wire—if not, please give quantity of wires for compound machine?—ZERATE.



[68850.]—**Astronomical.**—Can any one oblige me with recent measures of ξ Ursæ Majoris, and ι Cassiopeiæ?—EDWARD M. NELSON.

[68851.]—**Cool Shop.**—I want to keep my shop—a provision and butter business—cool during the summer, especially at night, when the gas is alight. Which is the best and most economical way? Can I have a fan in the cellar, with pipes in front, to come into different parts of shop, so as to distribute the air. Can it be worked by weights, or by a jet of gas? Do the fans give more air than a wheel made in the shape of paddle-wheel of boat? Any answer or idea I shall be thankful for. My address is in the Address Column, if any one will send me any illustrations.—PROVISIONS.

[68852.]—**Bacon.**—Which is the best way to abstract salt from bacon and hams before boiling? Is it best to soak in the London or soft water?—if the latter, which is the best way to soften water; and is there anything that will abstract the salt when frying rashers?—BACON.

[68853.]—**Neat's Foot Oil.**—I wish to obtain a pure oil from the Neat's foot oil, as sold at the small shops where cowheels, &c., are sold. I try to pass the oil as bought from the shop, through ordinary filter paper. This, however, is not a success. Then I use cotton wool; neither is this a success, unless I first heat the oil to [illegible] or 90° Fahr., when, of course, the opaque mass which is sold as oil at the shop becomes very liquid and transparent, and passes through the cotton wool, but [illegible] is filtered out by doing this, and when I allow the stuff to cool again to about 55° or 60° Fahr. it resumes its original state, being opaque and semi-solid. I have tried to deposit the solid matter by immersing strips of lead in the oil as bought. This is certainly a success, but deposition is going on for months, and the remaining clear liquid, from a pint of the original as bought, after being washed with bichromate of potash to clear away any dissolved lead, does not amount to many teaspoonfuls—about 6. I want a filtering medium that would take out any solid at ordinary temperatures, say, 60° Fahr., so that in using the filtrate for oiling dynamo, motor, or suchlike bearings I may use the best oil possible, and such that it will not swath the machine up. Of course I can mix paraffin with the oil; but I want animal oil alone, if possible, and clear as the oil used for sewing machines.—M. E.

[68854.]—**Corn Solvent.**—I am desirous of making some corn solvent composed of salicylic acid and collodion. Will some kind reader give me the necessary instructions through the columns of the ENGLISH MECHANIC, with the proportions, and time of saturation, &c?—L. S. [illegible]

[68855.]—**Steel Bronze.**—Will some correspondent give the process of bronzing brass work—the steel bronze—and also the red bronze?—BRASS FINISHER.

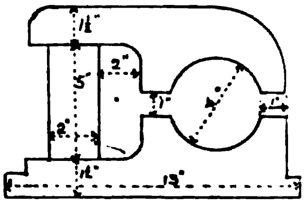
[68856.]—**Transmitters.**—To MR. BOTTONE.—[illegible] you describe the Hunning's transmitter, or the [illegible]? A sketch would greatly oblige, with detailed construction, one who is in a fix.—SILVER KING.

[68857.]—**Beaters.**—Can any reader inform me the relative merits of a two or three-bladed beater, as applied in scutching machines?—C. I. F.

[68858.]—**Horses.**—I have to look after a number of underground horses, and am most anxious to know of a good practical book treating on their diseases, cures, and also the cost of same, and by whom published?—HORSE-KEEPER.

[68859.]—**Cutting Blocks of Wet Glue.**—Can any reader inform me if a machine is made for cutting blocks of wet glue into sheets for the purpose of drying? —GLUE.

[68860.]—**Dynamo.**—Would Mr. Bottone give me his opinion of this type of dynamo? I don't know whether the sizes are well relationed—if they are, would Mr. Bottone tell the quantity of wire and sizes of the same for F.M. and armature? How many revolutions per minute should it be driven at? How many volts and ampères? What H.P. required, and what c.p.?—ELEKTRON.



[68861.]—**Testing Lubricating Oil.**—I have some samples of lubricating oils. Can any kind reader tell me the best way to test them?—A. FOX.

[68862.]—**Animal Charcoal.** — Will any reader advise me as to a practical method of preparing the above? Also a sketch of furnace or retort, and value (if any) of use of by-products. I want to draw and recharge the furnace while hot.—A NEW SUBSCRIBER.

[68863.]—**Electro-Motor.**—To MR. BOTTONE.—I wish to make an electro-motor of 1H.P. Would you kindly tell size of armature and field-magnets, size and quantity of wire on same? Also what battery?—P. C.

[68864.] — **Quadrant Link Governor.** — Will "T. C., Bristol," or "Glatton" kindly tell me if it is possible to govern an 8H.P. portable engine with an ordinary slide-valve?—YOUNG ENGINEMAN.

[68865.] — **Essence of Vanilla.** — Would any practical chemist kindly tell me how to make essence of vanilla? I want to make it from the real vanilla bean.—CYMRO.

[68866.]—**Opening Pipes.**—I wish to cut open, longitudinally, some old wrought-iron, steam or gas tubes, 2in. to 3in. diam. Can any reader suggest some kind of apparatus or machine that would do this?—SWINTON[illegible]

[68867.]—**Amber Varnish.**—Can any of our chemical friends tell me how to fuse amber, or give me formulæ for coloured amber varnishes for violins? Will be glad to have one or two.—NEW SUBSCRIBER.

[68868.]—**Immersion Objective.**—To MR. E. M. NELSON.—I have a very fine 1-16 water immersion object-glass of Seibert's, N.A. ·996? Would any advantage accrue in its use by substituting oil of cedarwood for water, or would any damage be likely to result by reason of the action of such oil on the cement used in the making of the object-glass? I have somewhere seen a statement to the effect that these homogeneous oils can be used with safety on such objectives as have their fronts specially cemented. Is such statement well founded?—J. F.

[68869.] — **F.M. for H Armature.** — To MR. BOTTONE.—I have a solid H armature, 1¼in. diam., [illegible] long, excluding end plates. Wire space 1in. broad, [illegible] depth and also quantity of wire unknown. Wound with No. 16 d.c.c. What quantity and size of wire should the single core of the F.M. be wound with? Core [illegible]in. by [illegible] diam. Would it be best to rewind A. to light [illegible] lamps, and with what quantities and size could I obtain 12 volts, and what speed?—W. L. W.

[68870.] — **Slide-Rest on Gap-Bed Lathe.**—I have a 8in. gap-bed lathe with slide-rest. Owing to the gap-bed, however, I am unable to place the slide-rest sufficiently close to the mandrel to turn articles within 3in. of mandrel. If any one can inform me to overcome this difficulty, they will greatly oblige.—A STRUGGLING AMATEUR.

[68871.]—**Telescopes.**—Will any of our correspondents who have personal or theoretical knowledge of Gregorian and Cassegrain telescopes, give me a little information about the eye-hole or pin-hole? What is the rule for its size and its distance in front of eye-glass? As it is not used in Newtonians, I suppose its only use is to stop out the light which comes on to the eye-piece direct—that is, not reflected from the mirrors.—A. H.

[68872.]—**Guarnerius and Amati Violins.**—Will some of our fiddle friends give me the proper thicknesses of backs and bellies of Amati and Guarnerius violins? A sketch showing where the thicknesses merge into one another would be very welcome; also proper proportions for a good 'cello.—NEW SUBSCRIBER.

[68873.]—**Gearing Facile.**—I have an ungeared Facile which I wish to gear. Will some one kindly tell me how I can do this?—MEMBER OF P.F.C.

[68874.]—**Bichromate Bottle Battery.**—Will Mr. Bottone or other of our electrical friends kindly tell me how to fasten carbons to the brass flanges of the bottle bichromate battery?—LOUGHBURIAN.

[68875.]—**Motive Power.**—Will any one kindly state how many horse-power would be exhausted by raising 1cwt. 30ft.?—also how many horse-power would be exhausted in holding it there twenty minutes?—NO SIG.

[68876.]—**Horse-Power of Engines and Boilers.**—What is the best and quickest way to calculate the horse-power of an engine, an ordinary mill-engine, and also locomotive engines; also to find out the horse-power of a boiler 35ft. long, 5ft. diameter, with two 18in. flues? I am chief engineer of the sugar hacienda, Tomasiri, and have a lot of boilers and engines. I should like to find out the horse-power of my engines and boilers.—EDWARDO SNOWDEN, Ingeniero de Jefe, Hacienda Tomasiri, Sama, c/o. Senor Don Santiago Diaz, Tacna, Chile, West Coast South America.

[68877.]—**Plaster of Paris.**—As this substance is likely to come into extensive use among electricians for the manufacture of Gassner cells, some exact data regarding its chemical behaviour would be very valuable. Calcium sulphate ($CaSO_4$) occurs in nature combined with two molecules of water ($2H_2O$), and is in this form known as selenite, gypsum, or alabaster. If heated moderately it gives off its water, and becomes plaster of Paris, and this readily combines with the two molecules of water, and sets to a solid mass. What, therefore, is the difference (except in name) between $CaSo_4$ and plaster of Paris; and between selenite, gypsum, or alabaster, and set plaster of Paris? If none, it would seem to follow that by heating old plaster casts, one could drive off the water, and get the original unset plaster.—W. PERREN MAYCOCK.

[68878.]—**Lightning Conductors.**—Will some correspondent kindly say if there are any instruments which could be made and used by an amateur for testing lightning conductors? Great accuracy would not be required. If I were to connect a No. 18 silk-covered copper wire to the top of conductor, and another similar wire to water-supply pipe, then using a small battery and an electric bell, if the bell rings will that be sufficient to show that the conductor is in good order? The particular conductor which I wish to test is branched, the join being about half-way down. Will it, therefore, be necessary to test the resistance more accurately? If so, how can I do that?—JOINER.

[68879.]—**Accumulators.**—I have endeavoured to avoid writing, and made one from advice given in back numbers, and have failed, not from lack of instruction, but from too much. I tried to make a spiral form one. One writer advised minium and sulphuric acid to be mixed, to form a paste, and laid on thick; another minium and dilute sulphuric acid, to be similarly used. I used 1 in 8, dilute; for the term "dilute," unless used as in the Pharmacopœia, is indefinite. The result was, I was able to get 1lb. on each plate; but on trying to roll it when dry, found it a light, friable powder, which flaked off in masses on the least attempt. Where have I gone wrong, and is this method inapplicable to the spiral form? What is the E.M.F. of an accumulator? Would Mr. Bottone take notice of this query, or any one whom he has helped?—J. D. H.

[68880.]—**Gramme.**—To S. BOTTONE.—Many thanks for answering my questions. I would take your advice, and make a Siemens H; but never having seen one, I do not quite understand the shape of F.M. or body of machine. If not too much trouble, a slight sketch would make it clear. You say I should want less wire. Where would be the difference? Which way should I commence winding the F.M., and number of revolutions per minute? May I trouble you with the following question? Could I light one 6 or 4 volt lamp for the space of one minute at a time, at intervals of one hour or more, with a Leclanché battery? If so, what number of cells?—or should I require a smaller lamp, as I do not want to use any other than Leclanchés. Is manganese steel better than wrought iron for a small armature?—it is more soft and pliable.—A BEGINNER.

[68881.]—**Link Motion.**—Is not the ordinary link motion, with all its simplicity and comparative freedom from derangement, a theoretically imperfect contrivance when the sliding block is situated at any intermediate position? When the block is at either end of the link, the valve-rod receives only the motion of the eccentric whose rod is jointed to that end, but in any intermediate position partakes of a motion compounded of the motions of the two eccentrics, because the latter are not situated diametrically opposite to each other, and, therefore, has its motion modified or interfered with by the eccentric with which it is, so to say, not in gear. Is this so, and was not the valve gear of Gray, which preceded the link motion, the more theoretically perfect, as only one of the two eccentrics acted at one time on the valve rod, whatever the travel of the valve?—SEMAPHORE.

[68882.]—**English Concertina.**—Thanks for your reply, "Regondi." Please add to my obligations by explaining the construction of bowing valves. I am ashamed to own that through my ignorance I have never heard of them. An explanation of the effect I mentioned in the latter part of my inquiry would also greatly oblige.—JOS. LEANEY.

[68883.]—**Bath Enamel Paint.**—Many makers advertise a white enamel paint for baths that will stand hot water. Can any of "ours" say if this is true, and if so, what is necessary to be added to the usual zinc white and varnish of the common enamel paint to make it stand the hot water (without stoving)?—B. SC., Plymouth.

[68884.]—**Enamel.**—What is the name and composition of the most durable enamel for coating metals? Can you give the name, publisher, and price of any standard work on enamelling?—EL GAUCHO.

[68885.]—**Metallic Durability.**—I would be highly pleased if some kind correspondent would state the name of the metal or alloy which would last longest when exposed to a slow and gentle state of friction? In what ratio towards it do the other metals stand?—EL GAUCHO.

[68886.]—**Converting Verge Watch into Lever.**—Will H. Wakes or "Irish Horologist" answer the following? I have a good verge watch movement and case. I should like to try my hand at turning it into a lever. First what wheels should I have to take out, and what tools should I require? I have turns and burnishers and files? What calipers to pitch the escapement, and how should I get the proper number of teeth in the new wheels, and whether I could get the new wheels ready for pivoting in, and whether I should have to have a depthening tool? I have a lever watch case that has the knob broken off. I have tried to solder it on with silver solder and borax, but it would not hold.—YOUNG WATCHMAKER.

[68887.]—**Gnats.**—Is there anything that will prevent gnats stinging one?—A. F. SHAKESPEAR, Dresden.

[68888.]—**Bicycle Spokes.**—Can anyone tell me of a speedy way of finding the exact length of spokes required to build up a wheel? Also how to tap the same, so that when screwed in hub no thread will be visible outside? There must be some other way than measuring from an approximate centre. I have sometimes lost a week, and my temper as well, trying to find length of spokes for 30in. wheels by this method.—A. F. SHAKESPEAR, Dresden.

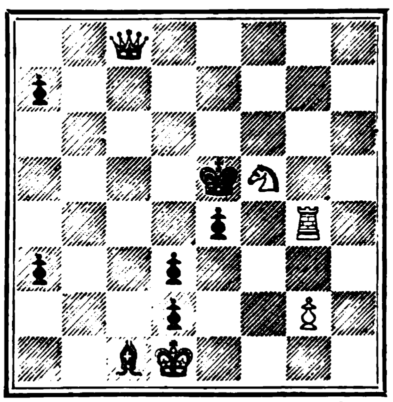
[68889.]—**Curious Railway Management at Birkenhead.**—Three carriages leave Chester G.W. station at 12.15 to be attached to the fast train from Birkenhead, which stops for this purpose outside the station. These carriages are drawn by an engine, which consequently has to get out of the way before the Birkenhead train can back on to them for screwing up. No doubt there is some good reason why the carriages are not pushed by their temporary engine, right up to the Birkenhead train, as soon as the latter stops. For that would obviously save one or two minutes. Can anyone explain what this reason is?—ANTARES.

CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLIII.—BY W. GLEAVE.

Black.



White. [5 + 7

White to play and mate in three moves.

SOLUTION TO 1,151.

White.	*Black.*
1. Q-K 3.	1. Anything.
2. Kt or Q mates.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,151 by W. Gleave (fairly good), F. C. Cook, J. Kilbee, Fr. Fernando, J. W. Read, R. T. Hood, T. A. Pringle, A. Dean, Muzio, and J. E. J. Smith; to 1,150 by J. Kilbee (but 1. P-K 7 will not do, as there is no mate if 1. R-Q sq), J. E. J. Smith (2), H. Warren, and B. Green (but if 1. Q-Q Kt 8, R takes B).

T. A. PRINGLE.—Yes; 1,149 is in section A.

PROBLEMS received with thanks from T. A. Cook, J. Keeble, and Black Pawn.

H. V. TATTERSALL, AND MENDELSSOHN.—1,151 is a two-mover; see notice in last number.

Mr. J. M. BROWN has kindly offered as another extra solution prize the twelve numbers of the *British Chess Magazine* for 1888.

A CURIOUS feature in ornithology is reported from Eckington, Yorkshire, where a hen has hatched two chickens from one egg, both chickens being in a perfect state, except that they are joined together on one side of the membranes of the wing.

ANSWERS TO CORRESPONDENTS.

. *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

. Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 12, and unacknowledged elsewhere:—

W. A. RYAN—R. G.—T. McClelland—R. O'Hara—Footplate—Jim—G. P. O.—A. B.—J. A.—G. F.—Thanks—Wm. Taylor—M. Burrows—D. G. J.—J. Higginsen, jun.—J. H.—Young Amateur—E. C. Owen—Lux—Tredagh—D. G. T.—W. P. Maycock.

HENRY J. PYWELL. (Why not study the textbooks or the cyclopædias, and obtain a little elementary information? As a "matter of fact," June 24 is Midsummer-day, not June 21. We agree with you that "accuracy in scientific and astronomical notes is to be wished for," and we believe we supply accurate information. We are always pleased to have errors pointed out, and sorry they should have been made; but, really, critics should know a little of the subject they write upon. 2. You "presume" wrongly. There is the Royal Society and also the Royal Astronomical Society, as you might have seen in the very work you quote. We referred to the President of the Royal Society, not to the President of the Royal Astronomical Society.)—RETINA. (We have frequently explained that the "black dots" before the eyes are known as muscæ volitantes, and in the majority of cases will not be seen unless they are looked for. They are of no importance. Take open-air exercise.)—MAGNET. (They are not hermetically sealed, as even when capped with brass there is a pinhole through the metal. The directions for making the so-called storm-glasses have been frequently given; but one is easily made. Take a thin glass tube, ¾in. in diameter, and about 12in. long, and put into it the following solution, covering the end with bladder or with a brass cap having a pinhole through it:—Dissolve 2 drachms of camphor, 1 drachm of salammoniac, and 1¼ drachm of nitre in 2¼ fluid ounces of proof spirit. Place in the tube so much as will occupy three-fourths of the length, and close with bladder, or with a cork or brass cap having a fine hole through it.)—ARCHITECT. (The Forth Bridge is being built on the cantilever principle. Full details have been published many times in our columns and elsewhere.)—W. VAN EYS. (Full particulars can be obtained from Dr. G. W. Hambleton, Dorchester-place, Blandford-square.)—J. J. (The subject has been debated several times; why not get some friends to try whether four men can lift another by means of their fingers while inhaling their breath? That would be a scientific experiment, and might be instructive.)—O'M. (Why not refer to the indices of back volumes, or to the textbooks? It is simply impossible to print the "world" of science every week at the behest of every correspondent who does not care to look for the information he requires.)—FRUSTIVE. (We do not know whether we have your signature correct; but we do know that your question is answered definitely in works on mensuration.)—WATER. (See recent numbers about water-motors. Several designs have been recently described, and if you watch the columns you may possibly find one that will suit you. But please see Hint No. 4 above.)—J. H. W. (We do not know of a treatise devoted to hot-air engines. They are described in several works dealing with the subject of motive power, and you will find much about them scattered through back volumes.)—T. M. (Momentum is the mass of any body multiplied by its velocity in units of distance.)—H. C. S. (We should have nothing to do with the society named.)—G. K. (Mr. Edison was born in 1847.)

All in Search of Health should wear HARNESS' ELECTROPATHIC BELT. It is guaranteed genuine, produces no shock, is comfortable to wear, and has cured thousands of sufferers from Rheumatic and Nervous Affections, Liver and Kidney Diseases, Functional Disorders, &c. Book of testimonials, pamphlet and advice free on application to the MEDICAL BATTERY COMPANY, Limited, 52, OXFORD-STREET, LONDON, W. Those who cannot call should write at once, and procure one of these invaluable health appliances.

THE Mannesmann process of manufacturing steel tubes by rolling is now pretty well known in this country, and by it it is easy to form a cylinder closed at both ends, in which case the interior of the tube, on cutting into it, is found to be full of some gas. This gas has recently been analysed, with the result that it was found to consist of 99 per cent of hydrogen and 1 per cent. of nitrogen. The steel which was made was found to have the following composition in parts per 100: Carbon, ·46; silicon, ·25; phosphorus, ·022; sulphur, ·01; manganese, ·23; with traces of copper.

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Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

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Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

Haydon and other Cutter Bars for Metal Turning. Guaranteed to work efficiently under all circumstances. New Cutter Bar List free per post.—EDWARD HINES, Griffin Works, Norwich.—[Advt.]

Holloway's Pills should be kept in readiness in every family. They never cause pain or irritate the most sensitive nerves, or most tender bowels. Holloway's Pills are the best known purifiers of the blood, the most active promoters of absorption and secretion, whereby all poisonous and obnoxious particles are removed from both solids and fluids.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Important,—All kinds of **Scientific Properties,** Apparatus, Instruments received for others or cash by A. Caplatzi, Chenies-street, Tottenham Court-road.

Referee **Safety Bicycle,** nearly new; also 2 genuine Demons. Will be sold cheap for good exchange. Inspection invited. Seen any time.—George Thurling, 64, Long-lane, West Smithfield, London, E.C.

Will post "**English Mechanic**" punctual for exchange. Offers invited for a term. Send list for exchange.—G. Howard, 56, Percival-street, Clerkenwell.

Bicycle wanted, Safety preferred, in exchange for 4½ back-gear Lathe, face-plate, two chucks, and tools.—13, High-street, Wells, Somerset.

Exchange 3lb. No. 12's **Cotton-Covered Wire,** 1lb. No. 18's Electric Bell Wire, "Bottone's Book on Electric Bells," for 18's or 36 Silk-covered Wire.—R. Newell, 12, Cheapside, Todmorden.

Wanted, Gem Air-Gun. Exchange only. Small Microscope and Slides, quite new, and value 30s.; approval.—Henry Ebbage, 344, Caledonian-road, London.

Breeches Bible, 1615; "Salmon's English Physician," 1693; "Curia Politiæ," 8 portraits, 1673; "Bolingdonensis," 1590; English Mechanic, Vol. VII.; "Carpenter and Builder," Vol. I. Offers.—A. Wood, 9, Richmond-road, Shepherd's-bush, W.

Perfectly new genuine high-class Coventry **Rover** Safety, latest 1889 improvements. Would exchange Bicycle or Tricycle in part payment.—2, Ansford-road, Castle Cary, Somerset.

Wanted a good ½-plate R.R. Lens and Shutter. Also a good ½-plate Camera. State wants.—W. Paton, Weaste, Manchester.

Hull of Model Steamer, 3ft. 6in. long, beautifully built. Exchange Boiler Mountings for Model Boilers, and ½in. bore Slide-valve Vertical Engine, pumps, &c.—F. Cooke, Elm Brewery, Southsea.

6½in. **Silver-on-Glass Reflector,** three eyepieces, finder, rigid iron altazimuth stand, slow motions. Exchange for Microscope, or value of £6. Bargain.—White, Sadowa Cottage, South Grove-road, Walthamstow.

Circular Plate-glass **Electrical Machine,** gives 1in. spark. Exchange for Banjo, Guitar, or offers.—Herbert Whiteley, 399, Victoria-street, Grimsby.

Superior set **Screw Stocks and Dies,** ⅜in. to 1¼in., with pair taps to each size. Exchange offers to value of 40s.—H. B. Massey, Spalding.

Wanted, Beasley's Druggists' General Recipe Book. Offers.—G. Annette, Cockshott-road, Reigate.

Wanted, Bottone's "Electrical Instrument Making," also book on the making of the dynamo. Exchange books.—J., 13, Brook-street, Wycombe.

Wanted, Self-centring Drill Chuck to take ⅜in. drills, perfect condition. Exchange only.—Chuck, 39, Roman-road, Bow, E.

Wimshurst Machine, new, and quart Leyden Jar, cost £3 15s. Exchange for Electrical Sundries to value 25s., part cash.—W. Rose, 2, Commercial-road, Lowestoft.

25c.p. Gramme Dynamo. Exchange for Square Cells about 5 or 6in. deep.—H. Boden, Walmer-place, Old Trafford, Manchester.

Liebig's **Condenser,** new. Will exchange to value 5s., anything useful; cost nearly double; lady's work box preferred.—John Collinge, John-street, Middleton, near Manchester.

Lathe Bed, 5ft., iron standards, 14in. headstock, T and tailstock, for wood turning, power. Exchange offers to—W. Smith, Bilston-road, Wolverhampton.

Lathe Wheel, Crank, and Treadle, 6in. Slide-rest, lot Bicycle Rims (Avery's), 4cwt. Platform Machine, lot Perambulator Wheels, 20in. axles, complete. Offers.—William Smith.

Wanted, "Machine Shop Practice," by Jos. Rose. Exchange Tools or Engineering Works.—H. B. Massey, Spalding.

Pair of 8in. Back-geared **Lathe-Heads,** also Lathe-Bed, planed, 6ft. 9in. long, 9in. face. Wanted, good offers. Stamp reply.—Sedoley. Below.

8in. centre **Saddle and Slide-Rest,** complete, with rack and pinion to suit the above. Offers. Stamp reply.—Sedoley, Witton-lane, West Bromwich.

Splendid **Violin, Bow, and Case,** Silver Geneva Lever Watch. Will exchange for 50in. Bicycle, to value 65s.; or anything useful.—Thomas, Marriott's Cottage, The Avenue, High Barnet.

80 7d. monthly parts "**Cassell's Great Industries** of Great Britain." Exchange Fishing Tackle, or what offers.—Thomas, Marriott's Cottage, The Avenue, High Barnet.

Wanted Catalogues of Electric Bells, &c., Electric and Photographic. Best value given in exchange.—D. D. Taylor, 11, Borough-road, Sunderland, Durham.

Lathe, 2½ centre, Fret saw and several tools. Exchange for Anvil, Taps and Dies, or any Engineer's Tools.—Geo. King, 10, Thornhill-square, Camberwell.

Portable Shop, good workshop, suit gardener, glass all round, roof, body, floor separate, size 7 by 4ft. 6in., 7ft. high, zinc roof. Exchange.—Watson, 36a, Eden-grove, Holloway, N.

Wanted ½H.P. Engine and Boiler (combined). Exchange to value.—H., care of A. Knight, Guildford-road, Chertsey, Surrey.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

New Illustrated Price List of **Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp—Morris Cohen, 132, Kirkgate, Leeds.

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Lathes. Lathes Cheap, good. List 2 stamps.—Robinson, Catherine-street, Sheffield.

Electric Depot, 14, Deansgate, Manchester.—Handiest shop in the trade. Largest stock. Greatest variety. Lowest price.

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Wheel-cutting and Dividing to 12 inches diameter, in brass only.—Clegg, Belinda-street, Hunslet, Leeds.

Write for **King, Mendham and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

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Cyclists.—Use "Graphine" on your chains; no grease, will not hold dust, 8 stamps, free.—Wolff and Son, Falcon Pencil Works, Battersea, S.W.

Astronomical Telescope.—Apparatus and parts made to order.—A. Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

Astronomical Eyepieces, any power, fitted to any telescope, 15s. each.—Clarkson.

Transit Instrument, by Ross, on iron stand, perfect adjustment, new condition; also others.—Clarkson.

Equatorial, by Cooke, of York, slow motions, will carry up to 4½in. telescope, £15.—Clarkson.

Universal Equatorial, with circles on tripod stand, will suit any telescope to 4in., £5.—Clarkson.

4in. **Telescope,** Cooke and Sons, York, new condition, on tripod stand, diagonal and five eyepieces.—Clarkson.

Astronomical Telescopes, some in stock, good condition, by leading makers.—Clarkson.

Astronomical silver-on-glass **Telescopes,** Mountings made for these; also flats, finders, rack, eyepieces, mounts.—Clarkson.

Astronomical Telescopes (good) sold for private owners if reasonable prices.—Clarkson, 28, Bartlett's-buildings, Holborn Circus.

"**The Amateur.**" A paper for Fretworkers, Carvers, Inlayers, Painters. Sixpence monthly. Lists of latest designs free on application.—Henry Zilles and Co., 24 and 26, Wood-street, Finsbury, London, E.C.

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Diamond Drills, from 1s. Spring Drill Stock and postage, 1s. 3d.; Upright, do., 4s. 1½d.—Below.

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Diamond Sparks, for China riveters, from 6d.—Woods and Toussaint, 54, Spencer-street, Clerkenwell, London.

Catapults, 7d., 9d., 10d., 1s. free. Elastic, 2d., 3d., 4d., 6d. yard.—Belleville, St. Mark's, Cheltenham.

Paris Exhibition.—Pressure of urgent orders prevented our exhibiting, but one of our firm will be in Paris on July 1st and is open to appointments.—Britannia Co., Colchester.

Tool Dealers and **Stationers** supplied with our Lathe Books. Other mechanical works will shortly be published.

Above **Book** contains chapters on **Metal-Spinning** on any Lathe, Rudiments of Ornamental Turning and Screw-cutting.

Also valuable chapters on **Chuck-Making,** angles of cutting tools. Price 3s., free by post.

Several **Soiled Copies,** 2s. each.—Britannia Co., Colchester.

Piles!—Palmer's "Indian Ointment" cures agonising cases, 13½d., 2s. 6d., internal remedies included.—Chapel-terrace, West Auckland, Durham.

Palmer's Renowned Prescriptions, 2s. 6d. Cure quickly Urethral Diseases, &c. Thirty years' celebrity. Blood purifying pills included.—Above.

Handy **Pair of Steps** and useful Long Ladder combined, 10s. 6d.—Taylor and Co., Driffield. Lists free.

Smoke Knight's Herb Tobacco.—Splendid flavour, delightful perfume. Neither injurious, like ordinary tobacco, nor expensive.—Below.

SmokeKnight's Herb Tobacco.—Quarter pound (nearly), 7d.; half-pound, 1s., post free.—Knight, Druggist, Portsmouth.

500 **Business Cards,** Billheads, Memorandums, 3s. 6d.; 250, 2s. 6d. carriage paid.—Clarke, 7, Rosedale-terrace, Fulham, London.

Use Danrab Pipe Plugs.—Smoking more enjoyable. Penny each. Boxes, 1s. free. Tobacconists supplied.—Danrab, Kirkburton.

Automatic Disinfector, strong, last for years, perfectly self-acting, with pint of fluid, free for 3s. Send for particulars.—Cambridge Chemical Co., Limited, Cambridge.

Safety Bicycles, superior make, warranted all ball bearings, from £10. Catalogue free.—Harger Brothers, Settle.

Your Name, Sir?—A complete Font of Rubber Type, consisting of two alphabets, with box, ink, pad, and holder, post free, 1s. 6d.; extra alphabets, 6d. per set.—E. C. Pr[illegible], Manufacturer, Cumberland-street, Bristol.

Dynamo Wire, best quality, cotton-covered, high conductivity. Sample, stamp.—F. Holloway, 35, Summerfield-crescent, Birmingham.

Launch Engines, 6in. 4½ and 3in. bore. Boilers, Lathes, all kinds of Machinery at reduced prices.—S. Smith.

Propellers, improved pattern, 12in. to 30in., in stock. Stuffing Boxes and Shafts.—S. Smith, 11, West-street, Soho, W.C.

250 Memorandums, Billheads, Cards, Eyeletted or Gummed Labels, 2s. 6d.; 100, 1s. 2d., free.—Victoria Printing Works, Scarborough.

Say, Boss! "The only Solution" is a work every parent should read. Catalogue of books free.—May, 50, Buckledge-avenue, Harlesden, London, N.W.

New **Lathes,** iron beds, 5in. centre, £4 10s. On view. —Britannia Co., 100, Houndsditch, London.

On view. **Britannia Co.,** 100, Houndsditch. Half-horse steel Horizontal Boiler, with valve and cocks, £4.

1½in. strong **Vertical Tubular,** £12, with all fittings except gauge.

Three **Lathes,** Holtzapffel's, one cost £750, offered at £250. On view at Britannia Co., 100, Houndsditch.

Steam Engine, in good order, 1-horse, £8; 1½-horse £15; 2-horse, £23 10s.; 5-horse, £31; 6-horse, £40.

Silent **Hot-Air Engine,** Robinson's patent, 1-man, £22, to heat by gas.

Several small **Hot-Air Engines,** nearly new, £8, £12.

Gas Engines, new, 1-man, £18; ½-horse, £35.—Britannia Co. All letters to Colchester.

Iron Safes, fireproof, low price for cash, or on hire-purchase.—Britannia Co.

A few Pounds will secure you against fire and thieves.—Britannia Co.

Anvils, new, 3¾in. wide on face, 27s. 6d.; 4in. 33s. 6d.—Britannia Co.

Best **Twist Drills,** equal to new, 1-16, 2½d.; ⅛, 4d.; 3-16, 5½d.; ¼, 8d.; 5-16, 10d.; ⅜, 1s. 2d.; 7-16, 1s. 3d.; ½in., 1s. 9d., post free. Other sizes equally cheap.—Britannia Co., Colchester.

Catalogues, 6d. List of second-hand, 2d.—Britannia Co., Colchester.

Call and see **Large Stock** at 100, Houndsditch; but all Letters to Britannia Works, Colchester.

Dynamo and Motor Castings, Manchester or Gramme type. Price list for stamp.—Alfred Crofts, Electrician, Dover.

Military Brass Band Instruments for sale, part of band, guaranteed perfect, no dents, good as new. Will send any or all on approval.—For list and particulars, address Band Secretary, Lewanick Lodge, St. Alban's, Herts.

Mixing Paints.—A new book, containing trade recipes, with instructions and details for mixing, making, and using all kinds of paints, oils, colours, &c., free 1s. 3d.—C. King, 2, Churchfield, Barnsley, Yorkshire.

Moulders' Letters! Moulders' Letters!! From ½in. to 4in.—Leaney, Langton-road, Brixton.

Steel Name Stamps, 3d. per letter; Figures (set), 2s. 4d., post free.—E. Baldwin, Robinswood-hill, Gloucester.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 21, 1889.

ELECTRIC-BELL CONSTRUCTION.—XI.

By F. C. Allsop.

The Continuous Ringing Attachment.

WHEN a number of bells are required to be made continuous ringing, it is preferable, instead of fitting each bell with a lever and contact post, as shown in Fig. 16, Article II., to employ a "continuous ringing attachment," which is so connected as to throw, when actuated by pressing a push, the current of a local battery on to the bells. Likewise, in the case of a single bell, where the gong is of large size, say, over 4in. in diameter, it is better to use a separate attachment, as bells fitted up in the manner described in Article II., are not very reliable when the bell is of large size.

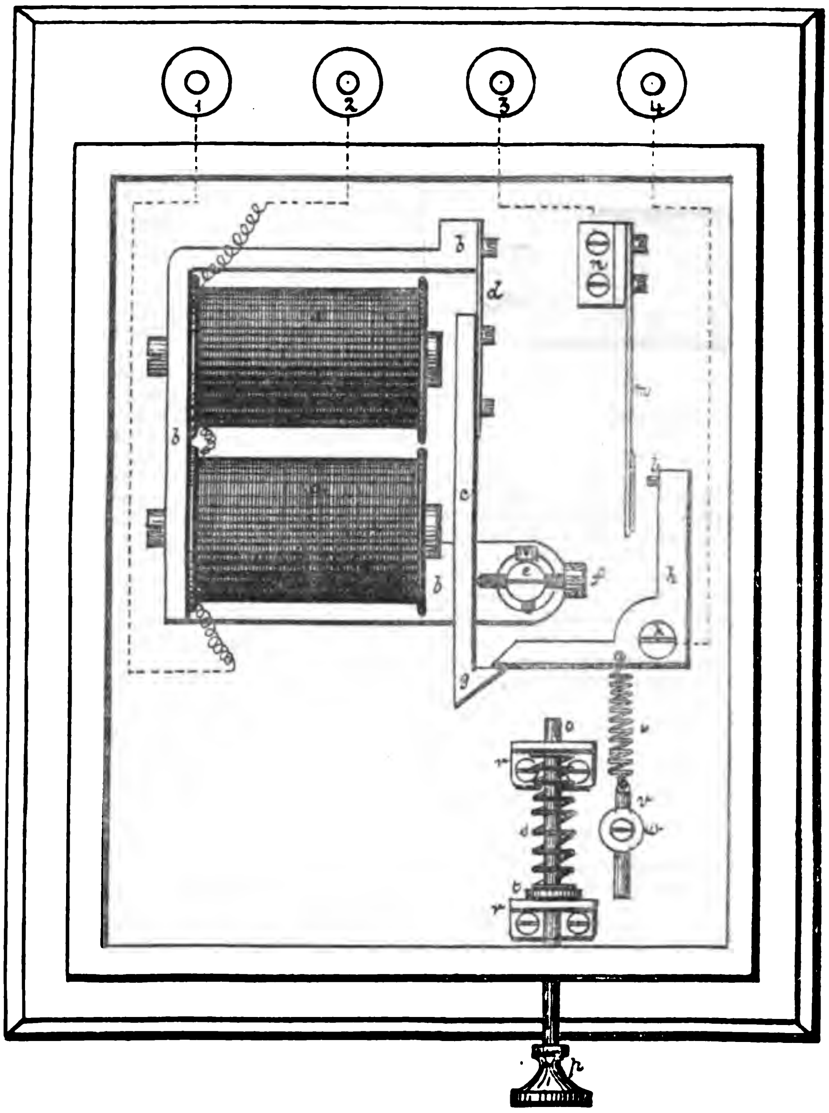


Fig. 63.

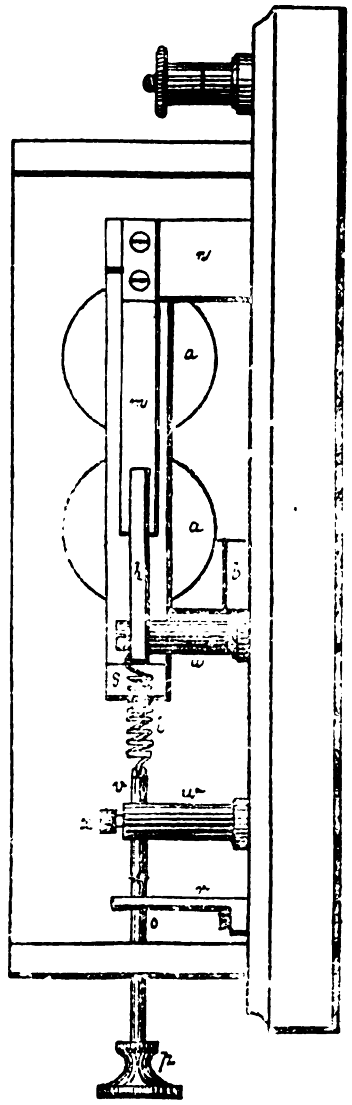


Fig. 64.

Figs. 63 and 64 show the most reliable form of the continuous ringing attachment, the whole of the movement being contained in a polished wood box with a glass front. Fig. 63 shows the "attachment" as viewed from the front with the glass cover removed, and Fig. 64 is a side view. The illustrations are full size, and similar letters in the two figures denote similar parts.

The attachment consists, it will be seen, of the two electro-magnets *a a* fixed to the iron frame *b*, the upper end of which carries the armature *c* by means of the spring *d*. To the bottom part of the iron frame is fixed a brass post, *e*, carrying the stop-screw *f*. This part of the attachment, it will be noticed, is similar to that of a single-stroke bell with the hammer removed from the end of the armature, and the catch *g* substituted in its place. Supported by the catch *g* is the contact piece *h*, which when released, impelled by the spiral spring *i*, swings round on the screw *k*, the platinum point *l* making contact with the platinum tipped spring *m*, fixed to the upright support *n*. Below the contact piece is the rod *o*, carrying at its lower end the button *p* and working in the two supports *r r*. To the rod *o* is fixed the washer *t*, against which presses the spiral spring *s*, thus keeping the rod down.

The action of the apparatus is as follows:—When a current flows round the coils of the electro-magnet, the armature is attracted, releasing the contact piece *h*, which, impelled by the spiral spring *i* makes contact with the platinum-tipped spring *m*. This closes the local circuit through the bells, which continue to ring until the button *p* is pressed, causing the rod *o* to reset the contact piece *h*, thus breaking the local circuit. By mounting the contact on the spring *m* instead of on a rigid post, as is usually done, a "wiping" action is obtained in the contacts in place of a dotting one, which has no tendency to keep the surfaces bright. For when the piece *h* is released the platinum point *l* presses against the spring *m*, and the spring gives, causing the point to travel along the platinum surface of the spring for about an eighth of an inch, thus insuring good contact.

In constructing the attachment we begin with the magnets, iron frame, armature, &c.; but as the construction of these was fully described in Article I. and II. on Bells, it will be unnecessary to repeat the instructions given there. The movement is the same as that of the single-stroke bell shown in Fig. 15, except that there is no hammer on the end of the armature. The armature is also ½in. longer than that described for the single-stroke bell, and has the catch *g*, which is filed up out of a piece of brass soldered to the end of it. It will be best, when this portion of the apparatus is completed, to make the baseboard on which it is fixed, so that we can fit the different parts as they are finished. This baseboard, which should be cut out of some ½in. walnut or teak, is 5⅝in. long by 4⅜ broad. For the sake of appearance a small moulding like that shown in the drawing should be run round the edge, and the whole when finished should be sandpapered and well French polished. If the wood is well seasoned and nicely French polished, it will be sufficient to mount the different parts direct on to the wood base; but if the wood is likely to warp, it will be necessary to have a metal base. In this case a piece of 1-16 sheet brass 4½ by 3⅜ must be cut off and screwed to the wooden base.

Having fixed the iron frame with the electro-magnets in its proper place, we next proceed with the contact piece *h*. This can either be filed up out of a piece of ⅛ sheet brass, or cast from a pattern. It is supported up from the base by the post *u*, to which it is attached by the shouldered screw *k*. The post can be turned up out of some ¼ or ⅜ brass rod, and is fastened to the wood base by a screw passing through from the back. The screw *k* must fit nicely in the hole, so as to allow the piece *h* to move freely and without any side-play. A small hole is drilled at the point *l*, into which is driven a small piece of platinum wire for the contact. A small hole is also drilled in the bottom arm of the piece *h*, into which passes one end of the spiral spring *i*, made by winding some thin brass wire round a small rod held in the lathe. The other end is fastened to the end of the rod *v*, which passes through the post *w*. This post is turned up out of some ¼ brass rod, and is fastened to the base, like the post *u*, by a screw from the back. A hole is also drilled in the top of the post, and tapped to receive the screw *x*, which, when screwed up, secures the rod in position. Thus the tension of the spring *i* can be adjusted to any degree by slackening screw *x* and moving the rod to the desired position. The contact spring *m* should next be fitted. The support *n* should be cut out of some 1-16 sheet brass, the strip cut off being 5-16 wide. The bottom is bent at right angles to the other part, so as to form a base for it to stand on. Two holes are drilled in the base and countersunk for the wood screws that screw it to the wood base. Two holes are also drilled in the top part and tapped to receive the two screws that hold the spring *m*. This spring is 1¾in. long by 3-16 wide, and has a piece of sheet platinum soldered at the end, just opposite the platinum point on the contact piece *h*. The spring should be cut off some thin sheet brass, taking care to get the greatest length in the direction of the grain of the metal, and afterwards hammered to impart to it the necessary elasticity. In making the replacement, the two supports *r r* are first cut off some 1-16 sheet brass, and bent and drilled at the base as described for the support *n*. The washer *t* is soldered on to the brass rod *o*, the lower end of the rod being threaded to receive the button *p*, which may be of brass or hard wood, as desired. Care must be taken in fixing the replacement to get the supports the right height, so as to cause the rod *o* to engage properly with the contact piece *h*. It will be noticed that, in Fig. 64, the spiral spring *s*, and the top support as well as the upper part of the rod *o*, are not shown, in order to make the drawing clearer. As to the size of wire on the bobbins, this will depend, of course, on the resistance of the circuit upon which it is required to work. The remarks on the winding of relays, given in the last article, will apply equally here.

Having fitted the different parts, the sides of the case may now be fixed in position, being made out of ¼ walnut or teak, according to the construction of the base. The glass front may either be made to open on hinges, or, what is simpler and perhaps preferable, to slide in and out at the top. It is well, however, to have some means of readily taking off the front for adjustment, and whatever method is used, care should be taken to get it as dust-proof as possible. Four terminals should be fitted at the top of the base as shown, the connections being indicated by the dotted lines. These connections should be let into the back in grooves, the grooves being afterwards filled in with melted paraffin wax. Terminals 1 and 2 are connected to the main circuit, and 3 and 4 are for the local circuit.

To adjust the attachment, the stop screw *f* should first be screwed up till the catch *g* on the armature only fairly supports the arm of the contact piece *h*. Now if the armature is pressed towards the magnets, it should touch the poles almost directly after it has released the contact piece *h*. The tension of the spiral spring *i* must then be adjusted till the point *l* makes firm contact with the spring *m*, when the contact piece is released. If the tension of the spring is too great, increased power will be required to attract the armature, and the attachment will not be found so sensitive. The rod *o*, when the replacement bottom *p* is pressed, should move the bottom part of the piece *h* about 1-16th above the catch *g*; otherwise it will not be reset properly.

(*To be continued.*)

A MODEL LOCOMOTIVE.—X.

The Cylinder Patterns.

THE turned body of the cylinder pattern destitute of its fittings is seen in Fig. 38. This is first jointed longitudinally and fitted with two dowels. The halves are then united

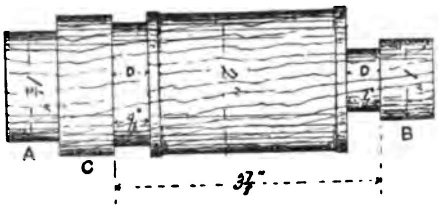
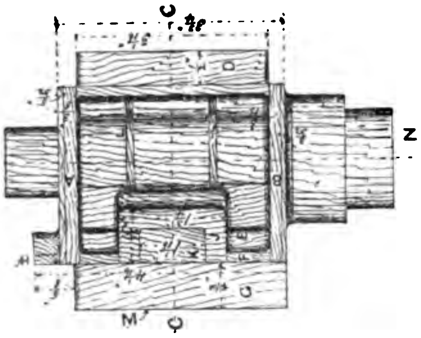
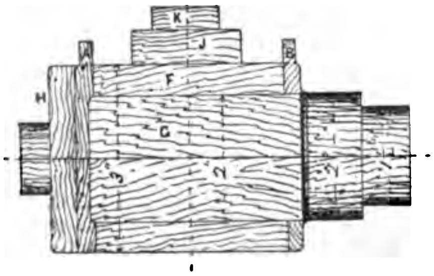


Fig 38.

with screws, plates, or dogs, and turned between centres. The prints A B are, say, $\frac{3}{16}$in. less in diameter than the bore, that being sufficient allowance in this case, and the head metal C is of the same diameter as the body of the cylinder, and about ¾in. long. The body is grooved for the end flanges to the depth of about ⅛in., and in this way the flanges are prevented from shifting. The grooves are made sufficiently wide to allow of the cutting of hollows on the backs of both

FIG. 39.





SIDE VIEW LOOKING FROM M

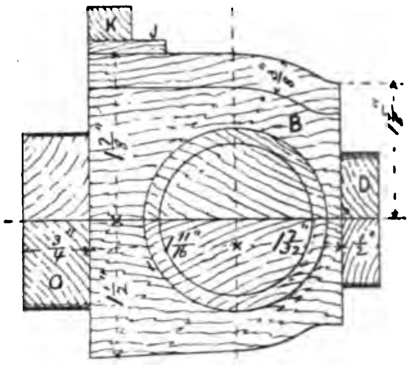
FIG. 41.

flanges, and on the front face of the flan... ...t comes next the head metal. This curv... the head tends to pr... in casting, which... tanglement with...

Joint and plan... A, B, Figs. 39—

Fig. 38. Mark their outlines (Fig. 40), and cut out holes at the centres given (Fig. 40) to fit around the grooved portions D of the cylinder body (Fig. 38). Then gauge the actual flange thicknesses = ⅜in. and $\frac{5}{16}$in., and cut faces and hollows with chisel, rebate plane, and gouge, merging the hollows into the cylinder body. The out-and-out dimensions of the flange faces (Fig. 39) give suitable allowance for facing. (Compare with Fig. 32 in the previous article, p. 297). Note

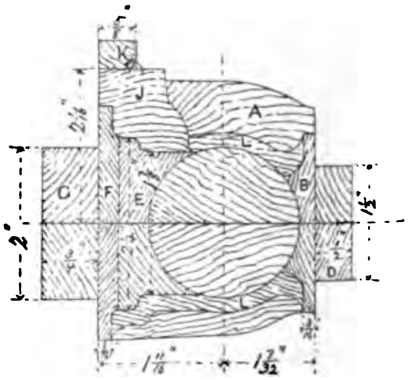
FIG. 40.



END VIEW LOOKING FROM N
FIG 39

the cutting out of the shouldered recesses or rebates for the reception of the tube and smoke-box plates. (Fig. 39, 40, A, B).

Upon one side of the cylinder we have the feet, which are bolted to the frames, and on the other the steam-chest body and its flange. Taking the first named, we shall not cut out the recess between the feet, as in the casting (see Fig. 33, previous article), because that would involve the use of drawback plates, and though these can well be used in a large mould, we shall do better to avoid them in so small a model, and a core will therefore be the alternative method. The section in Fig. 42 shows how the blocking B for the feet is fitted to the body, and how the core point D is attached. The pieces B fit between the end



SECTION THROUGH C-C
FIG 39

Fig 42

flanges, and the core point C stops short of the ends, terminating at the inner faces of the end flanges A and B.

The fitting of the steam-chest blocking piece E, flange F, and print G should be clear from Figs. 39, 42. The length of the print is seen in Fig. 39 to terminate at the inside of the hinder flange H, at one end, and at the cylinder end at the other, or front portion.

The flange H, with its gland piece, will be now glued upon the hinder end of the cylinder, as shown in Figs. 39 and 41.

The one half of the exhaust pipe I will be fitted at this stage. It is made as a block only, instead of as a pipe, with overhanging flange, ...cause the flange, if introduced, would involve ...lesome joint in so small a mould. It is ...herefore, to leave a little excess of metal ...e of the block is clear from the views ...' also that of its print K. ...ning ribs I ... fitted around the

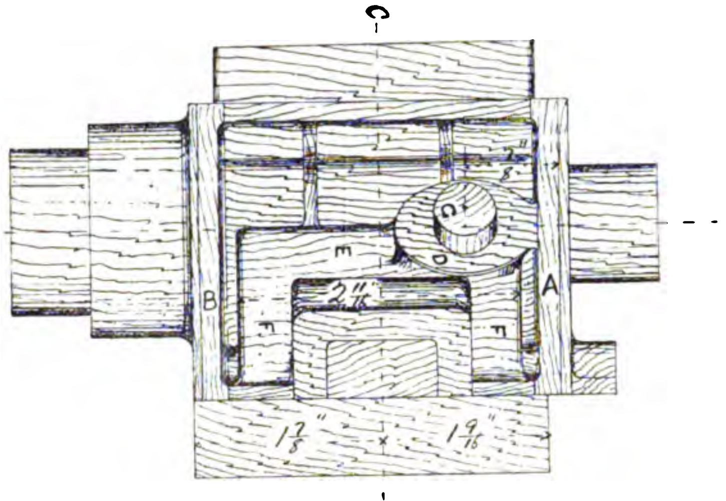
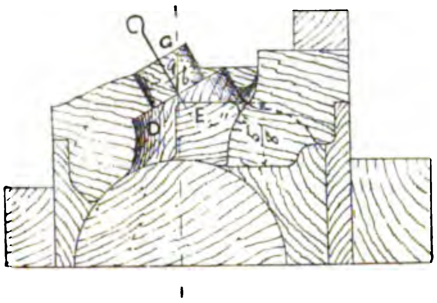


Fig 43

cylinder body, above and below, and being cut to outlines shown, are nailed on fast. Those at the side, between the feet B in Fig. 32, will go into a core-box.

I say nothing about taper, because it is scarcely required. The difference of one fine shaving in thickness between top and bottom parts will, if the pattern is made well, suffice for good delivery.



SECTION THROUGH C-C
FIG 43

Now if we make two patterns, there will be one with the steam-pipe and passage block, Figs. 43, 44, and one without. If we make one pattern only, the pipe and block must not be glued at all, but only secured temporarily with a couple of screws. And a single pattern must be reversed before it is right for the reception of the steam-pipe block. These cylinders are necessarily right- and left-handed. The simplest way to effect the reversal is to turn the pattern over on its longitudinal axis, when the alteration required will be at once apparent. It will be necessary to cut down the depth of the end rebated flanges A and B (Figs. 39, 40) on one side, and increase their depth, and add the rebate on the other side, and remove the exhaust block I from one side to the other. But if more than one or two sets of cylinder castings were required, I should rather make two entirely distinct patterns than cut and patch one.

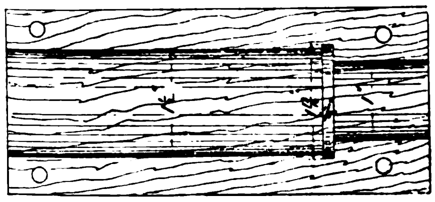


Fig 45

Some considerable care will have to be exercised in cutting the steam-block, as also its core-box, to correct o[illegible]s; otherwise there will be a lack of correspondence between the two, and the metal will be thicker and thinner in places, or the cores may even appear through the casting.

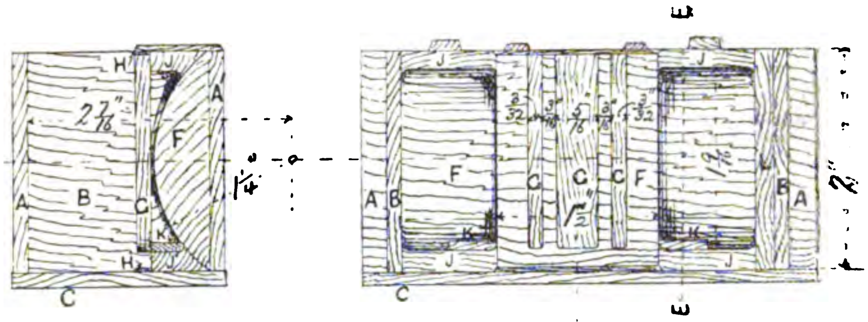
Fig. 43 is a plan view of the pattern cylinder which contains the steam inlet block—that is, the right-hand cylinder; and Fig. 44 is a section through the same, looked at from the front end of the engine. The steam entering pipe D passes along the cored block E, and enters the chest through the curved blocks F.

The print G, being on a bevel, must not be fastened on, but only held loosely with a single wire passing exactly through its centre. The moulder will remove this when ramming up.

Drain cocks will be wanted by-and-by. Sometimes bosses are cast on the cylinder for these, and brought out flush with the cleading, sometimes the pipes are tapped into the belt.

There is quite as much work involved in the making of the core boxes as in the construction of the patterns. They are six in number.

Having an internal flange at one end of the cylinder, we shall, in so small an affair, have to make a core-box for the bore. In a large cylinder the core would be struck on a revolving bar against the edge of a board, cut to sectional outline, and chamfered. Fig. 45 shows one-half this core-box in plan. It is long enough to include the prints A and B in Fig. 38, and care must be taken to have it of the proper length, else when the cylinder is cast, the thickness of metal in the internal flange may be less or more than it should be.



SECTION E-E

SECTION D-D

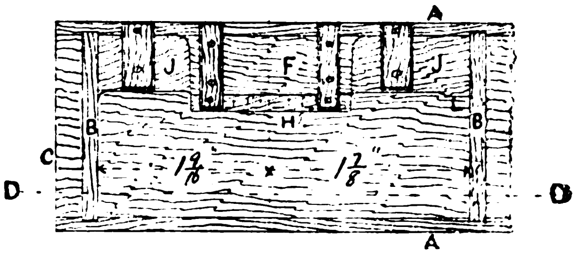
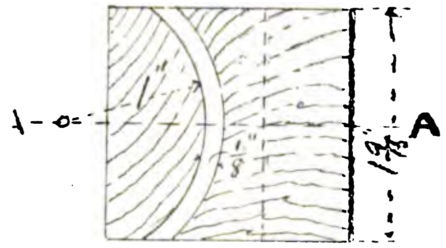


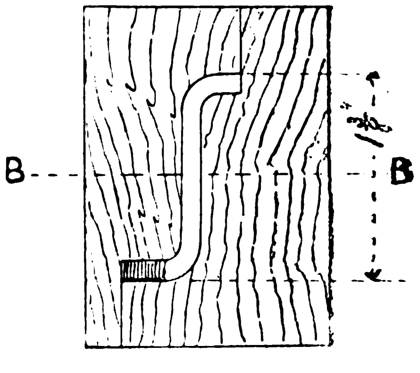
Fig 46.

PLAN

Next take the steam-chest core-box, Fig. 46. This will core out the steam-chest space, and also contain the prints for the passage and exhaust cores. If it were not for the fact that these cores are very much crowded, I should make the passages in one with the steam-chest core. This is often done where the conditions are favourable; but the situation is much too cramped in this case.



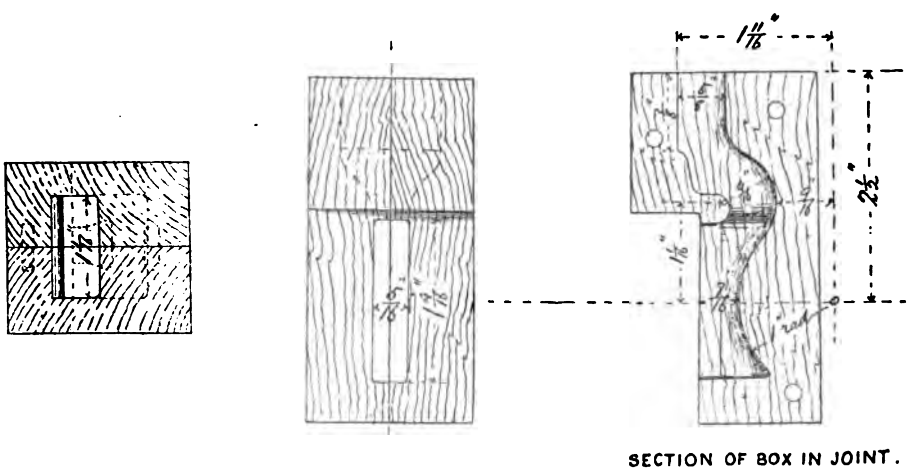
SECTION B-B



SECTION A-A

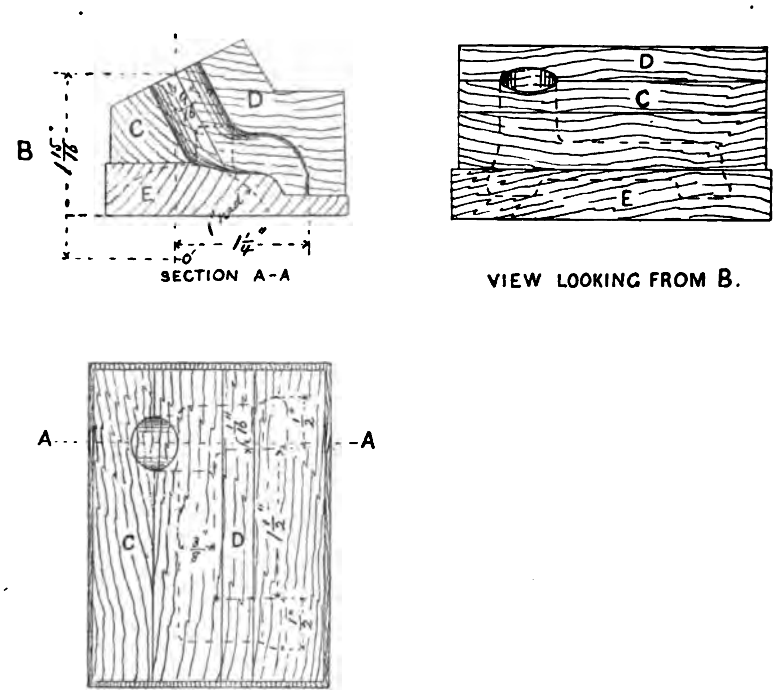
Fig. 47.

Two sides, A A, two ends, B B, and a bottom-board, C, the latter dowelled on, are the skeleton of the steam-chest box. Into this is fitted the piece F forming the face for the valve, and for the curved metal around the curved passages. Upon the valve face, the three pocket prints G G G are nailed for the passage and exhaust cores. These prints are brought right to the top of the box upon one side, to enable the cores to be put into place after the steam-chest core is in. The supplementary space above the cores is then stopped over—i.e., filled in with sand. These prints are made a trifle thinner than the width of the finished ports, to allow of cleaning up to



SECTION OF BOX IN JOINT.

Fig. 48.



SECTION A-A

VIEW LOOKING FROM B.

Fig. 49.

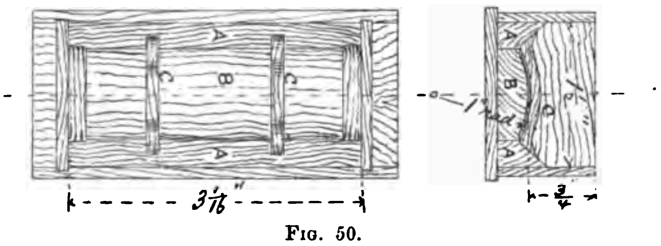


Fig. 50.

precise dimensions with a file for accurate cut-off. If these prints are not accurate, and pitched at the precise distances required, and square up and down the face, the casting will give trouble in the fitting-up.

On the valve face I allow 1/16in. for truing-up. It will be difficult, owing to the somewhat confined space available for working in, to file it. It should properly be planed in a shaping machine.

Note the guide-strips H H on the top and bottom for the contact of the valve edges. The lower one is nailed on the bottom board; the upper one is carried by two battens on the top of the box. Observe also the thickness pieces J J, which preserve the necessary thickness of metal around the contour of the steam-chest block, making the internal width at those parts equal to that of the passage cores. Two of these—the upper ones—are attached with battens.

I think it best to put two points, as shown at K K, to carry the corresponding ends of the team-entry core. It is an awkward job to insure he perfect correspondence of these steam cores and prints; but it would be more awkward if, in the absence of prints, the cores came through in the wrong places, or if they did not cut through at all, but were separated by a thick film of metal. The strip L is a facing strip for the stuffing-box cover, common to both cylinders at the front end.

The worst core to make, by reason of its thin section, is that from box, Fig. 47. For this reason special care must be taken to have the box perfectly accurate as to sweep, length, and thickness of space, and so give the moulder a good chance to make a core correctly. A sweeped piece has to be inserted to make the difference between the diameters, 1¼in. and 1⅜in., of the core at the opposite ends of the box, Fig. 45. One core is then made with the sweeped piece rammed in, and the other with it out.

The exhaust core-box is illustrated in Fig. 48. Careful marking out from full-sized drawings and the making of corresponding templets will have to be done, or the core will be cutting through in [illegible] places.

There [illegible] end core-box, Fig. 4 This is the most troublesome to make, and it can only be done correctly by cutting templets at different sections, and making careful use of them. Beyond the leading sizes, it is impossible to give dimensions where the form changes constantly. Neither the outline of the block itself nor that of the core is of much consequence, so long as there is sufficient area for the steam, and the core runs foul of nothing else. After that, the only care is to get the block and box so worked relatively to each other that there shall be about ⅛in. thickness of metal throughout.

Observe that I make the box in three parts—a divided upper portion, C D, being put on a bottom board E. This is the best plan, because then the face of the bottom board can be worked to the section taken from the drawing, and we thus get a definite base of operations upon which the outlines of the passage can be laid down.

Fig. 50 shows the core-box for taking out the recess between the feet B in Fig. 42. There are sides, ends, and bottom board. Two bevelled sides, A A, give the internal slopes of the feet. B, on the bottom board, represents the outside of the cylinder body, and C C are the strengthening ribs.

A good many dimensions of little importance, such as the thicknesses of timber in core-boxes, have been omitted. Such minor working dimensions also as are not included can be readily obtained from the previous article, p. 297, and if difficulties arise I will reply in these columns to inquirers.

J. H.

IMPROVEMENTS IN PNEUMATIC MACHINES.

The perfection of vacuum-making machines has during recent years occupied the attention of physicists and of instrument-makers a great deal, not only in connection with the advance of scientific research, but also in connection with the growing requirements of electricity, which render the production of good vacua a matter of the utmost importance.

The air-pump is said to have been invented by Otto Guericke about the middle of the 17th century, and the instrument which is now commonly used does not differ much from the original in any of the essential parts of its construction. In the common air-pump a solid piston is worked in a cylinder, which is connected with the vessel it is desired to exhaust by means of a tube; the strokes of the piston gradually remove the air, and an arrangement of valves prevents its return.

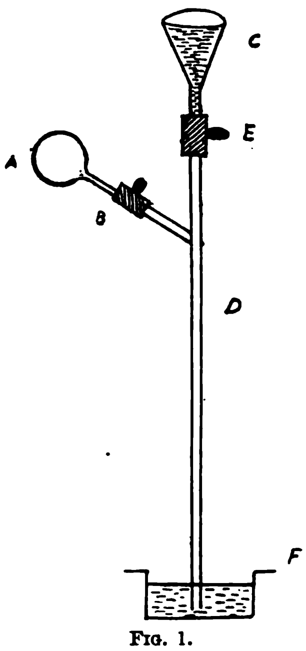


Fig. 1.

Various mechanical improvements have been made from time to time by Bianchi, Kravogl, Deleuil, Babinet, and others, and the instruments now made are fairly efficient for ordinary purposes. But still, even with the most perfect of these solid piston air-pumps, it is not found practicable to approximate *closely* to a perfect uuum. The causes of this are probably to be found in the *inaccuracy* of the most accurate workmanship, which gives rise to slight leakages at the valves, joints, &c. A further error is due to the oil which is used in lubricating the machines. The oil absorbs air, and partially yields it up at the moment when the piston is about to rise. This is most difficult to prevent.

In endeavouring to remedy these defects, it was suggested that instead of employing solid pistons, and in order to get rid of "untraversed space," a kind of piston of mercury should be employed. Such a piston would be dry, perfectly-fitting, self-adjusting, and frictionless, requiring no lubricant.

Geissler, of Bonn, was the first to take advantage of this idea. He produced a vacuum by causing the receiver of a mercurial air-pump to communicate with a Torricellian vacuum; by means of this arrangement he carried the exhaustion to a high degree. Using dry mercury, a vacuum equivalent to $\frac{1}{250}$th of an inch may very easily be obtained with a Geissler pump.

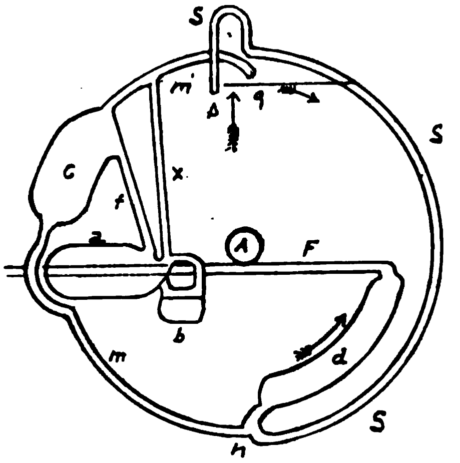


Fig 2

Dr. Sprengel introduced a modification and simplification of Geissler's mercurial pump, which is known as Sprengel's pump. Fig. 1 is a diagrammatic view of it; A is the vessel to be exhausted, connected to the apparatus by means of a tube, which can be tightly clamped at B; C is a funnel connected with a long glass tube, D, by an indiarubber tube, which can be tightly clamped at E; F is a reservoir. The mode of working this pump is to pour mercury into the funnel; then allow it to pass down and sweep out the air in the tube D, which, being connected with A, brings about a rarefaction in it. The clamps are closed, and the process repeated again and again till the exhaustion is that required. By this instrument air has been reduced to $\frac{1}{1300000}$ of atmospheric density; an exhaustion of one-millionth can readily be obtained, and this is equivalent to a pressure of 0·00003 of an inch of mercury. Geissler produced his machine in 1857, and an account of Sprengel's modification can be read in the *Journal* of the Chemical Society for 1865.

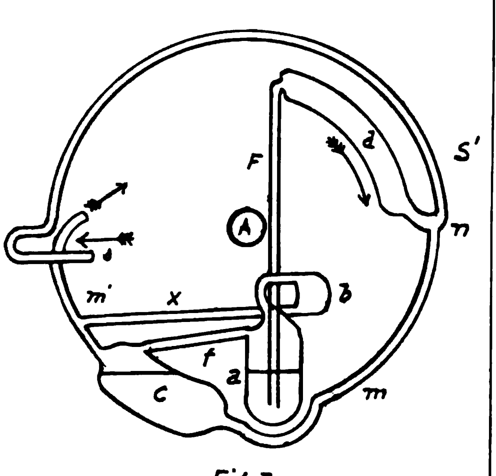


Fig. 3

Some of those scientists who work on the borderland between the provinces of chemistry and physics have devised other methods, amongst these the most notable is that due to Profs. Dewar and Tait. It is an application of the well-known fact, that charcoal will absorb and condense gases within its pores; thus Hunter found that, at 0° and 760mm. pressure, 171·7 volumes of ammonia are absorbed. While exhaustion by an ordinary air-pump is going on, charcoal is kept heated, and when the pump has reached the limit of its efficiency, the charcoal is allowed to cool and to complete the vacuum by condensing any remaining air. An account of their experiments is given in *Nature*, July, 1875.

Amongst the most recent attempts to improve pneumatic machines are those of Alvergniat and Jamin, who, at any rate, have succeeded in producing some very beautiful but complicated apparatus.

A new arrangement has now been invented by M. L. Chiozza de Cervignano, which has no stopcocks, no pistons, and no valves. It is composed essentially of a series of tubes united to a series of receivers, the whole system being movable around a horizontal axis. Figs. 2 and 3 exhibit sections of this apparatus in two consecutive positions.

The bulbs *a b c d* are the receivers, which are for holding the mercury while the apparatus is being worked. A "rocking" or reciprocating motion is given to the apparatus, which is, therefore, communicated to the mercury. The mercury tends to get into equilibrium in the various tubes and bulbs, and so leaves the tube S, drawing with it the air it contains, thus producing a rarefaction. The air withdrawn follows the direction of the arrows. Each "rocking" produces a certain amount of rarefaction, and by continuing the process a good approximation to an absolute vacuum can be obtained.

Suppose the apparatus to be rotated through an angle of 45° on the axis A, the mercury runs out of the tube S and out of the reservoir *d*, dragging with it air from tube S, which is connected at *s* with the vessel which is to be exhausted. This causes the rarefaction, for the air is obliged to occupy a greater volume.

Next comes the expulsion of part of this air. In order to effect this it is merely necessary to rotate the apparatus back on its axis into its initial position. During this movement the mercury in bulb *c* runs back into tube S, the reservoir *d* refilling and compressing the air which has previously been drawn into it. Owing to this pressure the mercury in tube F passes into bulb *a*, and allows free egress to the confined air, which escapes at last through the tube F, and then by way of *m'* and *q* into the atmosphere.

These two operations correspond to the work done by the first stroke of the piston in ordinary pneumatic machines—rarefaction and expulsion.

In order that the mercury may not fill *a* completely, which would obstruct the expiration tube *f*, and thus impede the passing out of the air, a small reservoir can be arranged close to *a*, which shall receive the surplus mercury; then, during the inverse movement of the apparatus, the mercury contained in *b* will run through the tube *x*, and will go to join that which will already be in the reservoir C.

As far as can be judged this new pneumatic machine seems to be very efficient; that being so, its simplicity of construction and action will be certain to commend it, for it must necessarily be comparatively inexpensive, and it has no complicated valve, stopcock, &c., to get out of order and so cause trouble.

THE PARIS EXHIBITION.

THE Paris International Exhibition, now in full sway, is attracting the attention of the whole world by the vastness of its proportions, and by the intelligent manner in which the exhibitors of all nations have arranged, in the space allotted to each, the natural products of their soil and the marvellous inventions due to their fertile genius. The whole area of the exhibition is about 175 acres. In this space we find not only the usual exhibitions of the progress of modern industry, but also a series of very interesting ethnographical and historical exhibitions. Of the latter we shall have nothing to say to our readers—they are altogether out of the scope of these articles, inasmuch as a description of them would be useless I have no doubt that all of "ours" who come to Paris will spend many pleasant hours in this instructive and recreating part of the exhibition, in which they will be able to observe the different habits of Asiatic and African people, and, so to speak, make a living trip round the world in a very short space of time.

Our attention will be specially directed to the mechanical and physical part of the exhibition. On a general survey of the buildings the visitor is struck with the fact that iron plays a most important part in the structure of all the galleries, and as most remarkable examples of the triumph of iron we must mention the Eiffel Tower and the Palace of Machines. The total height of the Eiffel Tower is 980ft., and its four pillars constitute a square base whose side is 425ft. in length. These four pillars comprise four immense iron arches, and support the first platform at a height of 175ft. above the ground. We need hardly say that the pillars are inclined, and that one of the great difficulties of the edification of the tower was the mounting of these pillars, because, as soon as the ironwork had reached a height of 85ft., the centre of gravity of the structure fell outside of the supporting base, and the whole thing had to be sustained in the exact position and with great difficulty by means of cranes. Special scaffolding had to be made to support the horizontal beams of the first platform, and when these were placed the inclined beams of the pillars were brought to coincide with the first by a slight rotation on their lower extremities.

The four arches of the first part of the tower have a height of 155ft. and a span of 138ft.

The four pillars of the tower continue for the first to the second platform to a height of 380ft. This platform is also square, and is about 90ft. in diameter. From this point the structure of the tower changes. We have no longer four separate pillars, but only one square column of iron lattice-work. We thus reach the third platform at a height of 900ft. The view from this platform extends to a distance of 56 miles. Above the third platform there are a series of rooms, which are reserved for M. Eiffel and for different observatories—astronomical, meteorological, and micrographical. The tower is surmounted by powerful electric lights. In case of an accidental inclination of the tower, four powerful hydraulic presses have been lodged in the foundations of the pillars, so as to be able to raise them slightly if necessary.

The public have access to the first and second platforms by the stairs or by means of lifts. The lifts are carried on the inclined rails by chains and pulleys worked by hydraulic power. From the second to the third platform there is a double lift composed of two cabins. The lower one is borne on hydraulic pistons, and the upper one by chains passing on pulleys at the top of the tower, and fixed to the lower cabins at their other extremity, so that when one cabin ascends, the other descends. Of course, the public have to pass from one to the other at the middle of the course. The weight of the iron employed in the construction of the tower is about 7,000 tons, and there are over 12,000 separate pieces.

Another triumph of iron is the Palace of Machines, 1,400ft. in length, 380ft. broad, and 158ft. high. The metallic arcs, having a span of 380ft., which constitute this vast building, weigh about 200 tons each. In order to allow free dilation, they are articulated at their summit and at their extremities, where they rest on the ground.

C. Detaille.

(*To be continued.*)

JAMES'S SHUNTER'S COUPLING ROD.

AN improvement on the simple coupling-rod for the use of train-marshallers and shunters has been patented by Mr. W. James, of Eldon-street, South Shields. Hitherto the device used for this purpose has consisted of a curved or twisted hook secured to the end of a pole or shank, without any arrangement for effectively gripping the coupling-link, with the result that the link occasionally slips off the hook. According to this invention, the socket of the hook is so made as to leave space for a movable tooth, which is operated by a rod preferably sunk into the pole or shank, and communicating with the handle end of the latter,

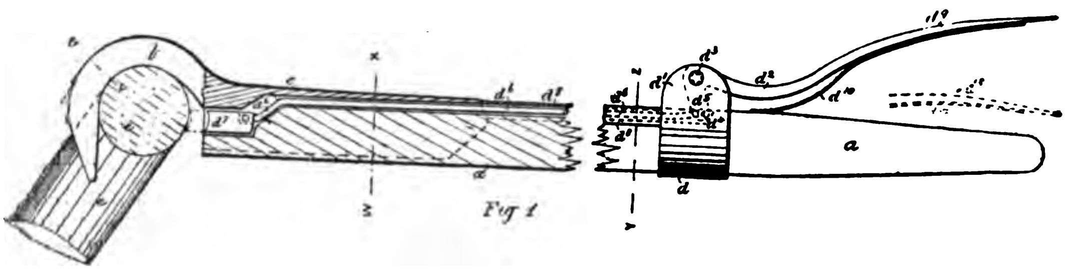


Fig 5

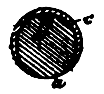


Fig 2

Fig 4

Fig 3

reciprocatory motion being given to the rod and tooth by means of a curved lever or handle suitably centred and controlled by a spring substantially analogous to the arrangement of the locking device on a locomotive reversing lever. Under normal conditions the spring keeps the face of the tooth within the socket, and on engaging a link for the purpose of coupling or uncoupling, the compression of the spring by the hand of the attendant projects the tooth against the link, firmly gripping the same against the side of the hook, which can then be manipulated with greater ease and certainty than has hitherto been found to be practicable. The release of the spring by withdrawing the tooth towards the socket disengages the grip, and allows the link and hook to become again disconnected. Figs. 2, 3, and 5 are cross-sections on the lines W X, Y Z, and U V in Fig. 1 respectively, and Fig. 4 is a cross-section of the movable tooth d^7. *a* is an ordinary wooden pole, similar to those now in use for railway coupling and uncoupling, on which the hook *b* is fitted by means of the socket *c* in any well-known manner; *d* is an iron hoop encircling the pole *a* near the handle end of the same, and terminating, on its upper side, in a pair of lugs or horns, d^1, between which the curved lever d^2 is mounted on a pin d^3. To the end, d^4, of short arm, d^5, of lever d^2 one end of rod, d^6, is attached by means of a double eye or otherwise, the outer end of this rod being attached to the tooth d^7 situate in a recess in the hook-end of pole *a*, and underneath the hook socket *c*. This rod d^6, which may be of three-sixteenth round iron, works in a groove formed in the pole *a*, and it is protected and guided therein by means of a brass or other plate, d^8, secured to the pole as shown in Fig. 3. The long arm d^9 of lever d^2 is controlled by a spring d^{10}, so arranged as to exert the pressure due to its resilience in an upward direction, so as to keep d^9 raised up from pole *a*, the effect of which is to keep the short arm d^5 in an inward position (as shown in Fig. 1), and as d^5 is connected by rod d^6 to tooth d^7, the latter is also normally kept in an inward position, as shown in Fig. 1. The operation of the invention is thus as follows:—The operator, holding the pole in his two hands, having slipped the hook *b* over a coupling-link such as *e*, shown in section, he then depresses d^9 in opposition to the spring pressure, as shown by dotted lines in Fig. 1, the immediate effect of which is to project the tooth d^7 against the link, as shown in dotted lines in Fig. 1. The link is thus jammed between the outer jaw of the hook *b* and the tooth d^7, with the result that the link can be manipulated with greater ease and certainty than has hitherto been found to be practicable.

RIGG'S PATENT WATER-MOTOR OR STEAM-ENGINE.

THE general principle upon which this engine is constructed may perhaps best be described by the analogy of fixing the flywheel of an ordinary engine instead of the bed; thus the admission of pressure would cause the whole engine to revolve around the crank centre. Such a departure from all former practice involves considerable changes in every feature of the gine, and it is worked out in the manner wn in the annexed diagram. There are four aders, each separate from the other, and not t together, but turning freely round a common . Their piston-rods are all connected with pins upon the face of a disc, which is mounted like the face-plate of an ordinary lathe. There is no other connection between the cylinders and wheel, and their respective centres are set at a given distance apart. This eccentricity is virtually the crank radius, and it will be seen from the diagram that No. 1 cylinder has its piston close to the bottom of a stroke, while No. 3 cylinder has its piston fully out, Nos. 2 and 4 cylinders in the meantime having their pistons in intermediate positions. In the central boss, and opposite each cylinder, there is a steam port, and this boss turns round and bears against a fixed valve face, provided with inlet and outlet ports. It is thus only necessary to arrange all these ports so that pressure shall be admitted while the pistons are moving outwardly, and exhaust occur during their return.

Whether such pressure arises from water, steam, compressed air, or any other source, it is equally available for driving this description of engine, and it remains only necessary to provide methods of regulation. With steam this is simply done by a valve to vary the angular length of the inlet-ports, and thus to alter the rate of expansion either by hand or governor.

But with water any provision for regulating must become a change in the stroke, provided the revolutions are to be maintained constant. In the new revolving engine this is accomplished in

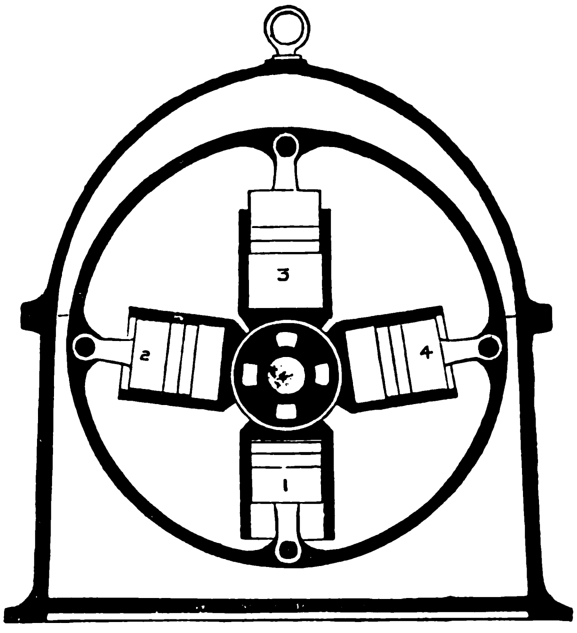


Fig. 1.

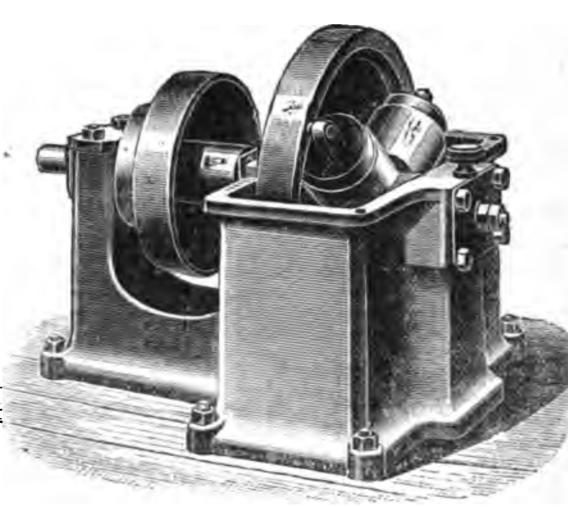


Fig. 2.

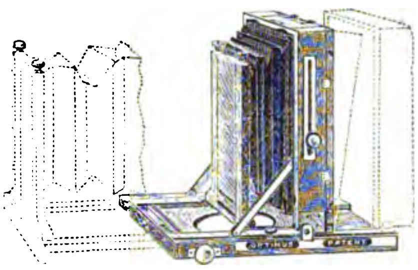
the simplest possible manner. Already it has been noted that the strokes of the pistons are determined by the eccentricity or distance apart of the centres of their revolution and the centre of the cylinder's revolution, and, when these centres coincide, there is no stroke whatever. A screw or ram arrangement is provided which shall effect the required changes in the eccentricity, and such rams constitute a second engine, with its valves actuated by any desired kind of governor. As the balls of such governor extend themselves, so does the stroke alter, and regulation can be had just as good as with any variable expansion engine; and in driving a dynamo with variable load, for example, it is easy to follow the changes in stroke as lamps are added or taken away.

At a central position there is no stroke whatever; but by moving the cylinder stud to the side opposite that shown, a change in the direction of motion issues, and thus these hydraulic engines can give their full power, or any part thereof, in either direction of motion. This feature is of value in driving capstans, and the engines are driven 500 to 600 revolutions per minute for drawing up the slack rope, or towing light craft with shortened stroke, reserving the full power for such times only as may be required for towing large vessels.

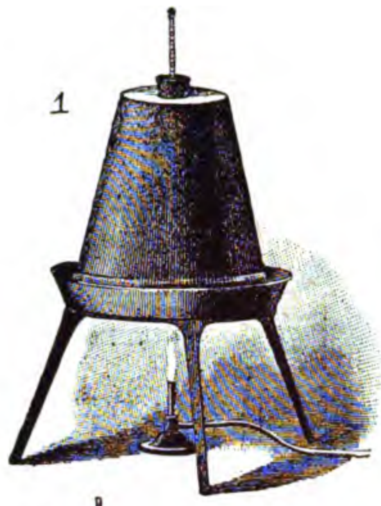
For the smaller purposes of a domestic motor giving one or two man-power, the complete arrangement is shown by the annexed woodcut. Here is a machine with three gunmetal cylinders driven by water from the street main, and exerting about one man's power. This motor has long been used for driving knife-cleaning machines and sewing-machines; and its competence to start or stop anywhere, and to go at any speed, renders it extremely useful. Indeed there is no difficulty whatever in stopping a knife-cleaning machine with its finger over the spot, nor in driving a sewing-machine and stopping the needle half-way up or down; a spring stop-valve being used for this purpose.

THE "OPTIMUS" WIDE-ANGLE EXTENSION CAMERA.

THE new wide-angle extension camera introduced by Messrs. Perken, Son, and Rayment, of Hatton Garden, will commend itself to the attention of photographers, as it meets all their wants as well as can be expected. It will go into a case having internal dimensions of 9in. by 9in. by 2¼in., and weighs only 3lb. while it is rigid, and the attachments so arranged that the lens can be turned down through the ring to which the tripod legs are attached. The illustration annexed shows in a graphic manner the capabilities of the camera, and explains how the focussing screen and body can be brought towards the front of the base-board so as to prevent obstruction or cutting-off of the view, when lenses of wide-angle aperture and short focus are used. It is provided with all the modern improvements or devices, double-swing arrangement, and long-focussing adjustment by means of a rack, which is so designed as to facilitate quick alteration by putting the rack out of gear. Like all Messrs. Perken, Son, and Rayment's productions, the camera is well made—it has "come to stop," as the Yankees say—and, we have no doubt, will meet with approval alike from professional and amateur photographers.



A SIMPLE AIR BATH FOR LABORATORY USE.*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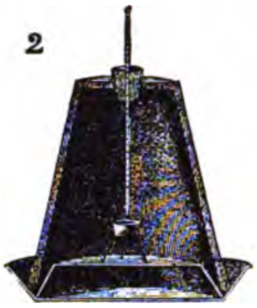
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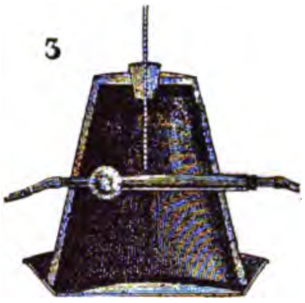
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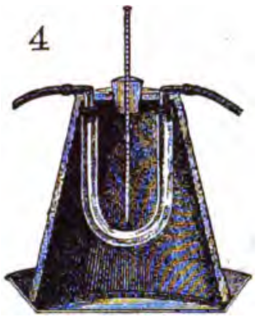
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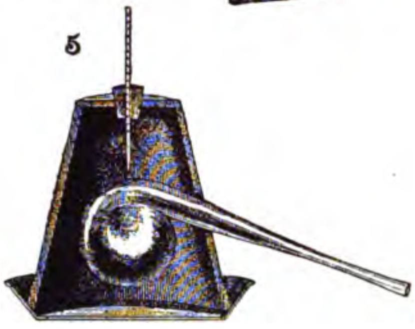
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THE air bath ordinarily used in chemical laboratories for drying precipitates, for making determinations of water by loss, and for similar purposes, is usually a rather expensive piece of apparatus. The iron or copper closet, with its door, tubulure for thermometer, shelves, stand, &c., works no more satisfactorily because of its somewhat elaborate or difficult construction. In the cuts is shown a simple substitute for this apparatus, that as regards simplicity cannot well be excelled, while its other good features certainly operate to commend it. It consists of an inverted flower-pot sustained upon an ordinary tin pan or sand bath, the whole being carried by a tripod or retort stand. The aperture at the top serves to receive a perforated cork, through which a thermometer is passed. An ordinary Bunsen burner is used to heat it. As the sand bath directly over the burner becomes very hot, it is advisable to invert a second smaller sand bath within the first, as shown in Fig. 2. This prevents too direct a radiation of heat from the hot metal. Upon this the little stand or bent triangle supporting the crucible or watch glass containing the substance to be heated may be placed. The thermometer should be thrust down through the cork until its bulb is near the substance to be dried, so as to obtain a correct indication of the temperature at that point. The entire arrangement is shown in external view in Fig 1.

To place a vessel in it or to remove one, the flower-pot is lifted off the sand baths. It will be observed that its porous nature provides a species of ventilation, while its composition assures it against corrosion. It even protects the plates below to a considerable extent, as drops of water or other fluid cannot run down its sides as it cools.

But convenient as it is in the rôle of air bath for simple drying operations, it will be found more so where drying tubes or retorts have to be manipulated at constant temperature. The flower-pot can be perforated at any place, and holes of any size or shape can be drilled and cut through it with an old knife, file, or other implement. Thus in Fig. 3 it is shown in use for drying a substance at constant temperature in a straight drying tube. The holes to receive this tube can be drilled in a few minutes. The arrangement as shown is of the simplest kind, but if the usual bath was used, it would require a special tubulation to be introduced or contrived for the tube to pass through. Flower pots cost so little that there need be no hesitation in preparing them for special uses.

In Fig. 4 a U tube is shown as being heated, while in Fig. 5 a retort occupies the bath, and is in use for fractional distillation or other operation requiring a constant temperature. In all cases it is better to use the second bath inverted within the chamber. It conduces greatly to the maintenance of an even temperature throughout the whole space. A hint may also be taken from the heavy drying plate formerly perhaps more used than at present. If for the light metal pans a heavy plate ⅛in. or more in thickness is substituted, the temperature will not be subject to as rapid variations, and less difficulty will be experienced in keeping a constant temperature. The tray furnished with the next large size of pot may be used instead of the sand bath upon which to rest the inverted flower-pot. This gives an absolutely non-corrodible construction.

When the bath is in use for drying substances, its top, which is at a rather low heat, affords an excellent place for drying precipitates wrapped in their filter papers. Its acts in two ways. It is generally just hot enough to dry them with reasonable quickness without danger of spurting, and it also acts by capillarity to absorb the water directly. It represents in the last respect the porous tile or blotting paper—appliances too little appreciated by chemists here. It must be remembered that the drying of a precipitate by evaporation leaves all the impurities of the wash water concentrated therein, while capillary absorption removes a great part of both wash water and its impurities, thus conducing to the accuracy of the work.

PREVENTION OF MAGNETISM IN WATCHES.*

ONE peculiarity of modern progress is the extent to which advancement in one direction exerts an influence in others which before had seemingly no connection. This is well illustrated in the recent improvements in watch construction. Owing to the very general employment of the dynamo, motor, and other electrical appliances, a pressing demand is arising for a watch which cannot be affected by magnetism; and, as usual, necessity, furnishing an incentive to invention, is conquering the difficulty which is now found to exist in the usual form of watches.

Those who have not given especial attention to the construction of a watch are apt to regard it as a rather intricate piece of mechanism. This is not the case, as it is in principle quite simple, consisting essentially of a train of five wheels and a governing attachment.

In this train there is, first, the largest wheel in the watch, the barrel, a flanged wheel, which contains the main-spring. This power wheel is geared into the centre wheel, whose staff, or arbor, carries the minute-hand. The centre wheel, in turn, actuates what is called the third wheel, whose function is simply to reduce the speed of the next wheel in the train, termed the fourth, to whose staff is attached the second-hand. This connects directly

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* By T. O'CONOR SLOANE, PH.D., in the *Scientific American*.

* By Prof. W. M. STINE, Ohio University, in the *Popular Science News*.

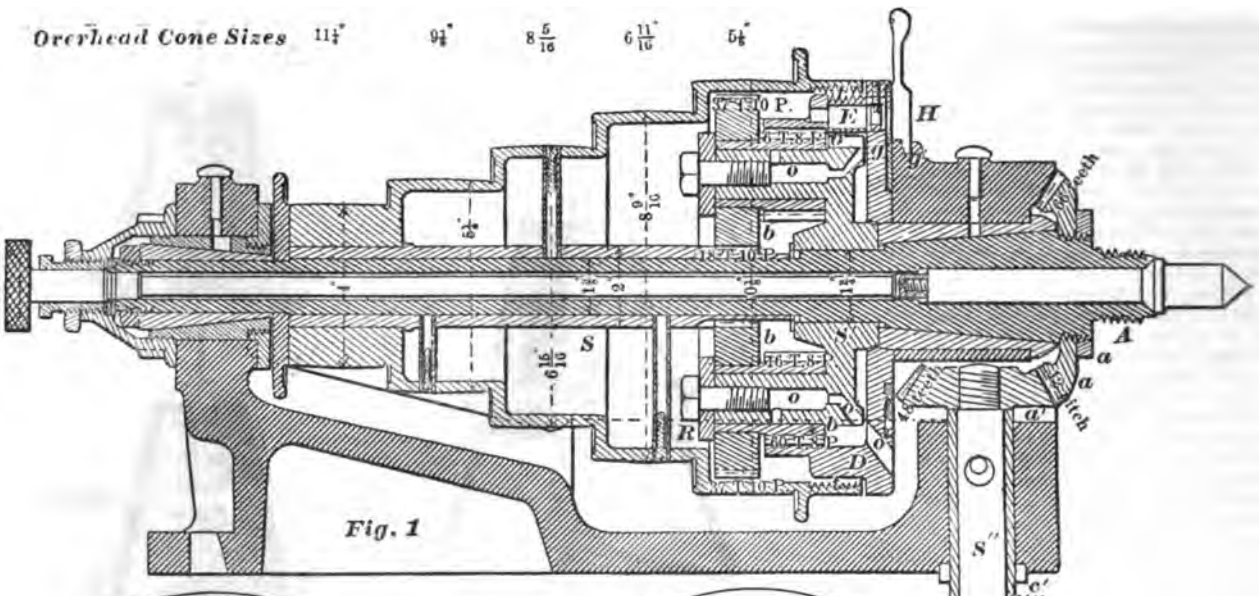


Fig. 1

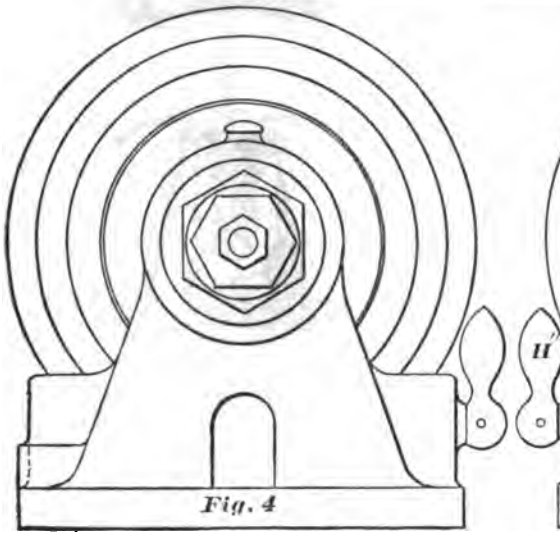


Fig. 4

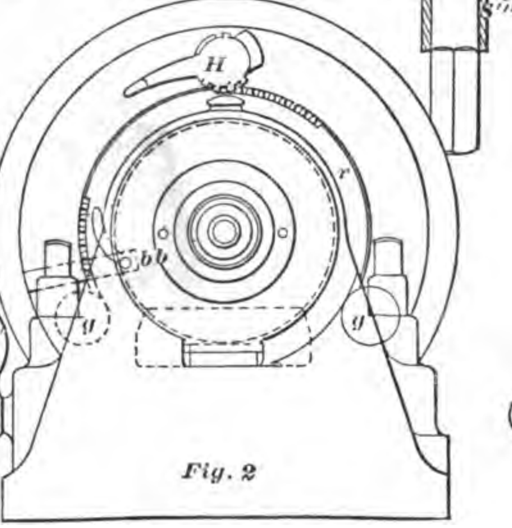


Fig. 2

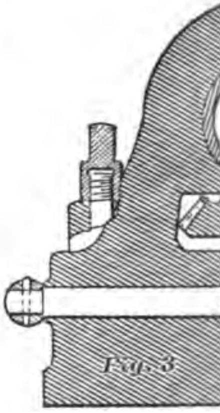


Fig. 3

to the last wheel, the fifth, or escapement, to which, by means of a lever, is attached the governing apparatus, and it is in this latter that we have what may be considered the vital part of the mechanism —since the time-keeping qualities depend almost wholly upon it; and it is also the portion to which the time and attention of the maker is chiefly given, and whose construction and adjustment largely determines the cost of the movement.

The governing of a watch, to make it a timekeeper, is accomplished, primarily, through the balance and hair-spring; the balance wheel playing the part of the pendulum in a clock—so that it may be regarded as an oscillating pendulum—while the hair-spring takes the place of the pull of gravity.

Into the coarse teeth of the escapement wheel, the pallets carried by the fork play alternately. The fork, being in direct connection with the balance staff, is kept in vibration by the combined action of the main and hair-springs. The free end of the hair-spring is attached to the balance staff, and coils and recoils with its reciprocating motion. As the hair and main-springs act against each other, the recoil of the main-spring delivered by the escapement turns the balance through a portion of a revolution and coils the balance-spring. When all the energy of the impulse of the balance is spent in coiling its spring, it pauses, and the elasticity of the hair-spring in recoil moves the balance in the opposite direction to its first position.

This, in brief, is the mechanism and action of the ordinary watch. To control this, so that it may run accurately and be relied upon under widely varying conditions, is, however a difficult task. The main-spring, it must be remembered, simply furnishes the power to keep the works moving, having nothing to do with the rate of the watch; this can be affected only in the controlling combination of balance and hair-spring, and any disturbing cause affecting the elasticity of this spring, or altering the moment of inertia of the balance, produces its corresponding change in the rate.

Thus the effect of temperature on a watch not compensated is very marked. An increase of 62° F. has caused a loss of 393 seconds in 24 hours; 62 seconds of this loss being due to expansion of the diameter of the balance, the lessened electricity of the spring resulting in a loss of 312 seconds, while a further loss of 19 seconds was due to increased length of the spring through expansion.

To obviate this the balance is usually compensated by being constructed of two metals—brass and steel—which, by their unequal co-efficients of expansion, change the moment of inertia of the balance, so as to counteract these deficiences. It is clear, then, that any condition which otherwise alters the electric power of the spring, or any force having a varying influence on the balance, must ultimately affect the time-keeping qualities of the watch. Magnetic influence is such a disturbing cause; it may produce a slowing or increasing of the rate, and it may even stop the watch.

If a watch has been exposed in a magnetic field, the balance-spring may become so magnetised as to exhibit a tendency to stick when coiled, giving rise to a change of rate, such as would be produced by a variation in the elasticity of the spring. In addition, the escape-wheel and fork may attract each other strongly, and the balance, in turn, with these parts may be attracted by the magnetism in the main-spring and various steel screws. It not infrequently happens that these forces become so adjusted that they stop the balance on a "dead centre." The magnetism of most of these parts, however, acts as a constant factor, and produces merely stoppage.

With the magnetised balance the case is different. It revolves in a field of constantly changing polarity, due to the motion of the steel escape wheel and the main-spring. The first would occasion a throbbing rate, and scarcely be noticeable in the long run; the second would alter the rate irregularly, at times accelerating and at others retarding the balance. These would not necessarily compensate each other, and would spoil the time-keeping qualities of the movement.

The chances of exposure to magnetic influence are numerous and constantly multiplying, owing to the increasing use of electricity. The electric propulsion of street cars is one thing that may work havoc with ordinary watches, and, as its employment is spreading so rapidly, will doubtless cause a general demand for a non-magnetic watch. Of course there is now a felt need for this amongst electricians generally, and those employed in running dynamos and motors. All the stationary iron and steel about a railroad, as well as the cars and locomotives, is apt to be more or less magnetised. Employés who travel over the same route find their watches occasionally becoming unreliable. Some companies have recognised this, and adopted preventive measures.

When once a watch has become magnetised, it can usually be taken out without harm. One method that has given satisfactory results is to twirl the watch rapidly in a strong field of constant polarity; another is to place it in a helix, through which an alternating current is passing.

There are now two methods employed for rendering a watch non-magnetic. One uses a shield or case of iron, but the results obtained with these are conflicting. Some investigatore find them insufficient in strong fields, though they may afford sufficient protection against weak ones. They seem to be in favour with railroad companies, some of which make their use compulsory.

The other aims to make the watch non-magnetic in its construction, producing a timepiece which is thoroughly reliable under all conditions of service. For the balance, brass would be sufficiently non-magnetic for ordinary purposes; but in order to have compensation, there must be some metal substituted for the steel. In one make of these watches the balance and hair-spring are made of alloys of palladium, the rim of the balance consisting of two alloys, having different rates of expansion, making a thoroughly compensated and non-magnetic balance. The escapement is of aluminium-bronze, so that the watch is not likely to be stopped by magnetism. Another leading make of non-magnetic watches employs alloys of platinum for both the balance and escapement. The non-magnetic qualities of these alloys is derived from combination of certain metals in such proportions that their magnetic qualities exactly neutralise each other. Platinum and palladium resemble iron in their magnetic behaviour—that is, a strong magnet so affects them that they exhibit polarity in the same order as the inducing magnet. With copper, gold, and silver, the reverse is the case. The former are termed paramagnetic; the latter diamagnetic. The metals actually entering into the alloy of the balance and spring of one make of watch are palladium, platinum, nickel, and steel—paramagnetic; silver, copper, and gold—diamagnetic.

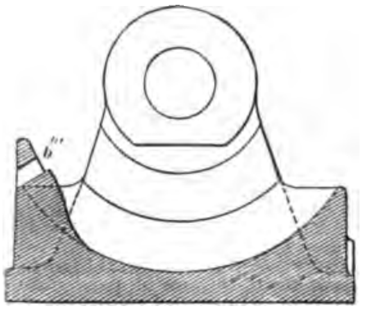


Fig. 9. SECTION A B.

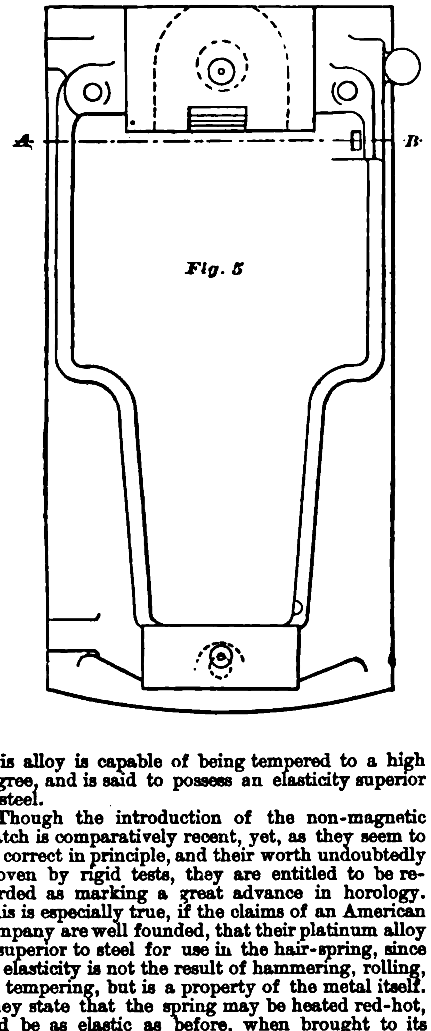


Fig. 5

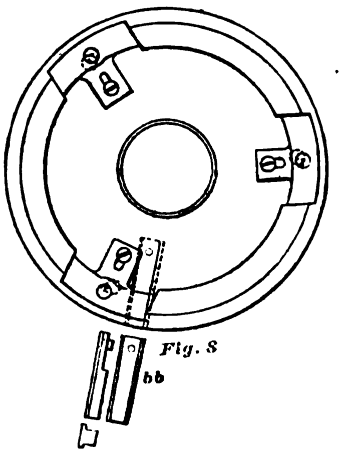
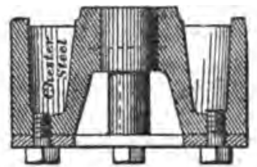


Fig. 8

Fig. 7



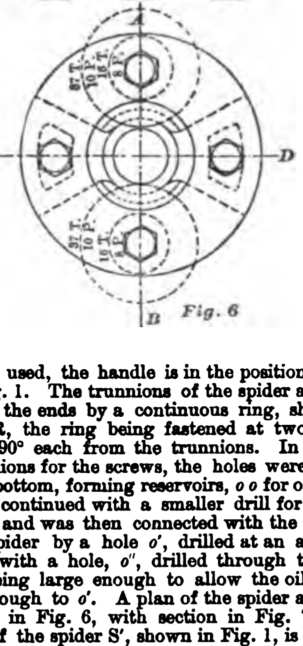


Fig. 6

This alloy is capable of being tempered to a high degree, and is said to possess an elasticity superior to steel.

Though the introduction of the non-magnetic watch is comparatively recent, yet, as they seem to be correct in principle, and their worth undoubtedly proven by rigid tests, they are entitled to be regarded as marking a great advance in horology. This is especially true, if the claims of an American company are well founded, that their platinum alloy is superior to steel for use in the hair-spring, since its elasticity is not the result of hammering, rolling, or tempering, but is a property of the metal itself. They state that the spring may be heated red-hot, and be as elastic as before, when brought to its original temperature. Thus the attempt to render a watch non-magnetic has resulted, independently of this quality, in producing movements superior to those already brought to such a high state of perfection.

DETAILS OF SWEET'S 16in. ENGINE LATHE.*

FIG. 1 represents a longitudinal section of the head stock, in which the construction is clearly shown. The arbor A has a peculiar arrangement of screw for holding the face-plate, the threads being cut parallel, but at the end and shoulder tapers are made, which have their counterparts in the face-plate. The plate is not fitted closely in the thread, the fit coming at the two tapers and shoulder. The collar and bevel wheel, *a a*, are screwed to the arbor, and have no tendency to unscrew, as the lathe runs in one direction only. The steel spider S' is keyed to the arbor, and has two trunnions projecting from diametrically opposite points with their axes parallel to the arbor, which carry the four spur wheels, *b b b b*. The hubs of the two smaller wheels project far enough to carry the two larger ones to which they are keyed. The small wheels engage with the internal wheel referred to as part of the disc D, the larger ones being driven by the sleeve S, to which the cone is keyed. When the gears are not in use, the disc D is drawn up to the end of the cone, and the gear, train, arbor, and disc all turn together, the handle H being in the position shown at Fig. 2. When the gears are used, the handle is in the position shown at H, Fig. 1. The trunnions of the spider are supported at the ends by a continuous ring, shown at section R, the ring being fastened at two raised surfaces 90° each from the trunnions. In drilling the trunnions for the screws, the holes were drilled into the bottom, forming reservoirs, *o o* for oil. The hole was continued with a smaller drill for a short distance, and was then connected with the outside of the spider by a hole *o'*, drilled at an angle to coincide with a hole, *o''*, drilled through the disc, hole *o''* being large enough to allow the oil-can to reach through to *o'*. A plan of the spider and ring is shown in Fig. 6, with section in Fig. 7. The section of the spider S', shown in Fig. 1, is at A B, Fig. 6, and the section, Fig. 7, is C D of Fig. 6. The serrated surfaces shown at *t* (Fig. 1) were originally intended to represent threads, so that, by throwing out the blocks, one of which is shown in section *t'*, the disc D would be screwed up against the end of the cone, thus throwing out the gears. It will be seen that disc D is shown drawn close to the inner nut of the hub which carries the main arbor bearing, and also that the hole through it is a double taper. The steel box projects through the casting a distance equal to one-half the thickness of the disc. This and the hub of the spider have a taper equal to those of the disc. When in position it will be seen that D has no contact with the spider at its hub, which revolves with the arbor, therefore no wear occurs. When the disc gears are out of action the disc is drawn to the taper on the hub of the spider, and all wear is avoided on that side. As the lathe was constructed, parallel grooves were substituted for threads, and the movement of the disc to the cone was caused by a lack of coincidence in their position. The handle H is fast to the shaft E, having an eccentric turned on its inner end with a short bearing beyond. This eccentric passes through the block *t'*, and throws it up and down. H also has as a projection on its opposite end, and when in the vertical position it is drawn into the groove *g'*. On this same shaft, and against the inner side of the handle, is a small wheel *g*, let into the surface of D by a counterbore. This gear engages with a continuous ring *r*, Fig. 1, having enough teeth cut on it for a half revolution of *g*. This device is duplicated, minus the handle, at points *g g*, Fig. 2, shown in dotted lines. On the end elevation of the head stock, Fig. 2, the ring *r* is shown with spiral slot, and sliding bolts *b b*, as shown at *b b*, Fig. 8. Two of these bolts were used, and, when thrown out, passed into a square slot shown in section of head stock at *b''*, Fig. 9. It will be observed (Fig. 2) that by moving H rotary motion is imparted to ring *r*, and by it to *g g*, which turns the three eccentrics which slide the three blocks up and down. A section of D, through the position of the blocks, is shown in Fig. 8. Coincident with these movements the bolts slide back and forth. This looks pretty complicated, but there is a grain of consolation as part of the dose; the wrench used to get the gears out and in never gets lost, and the belt never gets caught in the gears.

The portion of the section (Fig. 1) lying under the main bearing shows the vertical shaft S'' and gear by which motion is imparted to the screw gears. This shaft runs in the sleeve S''', which also has a vertical motion imparted by handle H'', Fig. 2, and which disengages gears *a a'*, Fig. 1. A transverse section through the centre of shaft S'', Fig. 3, shows the connection at this point. The collar on which the head stock swings when boring tapers is shown at *c'*, Fig. 1. The lower end of shaft S'' is square, and fits a bevel gear supported in position in the bed casting.

I wish to call special attention to the centres of this lathe, as I believe them better than the taper centre. When they were introduced here I thought the idea original, but have since found them in use on the headstock end of jewellers' lathes. Not, however, for their own merit, but to conform to the spring chucks, and to interchange with them. This much may be said of them, however—that they will remain tight in place. They can always be cleaned at the angle, and if there are any particles of dirt in the holes the centre will clean it out when put in place, and it can be taken out and put in indefinitely and run true.

PHOTO - LITHOGRAPHIC TRANSFERS.*

THE usual method of making photo-lithographic transfers is upon gelatine made sensitive with potassium bichromate. This is quite sensitive enough to daylight, or to electric light; but if transfers are required when neither day nor electric light is available, then bichromated gelatine is useless, and some other method is wanted. Try this:—Make a print upon any of the ordinary bromide papers of commerce, using a good negative from a subject in line, by artificial light; develop the image with alkaline pyro, then wash and place it upon the inking-board; next, blot off the water with a soft cloth, and dab all over with a sponge saturated with transfer ink thinned with turpentine; let the turpentine evaporate, then take a glue roller—i.e., a type-printer's roller, and roll until the whites are quite clear of ink. Now soak the print in the pyro again for a few seconds, and expose it to the light. Finally, wash free from pyro and hang the print up to dry. When the print is dry it is ready for the transferrer, who treats it the same as he would any other photo-lithographic transfer.

The only way to fail with this method is to over or under expose the print, or to use a bad negative. The negative must show perfectly clear lines. Some of the newer papers of commerce contain too little gelatine to succeed perfectly, therefore it is best to make the paper at home. It is not a very complicated process, as the colour of the image under the developer is not all-important. A good formula is

Gelatine	800 grains.
Water	30 ounces.

When the gelatine is quite soft melt it at 120° Fahr., and add 320 grains of ammonium bromide; stir it until it is dissolved, then add 10 minims of hydrochloric acid and stir well.

In 10oz. of water dissolve 450 grains of nitrate of silver, bringing this solution to the same temperature as the gelatine solution; now proceed to pour the silver solution into the gelatine in a very thin stream, stirring it vigorously all the time. Now strain it into a warm dish, and tilt the solution so that it is only along one edge of the dish. Having made a small roll of the paper, lay one edge of the roll upon the liquid, and as it curls take hold of it and lift it slowly up, when the paper will unroll itself, and receive a nice even coat of emulsion. Hang it up to dry, and repeat until all the emulsion is used.

For half-tone transfers use the bromide and chloride of calcium with 200 grains extra of gelatine, drying the paper at as high a temperature as possible without melting the gelatine. Paper with this emulsion upon will be very hygroscopic, and must be kept very dry. Before use always dry the paper, and warm again before developing, so as to encourage the reticulation of the gelatine.

This paper is to be exposed under a half-tone negative, developed and washed, then inked up as directed for the line transfers, followed by immersion in the developer, and subsequent exposure to light, washing, and drying. To transfer to stone, trim with a pair of long shears, then put it into the damping-book until quite limp; then sponge the back of the transfer with a solution of oxalic acid one part, water 100 parts. Take great care that none of this solution gets on the front of the transfer. Lay the sheet in position upon a cold, dry stone, and pull it through the press, with plenty of pressure, five or six times without lifting the tympan. The paper can be lifted off, leaving the image n ink on the stone. Gum it in and leave it for five or six hours before rolling up.

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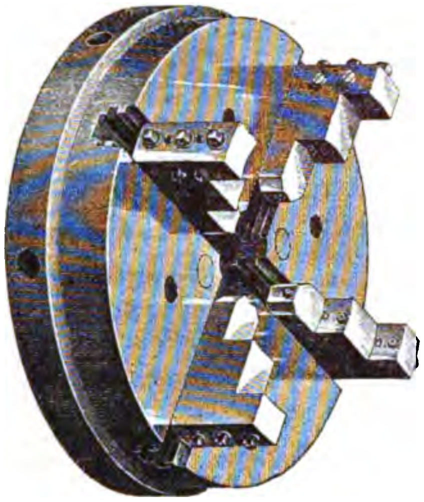
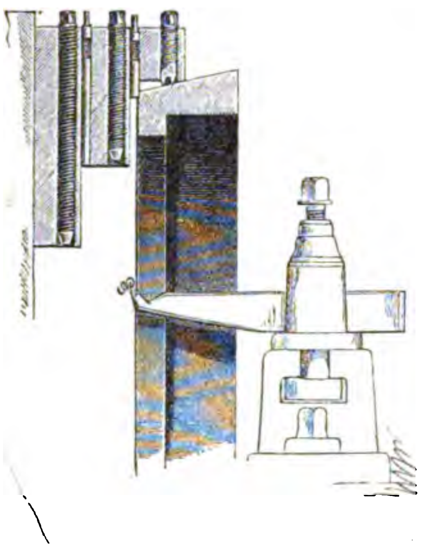
* By Prof. C. I. KING, in *American Machinist.*

* A paper by W. T. WILKINSON, read at the Camera Club Conference.

IDE'S IMPROVED LATHE CHUCK.

THE improved lathe chuck shown in the illustrations annexed has been patented in America by Mr. Samuel Ide, of Medina, New York state. One of the views is in perspective, and the other in longitudinal section, with the tool represented as cutting on the opposite side of the work from which it would be in practice, for better explaining the operation of the chuck. The chuck has one or more clamping screws with annular biting edges at their inner ends, the jaws having a series of steps or shoulders, and set screws working in threaded openings in the jaw and communicating with the vertical faces of the shoulders, while adjustable rods work in openings of the jaw on a level with the horizontal faces of its steps or shoulders, the set screws retaining the adjustable rods. When the work has to be bored entirely through, the rods are moved outwards and interposed between the work and the bottoms of the shoulders, thereby holding the work out of contact, and preventing the point of the boring tool from defacing the jaws after passing through the work. One of the most valuable advantages of this improvement is that the chuck is designed to hold tapering work that the common chuck will not hold, while it is designed to hold all work more securely while the cutting tool is in operation.





SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

FRIDAY, June 14th, Mr. W. H. M. Christie, Astronomer Royal, President, in the chair.

Mr. Downing: Seventy-five presents have been received since the last meeting of the society. Amongst them may be mentioned a series of drawings of Jupiter, made with the reflector of 3ft. aperture, at Birr Castle, Parsonstown. Also there has been presented to the society, by Mr. Knobel, the original MS. observations of Admiral Smythe's Bedford Catalogue.

Mr. Knobel: With regard to Admiral Smythe's MSS., it has been hitherto supposed that the original MSS. were in the library of our society; but it appears that they are only a MS. copy in Admiral Smythe's writing, which was prepared for publication. At a sale last autumn of Dr. Lee's MSS., I was able to obtain a large number of the original notes of observations as made each evening by Admiral Smythe. These number many hundred sheets. Unfortunately, they had all been torn in half, and the bottom and top halves had been indiscriminately mixed, and some had been lost, though I was able to obtain the top halves of all the observations.

Mr. Taylor read a paper on "Observations of the Spectrum of Uranus." The first observation was made on Thursday, May 16, 1889, at Mr. Common's Observatory, Ealing, when bright flutings were detected in the spectrum of the planet. The most striking features on the first examination were the four dark bands in the orange, green, blue, and yellow. The second dark band from the red end was by far the broadest. No trace of any solar or narrow lines in the spectrum was visible. As comparisons were difficult and no measurements could be made, light-curves were drawn by two independent observers, and, on comparison, these were found to agree in all particulars. The four dark bands agreed in their relative positions and respective widths. On the 18th he again observed the spectrum, and confirmed the light-curve made on the 16th. Subsequently ten dark bands were seen and the positions measured, as well as the position of 14 bright lines. On no occasion was any narrow line seen, as in the solar spectrum, they were found to be entirely absent. The presence of the broad flutings in the spectrum of Uranus indicates that we must considerably modify our ideas as to the physical constitution of the planet, and it must be to a large extent self-luminous—in fact, there seems to be a complete absence of solar light in the spectrum.

Mr. Knobel: I think after this very remarkable and interesting paper which Mr. Taylor has read it would be interesting to the society if I read a letter I received from Dr. Huggins yesterday on the same subject. Dr. Huggins writes under date June 11: "You may like to know of an interesting new result I have just got. I have succeeded by photography in solving the question of solar light in the spectrum of Uranus. With an exposure of two hours I got on the 3rd June a fine spectrum extending to M in the ultra violet. In the spectrum of the planet all the chief Fraunhofer lines are distinctly seen, and I am unable to distinguish any other lines bright or dark. It is certain, therefore, that the light of the planet, in this region of the spectrum at least, is solar. In 1871 I sent a paper to the Royal Society on the visible spectrum of Uranus, and gave a map and measures of six dark bands. I was unable, on account of the feebleness of the light, to catch the solar lines. In 1872 Vogel worked on the spectrum, and he also confirmed my observation of the absorption lines. The weather since June 3rd has not permitted me to observe again the visible spectrum."

Mr. Maunder said: I observed the spectrum of Uranus two or three years ago with our 12in. equatorial at Greenwich, and I was able to see the same dark bands which Dr. Huggins and Vogel have observed. I found the spectrum of Neptune was so faint, that it was not quite as easy to observe as Uranus; but I was not able to distinguish anything like bright lines or bands in the spectrum of Neptune or Uranus. Of course, that does not give one the right to speak about what could be seen with 25 times the aperture; but it struck me when Mr. Taylor was giving the wave-lengths of the flutings that a number of them were very suspiciously near the darker lines of the solar spectrum. If there was anything like the absorption of aqueous vapour in the spectrum of Uranus, we might easily get the appearance of faint lines or bright bands between the absorption spaces.

Mr. Ranyard: I have examined the spectrum of Uranus on more than one occasion, and it seemed to me there was a distinct difference between the spectrum of Uranus and the solar spectrum. I did not see any bright lines. It seemed to me that the absorption lines or bands were distinctly broader than in the solar spectrum, or in the spectrum of Jupiter, for example. As to Dr. Huggins's note, I should like to make the remark that his observation is not definitely and distinctly contradictory to Mr. Taylor's, because you might have absorption phenomena at the red end, and the solar spectrum only at the blue end. The natural spectrum of Uranus may only consist of long wave-lengths if it is a cool or only red-hot body showing through a dense atmosphere. Therefore, at the violet end we might have only the solar light, and an additional light in the lower part of the spectrum.

The President: This is a very interesting question which Mr. Taylor has brought before us, and the distinction there appears to be between the visible spectrum of Uranus and the invisible portion, as photographed by Dr. Huggins, is a very remarkable fact. In the case of some of the stars where you have flutings, it is quite easy either to suppose that you see bright lines or dark absorption bands; and in the case of Uranus I gather from Mr. Taylor's observations that there is no doubt very strong absorption, and independently of this there comes the question of whether these bright flutings are due, as he supposes, to the extra brightness of the spectrum, or to the darkening of the spectrum in the surrounding parts. So far as we can judge on the evidence before us to-night, it is a matter for further investigation.

Father Perry then read a paper on "Photographs and Drawings of the Sun made at Stonyhurst." He said he did not propose to institute any comparison between the relative merits of solar photographs and drawings, but merely to attempt to test the correctness that could be attained by solar drawings. He admitted that a photographic record of the solar surface was of primary importance for the study of solar physics, as photography had the great advantage of being independent of the bias of the observer. It was obvious, however, that the study of the sun's surface by the eyepiece had advantages which no photographs could supply. They were now concerned with the production of permanent records of solar phenomena, and the question of the greatest moment was, could they hope to add to the information they had obtained? He had examined the Greenwich tables for the year, which was most favourable for solar work in the North of England, and he found that the result of photographing the sun on 259 days in 1887 would be to supply useful pictures on three days. He had no hesitation in saying that the most useful permanent record that could be obtained was by accurate drawings of the solar surface. The results printed each year at the Royal Observatory offered the most trustworthy means of ascertaining the degree of precision at which they could hope to arrive. One very important element was the state of the sky at the date of observation, and that should be carefully noted at the period of taking each picture. Drawings of sunspots possessed a distinct advantage over photographs from one point of view. The photograph was taken at the instant when the sky seemed favourable, but at the moment of exposure the whole condition of things might be altered, whereas in the case of a drawing the draughtsman remained at his work a considerable time, and he always availed himself of the best moment of seeing and securing perfect accuracy of his outline. In conclusion, the Rev. Father Perry said although the paper might seem to have taken the form of special pleading in favour of solar drawings, still if it was a question of choice between photographs and drawings of the sun's surface, then he should decide in favour of the former; still he thought they would greatly advance their knowledge more by a skilful use of the pencil than by any other means that they could adopt.

Mr. Marth explained that he had not given in the last number of the *Monthly Notices* a list of lunar sketches because those who made the sketches had omitted the times of making the drawings: without such information the drawings were of no use for his purpose. He wished to speak of two occurrences which would happen this year, and which ought to be observed. The first was the close conjunction of Mars and Saturn on the morning of the 20th September. If they wanted to observe it, they must get up early. The conjunction would be closer than any on record. A dozen years ago he made a communication about the treble conjunction between Mars and Jupiter and Mars and Saturn. The nearest approach then was 74 minutes. This time it would be closer—namely, about 65 minutes. It would occur at 20 hours, so it would take place here in the daytime; but as those planets would be 30 degrees from the sun in a clear sky, both might be observed. The next preceding conjunction was in 1817, but it was not observed because it could only be observed in Australia. What made this close conjunction of the two planets so remarkable was that it took place within a degree, or within 45 minutes, of Regulus and Alpha Leonis. He had tried to find out when this had happened before, but it was an undetermined problem.

The following papers were also presented:—J. E. Gore, "On the Orbit of Sirius"; H. Ingall, "Note on the Nebulous Star in Mr. Roberts's Photograph of 81 and 82 Messier Ursæ Majoris."

WESTERN MICROSCOPICAL CLUB

THIS club held on Monday, June 3rd, its monthly meeting at the house of Rev. Prof. G. Henslow, M.A., F.L.S., Drayton House, Ealing

A large number of the members came early, and enjoyed a preliminary stroll round the extensive grounds, thick with splendid trees, including the Wellingtonia gigantea, cedar of Lebanon, various conifers, &c. The professor then gave a very interesting dissertation on "Floral Structures as Modified by Insects and other Agencies." The origin of flowers is unknown. Botanists see important connections between the reproductive processes of clubmosses and gymnosperms; but between the latter and exogens there does not appear to be a single "link" extant. Though gymnosperms are wind-fertilising, all existing exogens of such a nature are with little doubt degradations; while endogens, the lecturer maintained, are derived from exogens primarily, through an aquatic habit. Assuming then a buttercup as a starting-point, as being a type of the least differentiated flowers, the progressive changes which have occurred in the production of highly specialised flowers are due to alterations in the number of parts, to cohesions and adhesions amongst the members of the floral whorls, and especially to form, producing irregularities of various kinds, the results being innumerable correlations to insect fertilisation. As illustrations, especially seen in the modifications of the corolla, are first the formation of a tube as being the strongest method of counteracting the weight of an insect; then the adaptation of the varying lengths of the tube to the tongues and proboscides of insects, short-tongued diptera, &c., being the fertilisers of short-tubed flowers; lepidoptera those of long-tubed ones. One of the most characteristic adaptations is the enlarged anterior petal when it supplies the landing-place; but if the stamens be declinate, and take the weight off the anterior petal (if present) by supporting the insect this petal either retains its normal size, or is "pushed" to one side, or atrophies or disappears altogether, as in horse-chestnut. If there be no anterior petal, as in rhododendron, then while the stamens carry the insect, the posterior petals become hypertrophied and are marked with "guides," instead of their being on the anterior one, as is often the case when this forms the landing place, as in the pansy. The theory propounded by the author is that all such correlations are due to the responsive power of protoplasm to external irritations received from the insects themselves, so that parts of flowers have hypertrophied where special stimuli have been applied, and others have atrophied. The theory also accounts for mimetic flowers, in that such have assumed similar forms, presumably in consequence of similar insects having visited them: thus Polygala, Pelargonium, Corydaliforum, Collinsia, and others are more or less papilionaceous in form. Again, the fact that declinate stamens occur in such widely distributed flowers as horse-chestnut, dictamnus, lamium, pelargonium, and amaryllis—these have no affinity, and therefore some other common cause must be looked for to account for it. Similarly, the pistil always has the style and stigma in direct correlation to insect fertilisation, the stigma being invariably situated so as to strike the insect exactly where the anthers may have deposited the pollen. Lastly, the honey glands are always situated in the places in direct agreement with the essential organs. The fact that their positions are not reducible to any law, but are in such positions as happen to afford the easiest access to the proboscis of the insect, often varying in different genera of the same order, is another indication that they have been probably formed in response to irritations excited from without. In considering what advantages may accrue to flowers by being adapted to insects, only one "end" seems admissible, and that is the formation of sufficient and good seed. Now observations show that in proportion as flowers become specialised, so does the chance of insect visits decrease; thus—e.g., while buttercups are visited by more than 60 species of insects, species of Aconitum and Delphinium have only one effectual visitant each. Hence "intercrossing is inversely proportional to differentiation." The converse of specialisation to insect agency is degradation. This assumes two forms: self-fertilisation and wind-fertilisation, and in proportion as flowers become normally self-fertilised, so does fertility increase. Hence the second generalisation from experience is that "fertility is proportional to self-fertilisation." Lastly, it may be observed that while highly differentiated flowers are generally more restricted in geographical distribution, self-fertilised and wind-fertilised species of our Temperate flora are cosmopolitan. For further details and evidence in support of the theory proposed, the reader is referred to the author's work on "The Origin of Floral Structures through Insect and Other Agencies," M. Vernat, Sci. Series, Vol. LXIV.

ASTRONOMICAL SOCIETY OF FRANCE.

THE May meeting took place on the 1st, M. Faye, president, in the chair.

M. Schmoll proposed that the observation of the sun be undertaken in a systematic manner, and that observers adopt a uniform plan of drawing the spots, estimating their size, &c. A committee was named to that effect, composed of MM. Flammarion, Gerigny, Schmoll, Gunziger, and Bardou.

M. Flammarion mentioned a letter from M. Guiot, who had seen the crescent of Venus with the naked eye.

M. Faye explained M. Loewy's method of determining the constant of aberration, and reminded the society that the Royal Astronomical Society had granted their gold medal for this work. M. Loewy places two plane mirrors before the object-glass of the telescope, and thus brings into the field of view two very distant stars, and can compare the effects of aberration of light, which are very different for the two stars.

M. Faye called the attention of the society to M. Luvini's theory of atmospherical electricity, which, according to the author, is produced by the friction of crystals of ice in the superior regions of the atmosphere against the spherules of water contained in the damp air of the lower region, the two layers being brought into contact by descending currents of air.

M. Gunziger read a paper on "Observing and Drawing Sunspots."

INSTITUTE OF MARINE ENGINEERS.

A MEETING of the Institute of Marine Engineers was held on Thursday evening, 6th inst., in the Langthorn Rooms, Stratford, when the discussion on the paper on "Shafting in the Mercantile Marine," read by Mr. Manuel at the previous meeting, was continued.

In the absence of the president, the chair was occupied by the honorary secretary, Mr. James Adamson, who introduced the subject of the evening by referring briefly to several noteworthy points in the paper, with a view to court discussion, and invite members and visitors to relate their experiences or express their opinions. The first point referred to was the original lining off by the builders of the shafting, a matter of the utmost importance, which demanded great care and attention. Of no less importance is the providing in the design of ample bearing surface on the blocks. Mr. Manuel had referred to cases where considerable trouble had been experienced with steamers from the time of leaving the builder's hands, on account of want of attention to these details.

In connection with this part of the subject the chairman referred to the good practice adopted by some of marking the blocks at a point below the bearings, and making accurate gauges, so that the engineer could tell at a glance how far the shaft had fallen below the original lining off. Cases were cited illustrative of the want of sufficient bearing surface, where the use of water was of almost constant practice, to the detriment of the whole work of the engine-room, and of others where the bearings had not been touched during eight years of close running and hard driving. The need of more surface in the after than the forward bearings, and the fact of the after part of the shaft having greater strain upon it, were touched upon, and reference was made to a shaft which developed a serious flaw in the after bearing, where, as a safeguard, the shafts were reversed and the after-bearing with the flaw was shifted and became the forward bearing; this shaft ran for two years and more after this change. The exceedingly interesting description, illustrated by diagrams and samples of the process of manufacture and the testing of the material, were next referred to, and the surprising amount of accuracy with which the forgeman coupled his work, and so left the least possible amount of work for the turner. Mr. Manuel had referred to the paper on "Shafting" by Mr. Milton, read before the Institute of Naval Architects in 1881; but there was another and later one by Mr. Hector McColl, read before the Institute of Engineers and Shipbuilders in Scotland, session of 1886-7, and which would amply repay perusal. The difficulty experienced with regard to the propeller boss was mentioned as due largely to improper fitting at first, which opened up the way for the action of sea-water to have effect on the bearing surface of the boss, involving fitting the boss higher up the shaft cone, and occasionally, when the action had been going on too long, the cast iron of the boss had softened, and the process of refitting had been continued time after time, until it became necessary to fit a new boss or shaft on both.

Mr. F. W. Shorey questioned if much, or if any, damage was done to the shaft by the forgeman putting on an extra finish, as he had not found in his experience when turning large shafts that the outer skin was much different from the inner section —certainly not to the extent indicated on the diagram showing the section of the broken shaft.

Mr. D. Greer was inclined to agree with the view that the shaft in question did not break from being weakened by the extra finish put on it by the forgeman, but from other causes.

Mr. J. R. Ruthven spoke at some length on the subject of the undue strains to which, in these days of almost instantaneous reversing gear, the shafting of steamers is subjected. He considered that if records were kept showing the number of times the engines were reversed from full speed ahead to full speed astern, often by orders given from the bridge by the navigating officer thoughtlessly, it would prove that the shafting is not altogether treated justly. He gave an instance of a small steamer, which put into port with a broken shaft, where, for want of facilities to forge a new one in the time, a large shaft was turned down to suit, and although kept larger in diameter than the original, it gave way, showing that the inner section of the forging is not so reliable for strength as the outer portion.

Mr. J. H. Thomson referred to the paper read by Mr. McColl, a copy of which had been handed to him by the Hon. Secretary, whose remarks as to the value he endorsed, and spoke on the subject of crank pins in built shafts, and the different opinions which were held as to shrinking on the "webs," keying them, or fitting pins to prevent the tendency to slacken, cases of which had been referred to by Mr. Barringer at the previous meeting. Messrs. J. Stuart (Orient Line), W. W. Wilson (P. and O.), J. Simpson (National Line), J. Bruce (City Line), and others continued the discussion, referring to the breaking of propeller shafts, galvanic, corrosive, and mechanical action on these shafts; to the fitting of the bosses on the shaft, and causes leading to the bosses becoming slack, after which Mr. Manuel explained his own views, and illustrated more fully the several matters which were brought forward in the course of the discussion by the various speakers.

The proceedings were brought to a close by votes of thanks to Mr. Manuel and to the chairman of the evening, respectively moved by Mr. J. Bruce and Mr. R. Leslie, which were heartily responded to. The chairman, in closing, stated that members who had not yet received their copies of the first paper and discussion could obtain them now. He also announced that the samples of steel, all illustrative of the recent paper, could be inspected at leisure by members in the reading-room any evening by the kindness of Mr. Manuel. It had been considered advisable to close the present term for the reading of papers for the summer months. Arrangements were being made for the reading of a paper during the first week of September by Mr. W. J. Craig or Mr. Newall. Other papers had been promised by Mr. J. McFarlane Gray and Mr. Manuel, and by a few of the honorary members. The reading-room and library would remain open as usual for the use of members of all grades. The council would meet during the recess on the first or third Friday of each month, unless summoned for special business.

The Corkscrew Machine.—In the United States Section of the Machinery Hall (Paris Exhition) a very ingenious machine is shown in operation by the Clough Corkscrew and Capsule Company, of Newark, New Jersey. It has been for some time the practice of chemists and the vendors of fluids contained in small bottles, such as perfumes, ink, &c., to supply a corkscrew with each bottle sold; these are manufactured on the machines just alluded to. Wire from a reel is passed through straightening dies, and cut off to the right length, one end of the wire being cut square, and the other obliquely, by suitably shaped shears: the length of wire is then forced by a sliding bar around a circular mandrel in a direction at right angles to that in which the wire is fed into the machine; in passing round the mandrel the ends of the wire are brought together and passed into a rapidly-revolving twisting device, which bends one end of the wire into the form of a screw and wraps the other around the loop made by the mandrel upon which the wire is still retained; as soon as this is done the corkscrew is completed and is thrown into a receiver; the machine produces 3,000 corkscrews an hour. Another very ingenious application of the machine is found in the manufacture of screwed rings for picture-frames, which are produced at a still more rapid rate.—*Engineering.*

THE British Vice Consul at Ciudad Bolivar, in Venezuela, in his report for the past year, observes that in a few manufactured articles Germany appears to compete more strongly with English producers than before—for instance, in cutlasses, penknives, and scissors. On the other hand, English manufacturers are gaining ground again in other articles. The importation of English goods has not varied to any appreciable extent during the last two years. French enterprise and capital continue to be attracted to Venezuela, and during the past year visits of French engineers have taken place.

A LARGE white oak tree at Scottsburg, Ind., was lately bought for 75 dols. It was 9ft. in diameter. The desire was to get the largest board possible out of it, and one was obtained that was 10in. thick, 92½in. wide at the butt, 54½in. wide at the top, and 32ft. long. It took an entire day to move the board a mile and a half, with two yoke of oxen and eight horses. It is thought to have been the largest white oak tree in the United States. The board was shipped to New York.

SCIENTIFIC NEWS.

RECENT controversy in connection with astronomical drawings compels the observation that it would be better if photography were more extensively utilised. Astronomers draw what they see as faithfully as possible; but it is clear that they do not all see alike, even when observing at the same time. Dr. Boeddicker has recently issued a series of drawings of Jupiter made with the aid of the 3ft. reflector at Birr Castle, and he is about to publish a drawing of the Milky Way, which has been reproduced by a photo-mechanical process; but it would be better, when possible, to photograph direct, and we expect that considerable advances will be made in astronomical photography before the century comes to an end.

From the Rev. S. J. Johnson, M.A., F.R.A.S., of Melplash, Dorset, we have a brochure on "Eclipses and Transits in Future Years" (Parker and Co., Southampton-street, Strand, W.C.), which is a sort of supplement or complement to a previous work on "Eclipses, Past and Future." It represents the results of computations made during many years, and cannot fail to be useful for reference, while it will interest those who study eclipses. Some curious points are noted in connection with the eclipses of the next century: for instance, in 1917 no fewer than seven eclipses (the extremely rare maximum number) will occur, and in little more than an interval of twelve months (from Jan. 5, 1935, to Jan. 8, 1936), there will be the almost unique number of eight eclipses. Mr. Johnson illustrates his pamphlet with diagrams of eclipses from 1890 to 1950, and gives the dates and times up to June 10, 2498.

The eclipse of the sun on the 28th inst. will be annular only over a portion of Southern Africa, and no phase of it will be visible further north than Southern Arabia. At the Cape of Good Hope nearly 0·7 of the sun's diameter will be eclipsed at four minutes before nine (local time) in the morning.

Mr. Tarrant communicates to Nos. 2898—9 of the *Astronomische Nachrichten* a series of micrometrical measures of double stars observed by him at Pinner in the year 1887, in continuation of the observations made in 1885 and 1886, the results of which were published in *Ast. Nachr.*, No. 2866. The instrument employed is a silver-on-glass reflector by Calver, of 10¼in. aperture.

The "report" from Stonyhurst College Observatory for 1888 gives the usual records, with an appendix containing results from St. Ignatius College, Malta. The daily delineation of the sun's surface was carried on whenever possible, and 223 full-sized drawings were secured. The event of the year in connection with the observatory was the installation of a large grating spectroscope for the purpose of photographing the solar spectrum, and the spectra of sunspots in particular—a work which should be carried out with persevering regularity. The grating is a flat one, by Rowland, of 14,438 lines to the inch, and 3½in. in length. It is to be used in conjunction with a heliostat and a 5½in. object-glass by Alvan Clark.

Mr. Henry William Bristow, F.R.S., late senior director of the Geological Survey of the United Kingdom, died on Friday last, at the age of 72. In 1842 he was appointed a member of the staff of the Ordnance Geological Survey of the United Kingdom, of which, thirty years later, he became senior director. Mr. Bristow published various works on mineralogy and geology, besides editing and revising the English translation of Figuier's "World before the Deluge," and translating and editing Simonin's "La Vie Souterraine." He was also the author of the mineralogical articles in Brande's "Dictionary of Science, Literature, and Art," and of articles on minerals and rocks in Ure's "Dictionary of Arts, Manufactures, and Mines." He had been a Fellow of the Geological Society since 1843, of the Royal Society since 1862, and an honorary Fellow of King's College, London, since 1863. He had also received the diploma of the Imperial Geological Institute of Vienna, and from the King of Italy the diploma and insignia of an officer of the Order of SS. Maurice and Lazarus.

The deaths are also announced of Dr. C. Jessen, the Naturalist, lately of Berlin University, at the age of sixty-eight; of Dr. Bernhard Weissenborn, Zoologist to the German Cameroons Expedition; and of the eminent ornithologist, Eugen Ferdinand von Homeyer, president of the Berlin Ornithological Society, at the age of eighty.

Le Verrier's statue, in the court of the Paris observatory, is to be unveiled next Tuesday.

Last Friday, at the Royal Institution, Mr. C. V. Boys, F.R.S., discoursed on "Quartz Fibres," a subject he has made all his own. For purposes of scientific instruments there had been wanted, he said, finer threads than we had at command, finer than spiders' webs or spun silk. Turning to find some totally new material he had succeeded, and he would first show his simple method. The lecturer sat at a table supporting an oxyhydrogen blowpipe and a stand for a cross bow, the trigger of which could be released by a treadle. At the end of a small arrow was a little quartz. This was heated in the flame, and when fused the arrow was shot into a target, leaving a thread of quartz in its track. When placed in a microscope lantern with a scale ruled to the thousandth of an inch the thread was found not to exceed the five-thousandth of an inch. It was shown to be so much finer than a spider's thread that spiders put on a set of previously-made threads could not climb them, though a "baby spider" with small feet did succeed. Mr. Boys showed some of the practical uses to which such threads could be put, as for torsion balances and electroscopes, giving a delicacy hitherto unattained. Newton's large apparatus for showing the relative attraction of large and small globes of lead could now be imitated with globes of 15 grammes only, and so delicate was the arrangement that the difference in mass between two ordinary number five shot could be detected. The threads were strong, elastic, and of uniform size, except at their tapering ends.

Dr. Nansen, whose journey across Greenland has been recently described in the daily papers, has arrived in London, and will be present on Saturday at the conversazione of the Royal Geographical Society at Willis's Rooms, and among other things will exhibit the *ski*, or snow-shoes, on which he performed the journey across Greenland. On Monday evening he will appear at the meeting of the Royal Geographical Society, and give a detailed account of his journey.

At a recent meeting of the French Academy of Sciences, M. de Malarce, speaking of the extension of the metric system of weights and measures, made the astounding statement that only about 42,000,000 of inhabitants of the civilised world have systems which are neither metric nor decimal. In 1887 the aggregate population of the countries in which the metric system was compulsory was over 302,000,000, being an increase of 53,000,000 in ten years. In 1887, in countries with a population of close on 97,000,000, the use of the system was optional; and the countries where the metric system is legally admitted in principle and partially applied (as in Russia, Turkey, and British India) had in 1887 a population of 395,000,000, being an increase of 54,000,000 in ten years. The increase is due to the growth of population in the countries which had already adopted the system, and to its adoption by new countries. The systems of China, Japan, and Mexico are decimal, but not metric. The metric system is thus legally recognised by 794,000,000 of people, and the three last-named countries have a population of about 474,000,000.

The members of the Balloon Society of Great Britain, the French, and the Continental Aëronautical Societies will hold a four days' conference, commencing on July 31, at the Paris Exhibition. The inaugural address will be delivered by M. Janssen, and addresses will also be given by M. Wilfred de Fonvielle, President of the French Aëronautical Society, and by General Brine, chairman of the Aëronautical Committee of the Balloon Society.

Amongst recent patents we notice one for a filling, which consists of equal parts of lead [*sic*], patent driers, japanner's gold-size, and turpentine, mixed with "whitening" to the consistency of paste. Presumably white lead is meant.

Is electricity a manufacture? According to an Ohio judge, electric-light companies do not "manufacture" anything, and consequently are not exempt from State taxes as are manufacturing companies. That must be a nice point for American lawyers.

The success of electric-motors for working street cars seems to be fully established in the United States, and the system has certainly found much favour in "The Hub." The Board of Aldermen of Boston have granted to the West End Co. the right to place overhead wires on all the streets of the city, and the company accordingly intend to equip all their tramway lines as fast as possible.

An instance of what seems like sheer opposition for opposition's sake is reported from West Bromwich, where the Sewerage Committee have refused to allow the waste acids and liquors from a galvanising factory to be turned into the canal or into the public sewer. A similar policy is being pursued at Wolverhampton. One would think that waste from a galvanising works would do more good than harm if allowed to mix with the sewage.

The New York State Senate has passed a Bill, suggested by the Railroad Commissioners, prohibiting street railway companies in New York City from using centre-bearing rails, which are similar to the English bridge rail, and requiring companies now using such rails to take them up at the rate of 25 per cent. a year, and replace them with a grooved rail of a section to be approved by the Commissioner of Public Works. The Bill applies especially to New York, but in cities of 500,000 or more inhabitants these rails are to be removed at the rate of 20 per cent. a year. Grooved rails are little used in America; but the Beacon-street line in Boston has a 99lb. steel girder rail, with grooved head, which was made in England to designs of the chief engineer of the road.

Some doubt is thrown upon the accuracy of the photographs of lightning by M. Prinz, of Brussels, who contends that certain peculiarities are due to the imperfection of the lenses. The parallel lines are, he considers, due to reflection from the posterior surface of the plate and within the lenses. The subject is evidently not quite clear.

The Committee on Science and the Arts of the Franklin Institute has recommended the award of the John Scott legacy medal and premium to Dr. Richard Leach Maddox, of Southampton, England, for the "Substitution of Gelatine for Collodion in Photography."

At a recent meeting of the Academy of Sciences, Paris, M. Janssen, director of the physical observatory at Meudon, read a paper on some observations he had made to test the truth of the statement that oxygen rays in the solar spectrum are due to the presence of that substance in the sun. It was known that some of these rays are due to the earth's atmosphere; but it was uncertain whether others of them might not be due to the solar atmosphere. The Eiffel Tower, with its powerful electric lamp, offered to M. Janssen the required conditions. It is situated about 7,700 mètres from his observatory, and the intervening air is practically equivalent to the thickness of the atmosphere towards the zenith. A collecting lens was employed to give the spectrum of the Eiffel light an intensity equivalent to that of the solar spectrum in the same analyser. The effect was vivid, and the spectral field extended beyond A, while the group B was as bright as that from the meridian sun in summer. No oxygen band was visible, and M. Janssen concludes that the bands obey other laws than the rays. In fact, while for the rays it appears not to matter whether one employs a thickness of gas at constant density or a thickness equivalent in weight but of variable density; for the bands, on the contrary, the absorption taking place according to the square of the density, calculation shows that at the surface of the ground an atmospheric thickness of more than 50 kilomètres is necessary to produce them. M. Janssen considers his experiment an approximation; but as far as it goes it tends to prove that the oxygen rays of the solar spectrum are purely terrestrial.

Mr. J. Lawrence Hamilton, M.R.C.S., of Folkestone, says, in reference to some statements about poisonous mackerel, that fishermen have a saying that white mackerel is the best, then green, but that the red variety is the poisonous. In Guadaloupe there is a red-boned mackerel used as a rat poison. There are known and noted already upwards of seventy different kinds of food fishes which, within a few hours after their death, are reported to undergo such decomposition in their bodies or flesh as to give rise to poisonous symptoms after being eaten by man. So convinced is the Russian Government of the importance of this question, that it offers in 1894 a prize of 5,000 roubles (say £500) for the best essay on the nature and cure of fish poisoning. None of the fish found in the Norwegian waters are poisonous. It has been stated that all living healthy fish swarm with bacteria in their blood and lymph, which bears out my own observations regarding the early and rapid rate of decomposition of even freshly-caught fish. Hence I have long advocated that fish on capture should be immediately bled and gutted. The bleeding must, of course, take place before clotting: but British fishermen and fishmongers only gut their fish after clotting has taken place.

It is stated that a committee of the Anthropological Institute has been formed for the purpose of advising barrow openers and other archæological explorers. General Pitt-Rivers, the official Inspector of Ancient Monuments, finds that a great deal of irreparable damage has been done by unskilled explorers, who have neglected that accurate examination of the exhumed relics which is demanded by modern science—this neglect being especially notable with regard to the measurements of human skeletons and animal remains. At his instance a standing committee of aid has been appointed, and a schedule of instructions for explorers will in due course be drawn up.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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ABNORMAL APPEARANCE OF A STAR.

[30056.]—On the evening of August 10th, 1887, while searching for nebulæ with my 16in. refractor, the sky being perfectly clear, I ran across what appeared to me to be the most conspicuous and wonderful nebulous star I had ever seen. At first I had thought it a thin cloud, and feared that by it my night's work would probably be quickly brought to a close. Watching it carefully for fifteen minutes, I found that the supposed cloud had no motion, and emerging from the dome-room to learn the extent of the cloudiness, to my surprise, found the sky perfectly clear, nor was there the least appearance of haze. I then, after another observation, made the following record in my note-book: "Star, 8th mag., in centre of a very large, considerably elongated nebula." Examination showed the star to be 8 Serpentis—a star never suspected of nebulosity. The next night, with the seeing about the same, the star was not at all nebulous in appearance. Bright stars often appear surrounded with a pale milkiness; but the aspect in this case was entirely dissimilar to that, being denser and of a chocolate colour. During the night this was the only nebulous star observed. It was much elongated, considerably more than filling in one direction the entire field of 31′.

I have reflected much upon the cause of this strange phenomenon, and have come to the conclusion, as the most plausible theory, that at the time of observation the débris of a shooting star was centrally superimposed upon the star. And this calls to mind that during the great star shower of Nov. 14, 1867, I saw with my naked eye such a cloud, subtending an angle of about 2°, and moving exactly north with a very slow motion, passing centrally over Præsepe in Cancer. The brightness of the two being about equal, extinguished the cluster. The cloud or residuum was visible for 20 minutes or more, and assumed a variety of shapes, sometimes circling, and I particularly noted the forms of the capitals S and N. In this latter case also it is probable that a similar cloud may have occulted the star, and produced the phenomenon here recorded. This theory is strengthened by the fact that it occurred during the epoch of the August meteoric shower. Has any other astronomer met with a like experience? **Lewis Swift.**

Warner Observatory, Rochester, N.Y., May 31.

WHITE SPOT ON SATURN'S RINGS.

[30057.]—Having read the various letters, &c., published on this subject, and not being satisfied with the different explanations and theories offered, I will, with your permission, give my experiences in connection with it, which I think are rather different from any others yet recorded.

The first intimation I had of the existence of the spot was when I received *Dun Echt Circular* No. 169, which stated: "Prof. Krueger telegraphs from Kiel that Dr. Terby, of Louvain, announces the appearance of a white region on Saturn's ring opposite shadow globe." Now, as the shadow of the globe of Saturn is cast on the part of the rings behind the globe, as seen from the earth, I understood "opposite shadow globe," to mean that the white region was on the part of the rings in front of the globe; and so on the next clear evening I turned my 3in. achromatic on to Saturn, and closely scrutinised that part of the rings without being able to make out the slightest appearance there of anything unusual; but from the first my eye was irresistibly attracted by something very unusual in the shape of a bright spot on the part of the rings close to the shadow. Now I cannot understand how this could be the effect of contrast simply, as claimed by some of your able correspondents, because I had not been looking at the shadow at all, my whole attention having been fixed on the bright part of the rings in front of the globe, trying to find the spot there where I thought I ought to find it, until my eye was literally dragged round to the side of the shadow by the irresistible pull of something unusual there; something even brighter than the bright part I had been looking at; something I had never seen before in all the innumerable times I have gazed on that lovely planet, and, finding it on a part of the rings where I did not previously know that it existed, I regard myself as a sort of independent discoverer of it, a discovery which was afterwards confirmed by the first illustration you published of the spot—viz., the illustration by Dr. Terby himself (letter 29834, p. 153), an illustration which also confirmed my suspicion that the word "opposite" in the Dun Echt circular must have been a misprint for some other word meaning "near to" the shadow of globe, not "opposite."

Now I have simply related my experiences in connection with my first acquaintance with this mysterious spot, I shall not attempt either theories or explanations, leaving those for abler pens—indeed, I had not thought of troubling you on the subject at all; but finding that no other correspondent has yet related experiences similar to mine, I thought mine might be acceptable as adding something fresh to the controversy.

Excelsior.

PROF. JUDD AND LUNAR VOLCANOES.

[30058.]—On restudying lately Prof. Judd's valuable work on "Volcanoes," I notice some remarks about the moon which are of importance in regard to the possibility of glaciation, and beg to lay them before selenographical readers and "F.R.A.S." Chapter II. is mainly devoted to demonstrating that volcanoes are "great natural steam-engines," and that it is to explosions of pent-up steam we owe all our vast cones of eruption and craters, that it is at the base of all the eruptive and explosive phenomena of volcanoes. Referring to the outburst of Vesuvius in April, 1872, as an illustration, he says, page 25: "Enormous volumes of steam rushed out with prodigious roaring sound, the noise being so terrific that the inhabitants of Naples, five miles off, fled from their houses; this roaring sound was produced by detonations, or explosions, rapidly following one another, each accompanied by the formation of a great globe of white vapour, and each of these explosive uprushes of steam carried along with it a considerable quantity of solid fragments, and these fell in great numbers all over the surface of the mountain." At page 31 he says: "In Vesuvius and Stromboli alike, the active cause of all the phenomena exhibited is found to be the steam from the midst of masses of incandescent liquefied rock."

Your readers will observe from the above (and all through the book indeed) that the presence of water is a *prime essential in volcanic phenomena.* Prof. Judd is particularly careful to show us this, to a demonstration. But at pages 305-6 he refers to lunar surfacing as follows:—"In our nearest neighbour among the planets—the moon—the telescope has revealed to us the existence of a globe, in which the internal (volcanic) forces have not been checked and controlled by the operation of any external (erosive) agencies, for the moon appears to be destitute of both atmosphere and water. Under these circumstances we find its surface, as we might expect, to be composed of rocks which appear to be entirely of igneous origin." And at page 367 he refers to the vast lunar "craters" as due to volcanic forces of great intensity.

The references to the moon are clear, but brief, and it seems evident that the writer has made a "slip of the pen" in regard to the igneous nature of the lunar craters.

He demonstrates most clearly in Chapter II. that *water is a prime essential* in all explosively volcanic action, so that if there has been none on the moon (as evidenced by the absence of "valleys," &c.), the vast "craters and ring plains" could not have been due to volcanic action like ours, and the surfacing is hence neither aqueous nor igneous. The rocks are neither sedimentary nor volcanic, in our sense.

I do not know how to get a note to Prof. Judd, or should write him *re* the above (could "F.R.A.S." manage it?). If water is an *absolute necessity* for volcanoes, and there was none on the moon when being surfaced (as we see it), then the lunar crater forms *cannot* be volcanic.

Sibsagar, Asam, May 13. **S. E. Peal.**

PERMANGANATE OF POTASH AND DRY CELLS.

[30059.]—In answer to Mr. J. Gardner's letter of the 14th, I would like to state that I do not make any claim to a discovery regarding this. I put the matter down to the same cause as what Mr. J. Gardner gives in his letter; but on investigating into the subject, I came to the conclusion that there was a kind of secondary action set in, and which action's nature I am at present not prepared to answer; but I am at present going into the matter, and on the completion of the experiments I shall communicate to the "E.M." on it. I fancy Mr. Gardner is right in saying that the cell becomes active through the virtue of a new depolariser. I am very pleased with Mr. J. Gardner's dry cell. I am going to make a set, and hope to be able to report on their progress when I write on the above matter. I may say, in conclusion, that I am not much in love with the Gassner dry cell at all.

F. W. Mason, Consulting Electrician.

A NEW PRIMARY BATTERY.

[30060.]—So many of the readers of "Ours" are constantly asking for advice as to the best primary battery for small installations of the electric light, that I am induced to send you a short description of one which I have submitted to constant tests for the last five months, and have found very satisfactory. Some of your readers may remember that, some time ago, I mentioned that I had tested the Weymusch battery, but as it was not then in the market, I could not give particulars; now I shall be pleased to answer any inquiries. "The standard size consists of a rectangular trough of ebonite or wood, 9¼in. by 11in. by 13¾in., divided into six cells by means of ebonite partitions. In each cell is securely fixed a porous pot having a capacity of about 1 quart, and fitted with a short ebonite pipe; all these pipes are cured to an ebonite pipe running the full length of the battery, and fitted with an ebonite tap and a gauge-glass or level. It will be seen that by this means all the porous pots are connected together, and can be quickly and easily emptied, when the solution is exhausted, by merely opening the tap. In a like manner all the outside cells are connected together, and fitted with a tap. The general arrangement has been made with a view to reducing the time required for charging or emptying to a minimum, and permits of the battery being charged or emptied in a few minutes without the usual disagreeable labour usually attending these operations.

Two stoneware barrels, each having a capacity of six gallons, are placed on a shelf above the battery level and fitted with stoneware taps, to which are attached lengths of indiarubber tubing. One of the barrels is filled with the exciting liquid, 1 of sulphuric acid to 18 of water, the other with the new depolariser. When it is required to charge the battery the tubes are fixed on to the ebonite battery taps and the solutions allowed to flow until they rise to the marked point on the levels; the battery is then ready for immediate work. When the solutions are spent the battery taps are opened and the solutions allowed to flow away.

The elements are zinc and carbon; each cell contains two sheets of zinc placed in the outside cell, one on each side of the porous pot. The carbon plate is placed inside the porous-pot with the depolariser. The carbon heads are well coppered and securely fixed in tinned brass clamps, into which solder is run, thereby making a perfect and lasting contact, and doing away with the constant trouble usually given by carbon contacts. The zincs are specially amalgamated, and if the current is not allowed to exceed the maximum for which the battery is designed, they do not require reamalgamating.

The charge of depolarising liquid for the six-cell battery of the dimensions given is 11 pints; the voltage in open circuit 13 volts, and the working current for the best results 15 ampères; this current is maintained for seven hours per charge. During this time the current is very nearly constant, rising for the first two or three hours, then remaining constant for about three hours, and finally dropping slowly to the starting-point; these variations are very small. The total energy given out per charge is about 1,300 watt hours, of which between 750 to 800 watt hours are expended in the external circuit, or, say, 230 watt hours per quart of solution. If, after the seven hours' work, the current is reduced, by reducing the number of lamps in circuit to about 10 ampères, a further run of three or four hours can be obtained, giving a total energy per quart of depolariser of 300 watt hours.

Two of the above batteries will run ten 8c.p. incandescent lamps, or sixteen 5c.p. lamps for seven hours, and if, as indicated above, the number of lamps is reduced, a further run of three to four hours can be obtained.

I have, during the last seven or eight years, tested almost every new battery which has been devised; many have never appeared in the market, and I consider M. Weymusch's to be far superior to any yet invented.

From the above remarks, it will be seen that it is specially suited for small installations, motive power for boats, lathes, dental machinery, &c., and, therefore, of special interest to those numerous readers of the English Mechanic who are, judging by the "Query" column, continually on the look-out for a really good battery.

Should any of your readers wish for further particulars, I shall be happy to furnish them, either through "ours" or direct, on receipt of stamped, addressed envelope. My address will be found in the proper column. The battery is being introduced by the Indiarubber, Guttapercha, and Telegraph Works Co., Silvertown, E.

H. O. Beaumont.

49, Durham-road, Manor Park, Essex.

BATTERIES.

[30061.]—At the present day there is a good deal of discussion going on about batteries, one recommending one cell, and another another, that the amateur is often put in a fix to know which to use. My advice to such an amateur is, that he must be governed by circumstances. My rules for the use of batteries are the following:—

1. For electro-plating and for occasional work, where a medium strong current is required for a small interval as 1 or 1½ hour: Bunsen.
2. For bells or other light work where the current is intermittent: Leclanché.
3. For electro-motors: ferric chloride, or thermal chromic, or chromic-acid cell.
4. For coils, if portable: sulphate of mercury or portable Leclanché. For coils not portable: bichromate.
5. For electric lighting: according to circumstances, either bichromate, chromic acid, or the bromine cell.
6. For testing purposes: either the Daniell or Latimer Clark, or the cell designed by me, and termed the Portable and Standard cell.

Of course, by this I do not mean to assert that the amateur must have a set of each cells; but he will be able to see from the above what are the most suitable for his purpose. The cell that gives the strongest current, in my opinion, is the bromine and permanganate cell—this is a cell of ordinary single fluid bichromate pattern, with a solution of permanganate of potash and sulphuric acid, with a layer of bromine at the bottom of cell. This gives a most intense current, about 2·3 volt, for about four hours: it is one I always use when I require an intense current, six cells lighting nicely a 12-volt lamp through 18 or 20 yards of wire. For bell work, there is no cell in my opinion that can beat the Leclanché, notwithstanding all the talk there has been about dry cells. A good set of cells for an amateur to possess are 12 cells of the thermal chromic battery, described in the English Mechanic some time back. I have used a set ever since with every satisfaction. My set cost me £2 7s., but an amateur could construct himself a set for about 30s., if not less. For testing work, I recommend the amateur the Latimer Clark, or the cell designed by me. For portable business, there is no cell in my opinion that can beat the dry medical Leclanché. If I can be of any assistance to any in battery matters, I shall be very pleased to do so.

F. W. Mason, Consulting Eléctrician.

MERCURIAL REGULATORS.

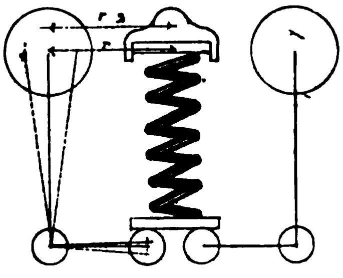
[30062.]—Mr. Sutcliffe is rather late in the field with his information on mercurial regulators. In view of the fact that it is eight years since he obtained provisional protection for his mercurial device, his present letter can scarcely be regarded as an act of philanthropy. The attempt which he made was certainly very creditable, but not more so than many others who have worked on the same lines, using oil, water, &c. Since patenting the device we have also found that Messrs. Reynolds and Herreshoff obtained a patent in 1872 for a device on the same principle; but, like Mr. Sutcliffe's, it came to nothing. Indeed, when, in conjunction with Mr. James Williams, C.E., of Manchester, the matter was placed before several eminent firms, the fact that the device was old in principle and had failed was the greatest difficulty we had to contend with. These difficulties, after the expenditure of considerable time and money, have been overcome, and the success of the device, as worked on our lines, has been established, both in England and on the Continent, many eminent firms having adopted it. That Mr. Sutcliffe's knowledge of the regulator is considerably greater than in 1881, a perusal of his specification will clearly show; and a comparison with my specification will show, I think, that our knowledge of the principles at work and our methods of carrying them out, are infinitely superior, and will explain the causes of our success.

In Mr. Sutcliffe's few lines of specification the improvements claimed for the regulator are that the governor is "made more sensitive and to act quicker," and that it "assists and hastens the governor." This is not the action of the device which I have patented.

I need hardly add that we are prepared to defend our rights, and would wish to warn your readers against experiments which will probably result in failure, and certainly in a lawsuit if they infringe our patents.

I note that your contributor, "F. C.," in an able paper on "Governors," thinks that the employment of springs enhances the defects of ordinary governors. This is certainly the case if a spring is substituted for the dead weight in an ordinary Porter governor; but if the governor is so constructed that the tension of the spring increases directly in proportion to the radii of the balls, almost perfect isochronism is the result. Fig. 1 shows Hartnell's method of accomplishing this.

FIG. I.



Here r_1 = 4in., r_2 = 6in. The initial tension of spring 80lb., and the final tension of spring 120lb. That is, by employing a spring of 40lb. to the inch, with 2in. initial and 3in. final compression.

The defect of these governors, in common with all isochronous governors, is their tendency to hunt, and in practice they are given stability by using a stiffer spring than the one giving isochronism.

J. Higginson, Jun.

LOCOMOTIVES.

[30063.]—The late historical letters from Mr. Stretton having awakened an interest in locomotive history, I took the opportunity during the holidays to visit the Museum at South Kensington to examine the old engines there, more particularly the "Rocket."

I was somewhat surprised, after a careful examination, that the valve-gear was not of the simple kind I had always supposed—that is, with two loose eccentrics and two reversing levers on the footplate; but found it was of that description alluded to in letter 29934 on the subject of the gear of "Old Ironsides," the two eccentrics being fixed together but loose on the axle in the centre, being shifted into gear with one of two "drivers" for forward or backward motion by a "treadle" on the footplate, in addition to the two reversing levers by the side of the firebox. The treadle is a single one, and locks by a catch when it is depressed.

I presume that this treadle is imperfect, and that it was originally double, so as to slide the eccentrics either way on the driving-axle; also that the original simple gear was modified after the engine had won the prize at Rainhill? **Footplate.**

[30064.]—Many thanks to Mr. Stretton for his reply, p. 305, in explaining how the mistake arose. It was only to one of the early editions of Mr. West's sheets that I have had access. I am very much interested in these articles on the growth and progress of the loco. engine, especially when coming from one whose information can be relied upon; but I may say that I know one railway only in Scotland, where all their light mineral traffic is still worked by engines with four wheels only, both coupled, each provided with a separate four-wheel tender. I mention this fact, as one is apt to consider, from perusal of the letters which have lately appeared, that the days of locomotives with four wheels only are numbered. **J. A.**

ESTIMATION OF SO$_2$.

[30065.]—I can fully confirm Mr. Davis's method of estimating SO$_2$, as I have tried it for some time, my attention being drawn towards it by a friend some time back. I am also not aware that it has been reported upon. In my estimation it is much to be preferred to the old method.

F. W. Mason,
Consulting Electrician and Chemist.

KEEN SIGHT.

[30066.]—In letter No. 29998, "H. S." says that a person must have abnormal sight to see a bright object the size of a crescent cut off a halfpenny as a crescent at 48 yards in the bright sunlight. Now, my sight is not at all abnormal, and I can see it as a crescent whether in the sunlight or not. Moreover, Mr. Dixon says that it was a quarter of an hour after sunset, so that it was not in the bright sunlight, and the glare of the planet could not have come on. Can "D. B. L." separate $\epsilon^1 \epsilon^2$ Lyræ with his inch telescope?

M. Burrows.

SMALL CHURCH CLOCK.

[30067.]—Mr. Buggins (p. 330) is wrong in saying the clock described by me is after the old Clerkenwell style of 60 or 100 years ago. The plan then was to have all the spindles working in upright bars, and to remove a wheel. The front bar had to be taken off, with the chance of the spindles all dropping down and bending the back pivots. As I do it, the brasses are riveted in short flat bars, which, having guide-pins, and being fastened to the frame by bolt and nut, can always be returned to exactly the same place. A wheel can be removed without disturbing the others, and the right depthing for the teeth can be easily got. As to the maintaining power, it is ugly enough to look at, but does its work well. The winder has merely to lift it up as far as it will go, which he must do before he can put the handle on to wind.

I know there is a very elegant maintaining power on the principle of the patent capstan acting from the arbor spindle, revolving the barrel by a wheel gearing into a wheel riding loose on one of the arms of the great wheel, the loose wheel driving an internal one at the end of the barrel.

If I had had expensive wheel-cutting machinery, I might have done it that way, but preferred the simpler way. I do not see any danger of the second wheel getting too loose if held between flanges, spring tight; and winding from the second spindle, to gain power, is less complicated than putting in another wheel and spindle.

No one who saw the cupboard of a place I had to work in would recommend a dead-beat escapement. It is impossible to keep the wind and dust out of the clock, so a heavy weight must of necessity be used, the fall being only 12ft. To lift the hammer from the great wheel, a very long barrel of small diameter would be required, two things mechanically incorrect. I contend the striking part in my clock is done in quite the modern way, and, in conclusion, must say that I write as an amateur for amateurs, and not for knowing ones like my critic. I work chiefly for the sake of occupation, and any man having the same tastes can, if he pleases, set up a good public clock at a very small expense for materials by using the cast-iron wheels supplied by Mr. Lloyd, of Birmingham, though, of course, not to compete with the regular makers in finish of work. **S. Maddison.**

ORNAMENTING IRREGULAR FORMS, ETC.

[30068.]—I am, I dare say, like many more amateurs, disappointed at not seeing some further discussion in your valuable paper regarding the above. A gentleman amateur in this neighbourhood some 28 years ago had a lathe on which he could with great ease turn a horse-leg, or, I suppose, any other irregular form. Not having seen it myself, I cannot say what was the nature of the mechanism; but I should like extremely well to know if the same kind of work is done now, and how it is managed. Mr. Northcott, in his book on Turning, gives an account of his mode of turning irregular forms, but I do not know if his apparatus is capable of copying, say, a vase with figures in relief. Can any gentleman say if there is any means of doing work of this nature? Perhaps Mr. Norman McLean will favour us with some further information regarding the geometrical lathe that he has had the pleasure of seeing and working.

I noticed recently a correspondent wanting to know what could be done with the dome chuck and spherical slide-rest. As no reply has been given so far, I would also appeal to gentlemen who have used both, as I have been told by one amateur of considerable merit that the dome chuck is quite as serviceable as the spherical rest. I would therefore add my appeal for further information regarding above, as the difference in cost when adding either is very considerable indeed. I believe Messrs. Birch, of Manchester, have made an improvement on the dome chuck. Would they favour us through your paper with the particulars? **A. F. D.**

HEAD COVERING.

[30069.]—About this time two years, you published a letter of mine on the subject of our head gear, which of course was adversely criticised by admirers of the fashionable "stove-pipe" hat. The shape that I advocated—i.e., "a cross between a helmet and a souwester," as it was aptly termed by a lady friend of mine, cannot, I think, be improved on. At that time I was in doubt as to what would be the best material of which to make it; but from some subsequent experiments, I am now inclined to believe that fine elastic steel wire, covered with porous woollen cloth, might be worth trying. The foundation or frame to be of light steel-wire netting, fine mesh, pressed between moulds to the shape of the helmet. For summer wear, in temperate climates, a single thickness of white cloth, fitting tightly over the wire frame, would probably be sufficient protection against the sun's rays, while its porous nature would afford better ventilation than any arrangement of apertures in a non-permeable material would give. The under-surface of the brim to be of a green tint, as being best for the eyes. The "sweat-band" interposed between the head and the internal surface of the wire would be of woollen material.

For cold weather the white cover could be replaced by one or more of darker colour. In short, this system gives the means of perfectly adapting the head covering to the state of the weather, for the different covers could be removed or put on in a very short time, presenting also facilities for washing them when soiled. Barring accidents, the foundation frame would last an indefinite time, so that the advantage of cheapness is likewise joined to it.

For tropical countries increased protection from the sun would be obtained by the use of, say, two or three cloth covers placed one over the other, and over them a second wire-netting foundation, just the same shape as the original one, but so much larger as to allow of an air space of ¼in., or 1in. or so all round. This auxiliary wire netting, being also covered with several thicknesses of white woollen cloth, would entirely shield the head of the wearer. Wetting the cloth of the helmet when practicable conduces to coolness of the head, as I know from experience gained when the mercury stood at 100° and upwards in the shade. The wire netting should be protected from rusting. When aluminium becomes cheap (if that ever happens), of course netting of that material would be preferable to steel. **Edward M. Richards.**

Grange, Enniscorthy, June 8.

FIRST RAILWAY IN SCOTLAND.

[30070.]—I understand that Parliamentary powers were obtained for the construction of the first public railway, and it was made by the Duke of Portland in Ayrshire in 1808. It consisted of a tramway 9¼ miles long, extending from Kilmarnock to Troon Harbour. There were two lines, the rails of which were of cast iron fixed on stone blocks. The line is said originally to have cost £50,000, and was opened for traffic in 1812. The waggons were drawn by horses, and a carriage for passengers ran daily both ways, also drawn by horses. I may state the rails carried the flange, not the wheels, at first. A few years afterwards an attempt was made to use a loco. on the line, but at the trial it broke the cast metal rails, and was laid aside. A loco. constructed by Stephenson, after the Killingworth model, was put on the line in 1817, and steam power was used ever after. Line is now part of the G. and S.W.Ry. system. This is all the information I have ever been able to obtain, but would gladly receive more, especially with reference to the loco. **J. A.**

CUTTER-BARS—BEARINGS.

[30071.]—It seems to me that any unpopularity of the Haydon tool-holder is due to the difficulty many amateurs experience in accurately grinding it: the fact of having to grind three faces is against it.

In one or two Haydon bars which I have examined, the cutter projected too far through the sling, the bending axis of the tool thus being behind a normal to the cut surface at the cutting edge. In a well-designed tool the bending axis should be before this normal, or as near to it as possible. The tool should project very little through the sling. I have used with much success a tool-holder in which the clearance angle is adjustable. I believe this tool-holder would be very excellent for screw-cutting. If anyone thinks it of interest, I will send description.

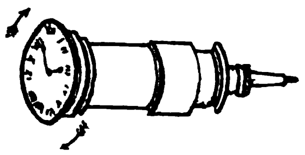
While calculating the energy absorbed at bearings, I found that the length of time a pivot or journal will run without the bearing being readjusted varies directly as the square of its length, or let L = the length or period of time the journal runs without readjustment, and l = length of journal, then $L = l^2 \times$ a constant. Not having seen this statement in any mechanical treatise, will readers give their opinion of the accuracy of it? **G. W.**

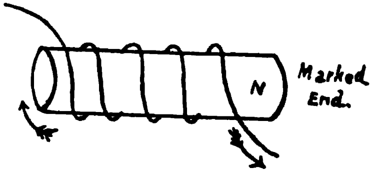
WHICH END OF AN ELECTRO-MAGNET IS THE "MARKED" OR NORTH POLE?

[30072.]—Many plans have been suggested for remembering this; but it is usually found that the "man swimming with the current" finds it as difficult to remember on which side the marked end of the magnet is as if he were not swimming at all, and I think the following will be found a better aid to memory.

It has become quite usual to speak of the North Pole of a magnet as the marked end.

Call the point of a pencil which makes marks the marking end. Pencils have been made with watches on their end; the direction of the motion of the hands corresponds with the direction of a current which would, if the pencil were a magnet, make the marking end the marked end. See sketches. **Glatton.**





METEOROLOGICAL—INCREASE OF SOLAR HEAT.

[30073.]—Letters have appeared in the *Times* newspaper suggesting that the wet summer in England last year, and the frequent changes of weather and floods this season, are occasioned by an increase of the sun's heat.

This, of course, is by no means impossible—our sun being probably like other stars, a variable one, of long periods, and our planet having been subjected at remote epochs to great changes of temperature, extremes of heat and cold, which have proved fatal to a large proportion of both the animal and vegetable life on this globe in those ages.

Should the sun's heat increase, the result would be a greater evaporation of the oceans and seas, and a corresponding increase of vapour or clouds, which, at first, would accumulate in the northern and southern hemispheres or poles, until, if the heat became greater, the earth would be enveloped in a dense pall of vapour or cloud, excluding the sun's rays; and although at first sight this might appear a safeguard to the inhabitants of this globe, they would be exposed to dangers of a different kind.

The cloudy envelope, as a consequence of the increased solar energy, would become charged with electricity to an extraordinary degree, and thunder storms, waterspouts, and tornadoes of terrible violence—such as the inhabitants of the world have hitherto had no experience of—would devastate this planet.

Of course this is taking an extreme view of the case; but even slight changes of solar heat would cause serious results, and it appears probable, from the recent abnormal state of the atmosphere, extending over both North America and Europe, that a disturbing atmospheric influence is at work, which may probably be caused by a slight augmentation of solar activity. The subject is one of great interest to meteorologists. **C. L. W. M.**

CONCERT ORGAN.

[30074.]—I am at present not well enough to enter thoroughly upon Mr. Swynfin's scheme. He can hardly have followed my later developments. I shall be happy to send him, or any other interested reader, a pamphlet on the subject.

Let me point out that it is not necessary to have so many pedal stops, for many of them will serve by "duplication" in more than one division. This system of duplication, applicable to manual and pedal stops and all couplers, is one of my most important discoveries, and raises the combinational power of any reasonably-complete organ by 50 per cent. It is, of course, an entirely different matter from "borrowing."

Though advocating more extensive use of the swell-box, I do not carry it to the same extreme as Mr. Audsley. I have previously explained the reason on scientific grounds, reserving it for

1. One complete organ of dynamic crescendo; a valuable organ effect not to be confounded with expression.
2. Assistance in attaining acoustic crescendo.
3. Attainment of the best substitute available for true expression in imitative stops.

Of course these effects demand completeness in bass and treble.

The mechanical arrangements for "duplication" not only allow us to take solo stops out of the normal *ensemble* organs, great, swell, and choir, but enable us to exclude from them such stops as interfere with their legitimate tone or hamper the *ensemble* registering. As in addition to this the pedal stops and couplers are practically automatic, the registering is so much facilitated that I do not propose to have any combination movements except a few composition pedals for broad contrasts of great and swell, and my very useful "full organ" pedal. The latter moves no exterior stop or accessory, simply driving (something like the "grand jeu" of the harmonium) all stops and couplers appropriate to the full organ, and taking off, *pro tem.*, all such stops as clarionets, tremulants, &c. The stops, &c., may be freely moved into fresh combinations while it is down, to enter when it is released.

Full organ pedals have been made before, but the peculiarity of mine is that the organ still remains subject to the "Help." Any division of the organ is thus separately available, "full," with proper pedal basses and couplers. This one accessory thus does thoroughly the work formerly done imperfectly by some half-dozen. It is one of my chief aims to simplify and systematise the control abolishing the museum of arbitrary and makeshift combinational accessories, such as "on and off great to pedal," &c. The growth of these and of cheap, useless couplers is one of the great evils of organs as now built, rendering them clumsy and unwieldy, and demanding a temporary apprenticeship to each particular organ.

I do not propose in organs for any purpose to desert the well-established lines of the organ proper—viz., Great, Swell, and Choir, for we must look to the future as well as to the past, and in the not distant future much of the orchestral work now intrusted to the local organist will be taken by a real orchestra. For a concert organ the orchestral stops may be introduced at a less complete stage of development of the organ proper, but beyond that I do not go.

Mr. Swynfin will, under the circumstances, excuse me from the arduous task of going through his specification. I give you a specification of an ordinary church organ of three manuals, followed by a description of the same organ as I would arrange it. This will give the best notion of my system as at present developed.

In relation to the question of big organs lately discussed in your columns with so much warmth, the following pronouncement of the greatest of living organists, Mr. W. T. Best, may interest your readers and should settle the dispute:—"I return Riga specification, which exhibits but little enterprise. *The day for these monster organs has passed.* No organ need have more than fifty stops. The varieties of organ tone are few, and their multiplication upon numerous claviers simply a nuisance to the performer, but of great use to the builder, after erection, from the white elephant point of view." May I point out to your readers that my system is patented?

ORDINARY ARRANGEMENT.

Great.

Bourdon	16ft.	Harmonic Flute	4ft.
Open Diapason	8	Twelfth	2⅔
Do. Do.	8	Fifteenth	2
Hohlflöte	8	Mixture	III.
Gamba	8	Trumpet	8
Principal	4		

Swell.

Bourdon	16ft.	Gemshorn	4ft.
Geigen Pr.	8	Mixture	III.
Gamba	8	Horn	8
Rohrflöte	8	Oboe	8
Voix Celeste	8		

Choir.

Dulciana	8ft.	Piccolo	2ft.
Lie. Gedackt	8	Clarionet	8
Fl. Traverso	4		

Pedal.

Open Diapason	16ft.	Quint	10⅔ft.
Bourdon	16	Principal	8
Violon	16	Trombone	16

Couplers.

Great to Pedal	Swell to Choir
Swell to Pedal	Swell in octaves up
Choir to Pedal	Swell in octaves down
Swell to Great	

Three Composition Pedals to Great, acting on Pedal Organ.

Three Composition Pedals to Swell, not acting on Pedal Organ.

Foot Pedal (generally so called) "on and off" Great to Pedal.

Tremulant to Swell.

CASSON SYSTEM.

(Duplications marked * with number of original stop.)

Great Organ.

On First Manual, 3¼in. wind.

1.	Bourdon	16ft.
2.	Open Diapason	8
3.	Open Diapason	8
4.	Claribel	8
5.	Principal	4
6.	Harmonic Flute	4
7.	Twelfth	2⅔
8.	Fifteenth	2
9.	Mixture	III.
10.	Trumpet	8 (6in.)
I.	Swell to Great.	

Manual Help.

Great Pedalier.

3¼in. wind.

11.	Acoustic	32ft.
12.	Open Diapason	16
13.	Bourdon (from 11)	16
14.	Great Flute (from 12)	8
15.	Trombone	16 (6in.)
II.	Great to Pedal.	

9, 10, 11, 13, and 15 in Swell-box No. 1.

Pedal Help for Great and Solo.

Three Composition Pedals for *all* the above stops and couplers.

Solo Organ.

On First Manual.

16.	Violoncello	8ft.
4.	*Claribel	8
6.	*Harmonic Flute	4
	(No. 16 and 17 in Swell No. 1.)	
10.	*Trumpet	8
17.	Clarionet	8
I.	*Swell to Solo.	

Manual Help.

Solo Pedalier.

18.	Violone (in box 2)	16ft.
14.	*Great Flute	8
15.	*Trombone	16
II.	*Solo to Pedal.	

Choir Organ.

Second Manual, 3¼in. wind.

19.	Viole Sourdine	8ft.
20.	Lieblich Gedackt	8
21.	Flauto Traverso	4
22.	Flautino	2
III.	Swell to Choir.	

Choir Pedalier.

13.	*Bourdon	16ft.
18.	*Violine	16
IV.	Choir to Pedal.	

Pedal Help.

(If any part be inclosed, No. 22 should make room for a salicet of 4ft., but No. 19 should on no account be inclosed.)

Swell Organ.

Third Manual, Box 2, 5in. wind throughout.

23.	Bourdon	16ft.
24.	Geigen Principal	8
25.	Rohr Flöte	8
26.	Violes d'Orchestre	8
27.	Geigen Principal	4
28.	Mixture	III
29.	Horn	8ft.
30.	Oboe	8
V.	Swell in octaves up.	
VI.	Swell in octaves down.	

Manual Help.

Swell Pedalier.

11.	*Acoustic	32ft.
18.	*Violone	16
13.	*Bourdon	16
15.	*Trombone	16
VII.	Swell to Pedal.	

Pedal Help for Swell and Echo.

Three Composition Pedals acting from 23 to VII.

Echo.

On Third Manual, 5in.

25.	*Rohr Flöte	8ft.
26.	*Violes d'Orchestre	8
31.	Violes Célestes	8
30.	*Oboe	8
V.	*Echo in octaves up.	
VI.	*Echo in octaves down.	

Echo Tremulant (by hitching pedal.)

Manual Help.

Manual Help.

Echo Pedalier.

13.	*Bourdon	16ft.
VII.	*Echo to Pedal.	

General Accessories.

1. Full Organ Pedal.

P.S.—I am a little hampered in dealing with two identical organs; but, assuming both to be tubular pneumatic, the difference in cost is very trifling in relation to the increased resources. The two schemes suffice to show my system as *a system of control, based upon absolute completeness in every division*. The Choir Organ may be on the same manual as the Great and Solo, a simplification desirable in organs for export or for extreme climates, though I prefer a third manual.

Denbigh. Thomas Casson.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67955.]—**Ivory.**—Thanks to "Vooght" (p. 331); but as I am not interested, why should I advertise my address? I have known Parkesine, xylonite, &c., for twenty years, and am acquainted with the various preparations offered to pianoforte key-makers as substitutes for ivory. If, as "Vooght" says, he saw "beautifully grained" celluloid eighteen months ago, he should advise the makers to advertise it in the English Mechanic, for there is a demand for such a substitute of ivory, especially if it is like that sent by Dr. F. L. James, and can be sold at a lower price than ivory. I am afraid that "Vooght" is also "behind the times," and does not know what has been done with celluloid, although he has seen some dressing combs "beautifully grained to imitate ivory." "Cosmopolite" (p. 307) explains, *more suo*, how the "grain" is imitated in celluloid; but I trust he will forgive me if I venture to doubt the accuracy of his explanation. Celluloid is not a substance to be easily "sliced up into thin sheets," and even if it were, I suspect those processes would render it more costly than ivory, which has been getting gradually dearer for many years, so much so that the cutters who slice it up have been altering the arrangements of their machines until the back ends of the "tails" used for keys of cheap pianofortes are as thin as paper, and an abnormal quantity of whiting has to be mixed with the glue to prevent the ivory looking brown when affixed to the wood. Old pianos have ivory on the keys that will bear scraping; but if such celluloid as Dr. James has sent can be supplied cheaply there will be no occasion to use ivory at all, as, barring its liability to burn, it answers all ordinary purposes. Nun. Dor.

[68312.]—**Saw-Setting (U.Q.)**—The best method of setting the teeth of a saw is to do it with a "set hammer." This will demand some practice before you accomplish the job satisfactorily; but it is worth all the trouble. If you have not seen the operation of setting with the hammer, get some one to show you how it is done. Saw teeth that are set by bending or twisting have always more or less of a latent strain on them, and do not keep the set well, whereas in the case of setting with the hammer the teeth are permanently hammered into position, and have no tendency to spring back. You will also find that by this method you will break fewer teeth than by any other. Sandy Dunn.

[68403.]—**Chromic-Acid Battery.**—I had determined to pass by Mr. W. Perren Maycock's attack on *Work*, and the article in its first number on the "Bunsen Battery," for several reasons beside that of disinclination to take any notice of anonymous attacks. I was charitably disposed to think that Mr. Perren Maycock was suffering from an attack of indigestion, neuralgia, or gout, when he penned his little note, for it bristled with the fretful manner of a sick man. As one of my colleagues has, however, ventured a remonstrance, perhaps the author of the offending article may also be allowed to say a few words on behalf of the Bunsen battery. I should be well acquainted with the battery and all its ways, for I have had it in almost daily use in my workshop for the last 12 years. At times I have had three batteries going at the same time in the same room; but, except in damp weather, or on the near approach of rain, neither myself nor my assistants have ever been inconvenienced by the nitrous fumes. I have tried various primary batteries, including the single and double-celled bichromate, but have not found any so handy or so cleanly in working as the Bunsen when properly set up and attended to. If neglected or put up in a slovenly manner, or made up with inferior materials, it will certainly resent the neglect by giving forth a noisome stench. This, however, is not so much the fault of the battery as of its attendant. During all my experience with it I have never injured sixpennyworth of clothing by spilling the acid, but have ruined several shirt-sleeves whilst amalgamating zincs, before I got used to the proper method of doing it, and this most frequently whilst brushing the zincs of the Daniell batteries. Now with respect to cost—that is, the comparative cost of the Bunsen and the chromic-acid battery. The only difference will be in that between the cost of the charge for the porous cells, since the elements and the charge for the outer cells are the same in both batteries. I find that I can charge a four-celled quart Bunsen with 1¼ pint of nitric acid; as I get this for 3½d. per lb., we may put down the cost in round numbers as 6d. With careful working, this gives me 24 hours' service. Can Mr. Perren Maycock, or anyone else, beat this with chromic acid? I write as I experience as a workman, and hope others will do the same. The article published was written to help young workmen, by teaching them how to properly set up and attend to a Bunsen battery, and I am pleased to be able to state that it has been very much appreciated by many readers whose letters I have received since its publication. George Edwinson Bonney.

[68531.]—**Brighton Railway Engines.**—Mr. Stroudley seems to have begun naming the L.B. and S.C.R. engines about 1872. Those scrapped lately which had names are: 162 London (afterwards Penge), scr. about December, 1884; 16[illegible] Brighton (afterwards Sandown), scr. January, 1888 (these two were Mr. Craven's 7ft. singles, cylinders 18in. by 24in.); 177 Hayling, coupled, scr. May, 1889; 197 Cavendish, single, scr. about 1885; 373 Shanklin, single, scr. about 1881; 3[illegible]5 Croydon, single, scr. July, 1888; 451 Lancing, single, scr. June, 1886; 452 Worthing, single (originally 147), scr. June, 1886; 453 Ryde coupled, scr. October, 1886; 475 Dorking, single, scr. about 1884; 477 Reigate, single, scr. July, 1888, 482 Hastings, single (originally 255), scr. July, 1888, 484 Solent, ? (originally 266), scr. ?; 487 Horsham, single, scr. about 1884; 506 Rouen, coupled, scr. ? The following are tanks:—222 Egmont, scr. about 1885; 375 Bishopstone (in 1885 had her name off), scr. about 1886; 359 Hayling Island (originally Brighton Works 1865), scr. ? 1886. The following Mr. Stroudley rebuilt:—Built by Messrs. R. Stephenson: 201 Belgravia, rebuilt November, 1872; 202 Goodwood, rebuilt July, 1872 (these two are rear coupled 6ft. 6in.); 203 Sussex, rebuilt April, 1871 (single 6ft. 6in.); 204 Westminster, rebuilt January, 1872; 205 Kensington, rebuilt July, 1872; 206 Carisbrooke, rebuilt October, 1875, 207 Freshwater, rebuilt December, 1875 (these four are rear coupled 6ft. 6in.); 404 Epsom, ?, rebuilt December, 1882 (rear coupled about 5ft. 9in.).

June 19. C. F. Dendy Marshall.

[68552.]—**Maxima and Minima.**—To your correspondent "W. J. A." belongs the credit of first explaining the true nature of this question. As he remarks, I was in error when I made the third D. C. vanish as well as the second. I did not actually calculate the value of this coefficient; but making $x = \frac{\sqrt{3}}{3}$ = ·577 nearly, the supposed maximum was $\frac{3\sqrt{3}}{4} = 1·299038$; then by putting ·[illegible] and ·5 successively for x, I erroneously obtained two results each less than $\frac{3\sqrt{3}}{4}$ through some numerical slip, thus inferring that the third D. C. vanished. Altogether I have never seen a better illustration of the process of finding max. and min. values than this problem furnishes.

Portsmouth. A. M.

[68558.]—**Chiming Clock.**—I have not been able to reply, for a number of reasons, to the several correspondents who have written on the above subject. The chimes that I gave on p. 246 were the Cambridge chimes as used in the Westminster clock. In reply to "G. E. H.," the Westminster are the Cambridge chimes. In reply to "Nemo," the reason why the pin-barrel revolves twice an hour is this: consider, you have four notes changed five times in the chimes given; now, in one hour you have the five changes struck over twice, so that you must either have the barrel to revolve twice, or the changes put on the barrel twice. The former is used in the trade. Now to "F. T.," the reason why I gave so heavy a weight was, first, that I intended the weight for a double line, which requires twice the weight; and, secondly, I thought that his clock was probably of rather a rough make if it is somewhat old. The advantage of the double line is that it halves the distance that the weight has to fall. A weight quarter-clock made in my shop not six months ago had a weight of 10lb. for the gong, 14lb. or 15lb. for the striking, and 18lb. for the quarter side. It was eight-day, of course. The reason why such a heavy weight is wanted for the quarter-side is because the hammer-stems have the heads to carry with the springs pressing against them, and are lifted with a very short lifting arm. As to horological literature, the amateur is at a disadvantage here. There is no book that describes how to make a chime-clock. Reid's book, although invaluable, is old, and the quarter-repeating work used there is modified in form now. Britten's book will help you a lot if you get the 1889 edition. As to "Pegwood's" letter, it is not worth much, teeming as it does with mistakes. With the permission of the Editor I will accept "Nemo's" invitation, and hope by describing how to make a chime-clock with sketches to illustrate, that those who have written may be able to proceed with their conversions—i.e., adding a new train to an old clock. This I defer till next week.

Charles A. Jones.

12, Ann-street, Union-square, N.

[68563.]—**Cement for Glass.**—Will not gutta-percha cement do? At any rate, "Wag" will find in back volumes recipes for making all the known cements, and if one of them will not do, I should advise him to have his "cells" specially made, which would be the best course to pursue, any way.

M. C.

[68565.]—**Solubility of Chemicals.**—I do not see that this query can be of any interest to readers, and I would suggest that the querist should advertise for replies. Many will answer when the information may be useful to others; but this query is not only a bit of a puzzle, but it cannot be of much interest to the generality of readers.

C. T. C.

[68570.] — **Clock Dial.**—If "Country Clock Dresser" will say what his clock dial is made of, and what he wants to make of it, no doubt he will get an answer; but as it is, I don't see what anyone can say, except tell him to send it to the platers, and give them directions what to do. Q.

[68574.]—**Polishing or Burnishing.**—The surfaces are brought up with fine emery, and then finished with rouge; but it is difficult to understand what "Metal Worker" means from his query, or how he can be a worker in metals and ask so stupid a question. W. M. P.

[68579.]—**Concrete Walls.**—There are plenty of works which will enable those with brains to work out this problem; but I would suggest that, as an architect should be employed and take the responsibility, "Inexperienced" has no business to build a wall 30ft. high and 60ft. long. X.

[68580.]—**Indiarubber Hose.** — I believe the best way to keep indiarubber (presumably vulcanised) goods in stock is to keep them under water; but modern vulcanised rubber is very perishable under most conditions. T. J.

[68584.]—**Racquets.** — Wet them thoroughly, and put under a hydraulic press, or load with heavy weights. To use steam would, I think, injure the gut; but there can be no harm in wetting thoroughly, especially the woodwork, and then keeping under pressure. T. M.

[68596.]—**Tempering Hoes.**— Does "W. F." imagine that he is going to do "at once" what it has taken years of experiment to acquire. He must heat his hoes to a cherry-red in the dark, and dip straight into the water; but the whole thing consists in knowing just when to do it, and that nothing but experience can teach him.

Nun. Dor.

[68606.]—**Burnishing.**—The querist wants a set of "dollies" and polishing powders; or, if he wants to really "burnish" in the technical sense, he must have tools of smooth-nosed steel, which are pressed heavily against the work. Let him take a piece of flat silver plate and polish it with powder. Let him note the effect. Then let him rub it over with a smooth bit of steel, and he will learn more in five minutes than he could be taught in a column.

Nun. Dor.

[68607.]—**Tin Boiler.**—Simply a sheet of tin-plate cut to size; edge turned up, and soldered on. What a helpless querist! R.

[68612.]—**Flattening Wood for Fretwork.** Wood is easily flattened in the planing-machine, or it can be planed flat. If it already has smooth sides it can be "flattened" by steaming and pressing in the hydraulic machine. What is it the querist means? Nun. Dor.

[68617.]—**Speaking-Tube.** — A speaking-tube would answer; but if the line is at all straight, why not try a mechanical telephone? I have heard speech clear enough on a mechanical telephone line in the heart of London—at the noisiest time of the day, too. Nun. Dor.

[68622.]—**Backgrounds in Photography.**—Would "A. A." say what it is he wishes to do, or what information he wants? To make a background or a screen we procure some pantile laths and make a frame on which we stretch canvas. On that we paste paper, and paint it to suit. What more can be said? C. T. L.

[68639.]—**The Megascope.**—Would F. W. Mason be more explicit, and give particulars of how a megascope should be constructed—size of lens, &c., for a disc of from 2ft. to 5ft.?

E. C. Owen.

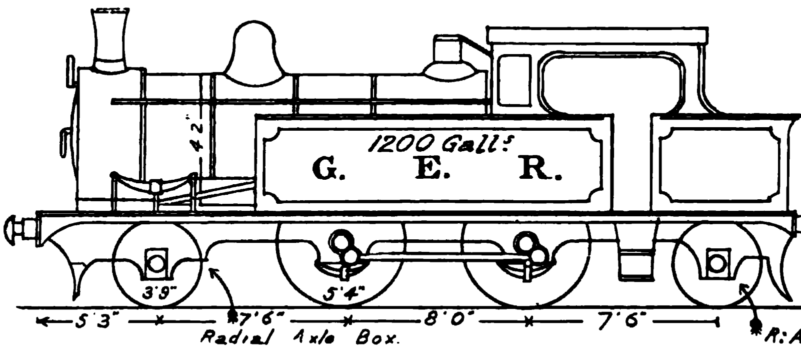
Friar Stile Lodge, Richmond Hill, London, S.W.

[68677.]—**Leg Irons.**—"F. G. Ll." cuts up "New Chum" rather short. The advice is good, but at present the little pet needs treatment as well as proper food. Bathe the legs in water, comfortably warm, once a day, giving as a finish a douche (dash) of cold water, say a quart-jugful over each ankle, then wipe thoroughly dry, giving a polishing wipe with another towel. Stretch the child upon his back, say across a bed, or on a table, with a soft pillow under his shoulders, whilst you hold first one, then the other leg at full length, and chafe with your hand for at least a quarter of an hour, moving hither and thither the bones of the ankles and feet, exercising them as much as you can, which exercise will gradually impart vigour to them. Get the boy to kick about and exercise himself if you can, in a nice warm bath until he is tired, say for half an hour at a time, two or three days in a week. He should be discouraged from walking for the next year or two. This "ricketts" is a very common complaint with young children, and needs care and patience. I have known powdered egg-shells recommended by the faculty to supply lime to the system.

An Experienced Mother.

[68717.]—**G.E.R. Tank Engines.**—M 15 class. T. W. Worsdell's, 1884, 30 engines, 196 tubes 1¾in. diameter; weight, loaded, 51 tons 18cwt. 1qr.; cylinders: diameter, 18in.; stroke, 24in.; heating surface: firebox, 98·4ft.; tubes, 955·7; total, 1054·1sq.ft. Radial axle-boxes. Painted dark blue.

C. F. Dendy Marshall.



[68721.]—**Metal Speculum.**—We do not usually advise the employment of metal at all, but glass, for specula. It is a matter of taste, of course, and if you will write to me I will give you the address of a friend that I think would cast one for you. As near as I can judge, I think 1s. 6d. per pound for large, and 2s. for small mirrors, would be a fair charge.

Ramsgate. J. C. Linscott.

[68729.] — **Electric-Bell Fixing.** — Mr. W. Perren Maycock is quite correct. I am sorry I have been so foolish as to make that disagreeable blunder, with the method I gave. It would have given about 1·43 ampère. Use 36 or 40 No. 1 Leclanché.

F. W. Mason.

[68743.]—**Large Tree.**—"Winder," p. 332, I think is wrong. The Wellingtonia gigantea is a conifer, and, as he says, comes from California, Sierra Nevada. It was introduced here (England) in 1854 according to Mongredien, and in 1853 according to Grigor. Now the Eucalyptus globulus has no appearance like a conifer. It is the Australian blue-gum tree, and bears the character of being a good tree to be sown in marshy places to prevent malaria. I have one-year-old (now 16 or 17-month plants) plants of each tree, grown from seed. The Wellingtonia is like a tree with numerous branches, only about 2½in. to 3in. high; the Eucalyptus is nearly 3ft. high, more like a plant, and has the peculiarity of having a round stem at the base and higher up a perfectly square (really square) stem between the joints. To my mind, nothing is more unlike than these two trees. I do not believe that the Wellingtonia gigantea is a species of Eucalyptus.

The Cotswolds. B. P. A.

[68759.]—**Oculist's Formula.**—If our worthy Editor would grant me half a column, I could give you more information; but as I doubt whether it would be of sufficient general interest, I may say that + ·50 D. means a convex lens of half a dioptre focal length, or 72 Paris inches. The glasses are usually kept in shops numbered on the inch scale, and not on the metrical scale. If I had the space at my disposal, I would show you how to convert dioptres into inches, and also find focus of glasses, and thereby answer another gentleman's query. It seems strange that oculists always order in dioptres while glasses are numbered in inches.

Derfla.

[68766.]—**Persian Cat.**—I am afraid "Lydney Dispenser" and his homœopathy are rather hard on my answer. I only gave 10 grains in 16oz. of aquæ, and glycerine ½oz., and as an outward application would not necessitate the use of more than ½oz., this would really give three-quarters of a grain cantharides, and as the glycerine would mitigate in some small sense the action of the flies, there is not, in my estimation, much to be feared. I was under the impression the recipe was well known, as it was taken by me some time back from a leading medical book (not homœopathic), and likewise the recipe has been practically tested by me in some dozens of cases. I may state, though, that I do not hold with drug-giving whatever, either to man or beast. As I stated in my answer, that it would be better to let nature take her time, it might be of interest to "The Lydney Dispenser" to know that I am a follower of Dr. Allinson (though not in vegetarianism), and so naturally do not hold with drugs. F. W. Mason.

[68760.] — **Hydrostatics.**—I am sorry that I mistook the querist in my hurry, and hope that "T. C., Bristol," will forgive me. I also mistook the tone of the query, and in consequence answered it in a different spirit to what I should have done; for this I also ask pardon. I must maintain that in questions of this kind the integral calculus should not be used, not being a machine for churning out results, but for performing operations which turn up in the course of the reasoning. In this case the principles would be obscured by its use. Ignotus.

[68796.]—**Mensuration Problem.**—My thanks are due to "J. C. Q." for noticing my query; but it is not clear to me that his solution is correct. The expression $\sqrt{a^2 + b^2 - c^2}$ would refer, I take it, to a right-angled triangle, the diagonal being the hypotenuse, C the perpendicular let fall on upper side of road produced beyond b from end of diagonal; therefore l will be greater than true length of road. "J. C. Q.'s" solution would answer if the diagonals were both equal—i.e., when the road would be wide enough, 60ft., to occupy the whole ground. A. W. Lambert.

[68804.]—**Geology in the Field.**—A class for the study of geology face to face with nature has been conducted by Prof. H. G. Seeley, F.R.S., on Saturday afternoons during the summer for the last four years. During that period the class have visited some of the most interesting and instructive sections round London, including Loam Pit Hill, Charlton, Erith, Grays, Northfleet, Boxmoor, Dunton Green, Otford, Godstone, and Sevenoaks. Longer excursions were arranged for Whit Monday, and these have included Herne Bay, Oxford, Maidstone, and Guildford. One of the chief features of this class is that the work is systematic, and the excursions are so arranged as to insure a familiarity with facts and principles. The work of the field is complemented by a series of winter lectures given by Prof. Seeley at some central hall in London, in which the facts noted during the summer are gathered together and compared, and their bearings upon the work to be done in the future shown. The general principles underlying those facts are clearly pointed out, and their connection with the structure of other countries. The class includes the following divisions:—C section: for the study of scenery in relation to the geological structure in the London district. B section: for the study of the geological history and succession of strata in the London district. A section: for the detailed study of a single stratum in the London district. The class is somewhat early this year, and hold their last excursions on the 15th and 22nd of this month; but I shall be happy to furnish your correspondent or any of your readers with further particulars, if they will communicate with me. The report of the society is published by Geo. Philip and Son, 32, Fleet-street. Price 1s.

R. Herbert Bentley,
Hon. Sec. Class A, L.G.F.C.

31, Adolphus-road, Brownswood Park, South Hornsey, N.

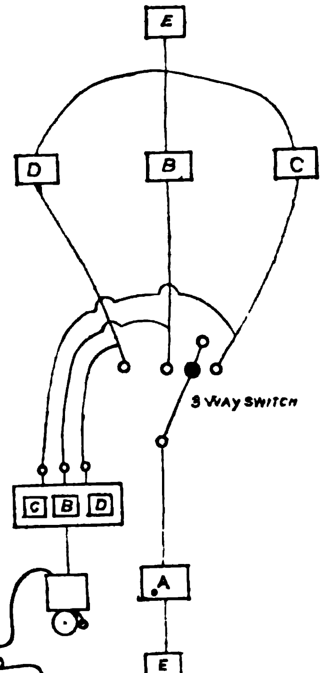
[68814.]—**Best Shoe for Harness Horses.**—The best shoe for harness horses is a shoe that will assist nature in its work on our made roads—one that has been thoroughly tried by myself and by a firm who have used over 20 tons. Unfortuately, business men are not always endowed with honest principles; otherwise the shoe would be now in general use, although its price was a drawback, being somewhat higher than the price of the ordinary shoe. The Dejean and Jeffery's patent reverse-nail non-slipping horseshoe, which is now on view at the Animals' Institute, Kinnerton-street, Belgravia (free), has been tried by cab and 'bus owners on their horses, representing over 800, and they are perfectly satisfied with the shoe, being thoroughly non-slipping, and its durability is surprising. The shoe, having recesses or divisions by the reverse-nail and the reverse way of nailing, picks up its own wearing power; but to be understood a trial is necessary. Should you, Sir, desire to prove this assertion, I will willingly put some on any horse you choose—one that is constantly slipping about preferable, as greater will be the satisfaction after the trial.

British Museum, W.C. C. T. Jeffery.

[68815.]—**Portable Musical Instrument.**—There is an instrument on the same principle as an accordion which might suit "Honduras"—viz., a "Polychord," which can only be used for accompaniment. It's tone resembles a chord on the harmonium. The keys are arranged in sets of four, which, if pressed down together, give a perfect chord; if pressed down in succession, can obtain a legato accompaniment. By changing from one set to another a vamping accompaniment can be kept up to any ordinary tune. The wind is supplied by working the bellows with the thumb. It can only be used in certain keys—viz., in C, G, and D major and their relative minor keys. Its manipulation is simple, and does not require a knowledge of music. It is portable—it can be placed on the table, or fastened to a strap around the neck. Of course, such an instrument will not suit any one who means to study music. It might answer well in conjunction with comic songs, whistles, &c.

Chas. A. M.

[68817.]—**Telephone.**—B C D represent the three out-stations; A the home-station; I I I are indicators, &c. When A wishes to speak B C D he places the 3-way switch accordingly; switch × being "off," × must always be "on" when no speaking is going on, thus enabling B C or D to ring up A through indicator and bell.



W. Perren Maycock, A.I.E.E.

[68818.]—**Tuning Fork Standard.**—If A. Baldwin will examine the three tuning-forks he mentions again, he will see that the middle one only is stamped "Society of Arts, 530," that being the pitch recommended by that body for "pitch C." The fork stamped 518 is French normal diapason, and the 540 is Philharmonic pitch. These three standards were sent out some years ago by Messrs. Brinsmead and Sons. The following table, selected from the *Journal* of the Society of Arts for June 6th, 1860, and elsewhere, will show some of the variations of "concert pitch." The number of vibrations is in each case for A, second space treble clef:—

Paris Grand Opera, 1699	404
Ditto., 1858	448
French normal diapason	435
Handel's tuning fork	416
Philharmonic, early in this century	433
Schiebler's, recommended by the Society of Arts	440
Italian Opera, London, 1859	455

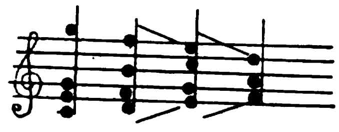
Attempts have been made at various times to use one uniform pitch throughout this country, but the result has been up to the present time *nil*.

A. B. C.

[68818.]—**Tuning-Fork Standards.**—There is no generally recognised standard of pitch in England. I have a case of forks by Brinsmead similar to those referred to by A. Baldwin, though neither of mine are "Stamped Society of Arts." The lowest in pitch is marked 517·3; this equals A 435—the normal diapason of France. This pitch has been adopted in England by Tonic Sol Fa College. The second fork is C 530 medium; the highest C 540 Philharmonic. The pitch known as Society of Arts Pitch is 512. The calculations in works on acoustics are generally made on the basis of this theoretical standard. H. T. W.

[68819.]—**Magnet.**—Many thanks to F. W. Mason for his reply, and would he kindly supplement it by answering the following: sizes of bobbins, kind of wood, also size of Daniell cells, also the work to be got out of the Daniell or Leclanché cells proportionately (such as four and a five) or whatever it may be, round or square iron for magnet core. Locomotive.

[68826.]—**Harmony.**—The difficulty this querist has found with respect to doubled thirds is solved by Macfarren in his "Harmony," ch. IV. 4 and 5, which reads as follows:—"The fifth of a common chord may be omitted, and thus the harmony consists of the root and the third only, or of these two, with either or both of them doubled. The third should not be omitted, except in very rare and peculiar cases." Then, again, in same chapter, at No. 20:—"When the bass is the major third of a chord, it may not be doubled, except if one part rise to it and from it by the step of a second, and the other part fall to it and from it by the step of a second, thus—



and except if the note be retained or repeated from the previous chord." So you see it is allowable in certain cases to double the third, although too much sweetness is very apt to surfeit; and by far the best thing you can do is to just notice the progression of parts of music by well-known composers with your eyes as well as ears, but don't follow modern hymn tunes, most of which are written in defiance of taste as well as rules. D. G. J.

[68835.]—**Dark Interior Photography.**—The best plate for above purpose is any good make of slow plate. My experience teaches me that most of the plates in the market are good. I generally use Thomas's, and they never play me false. By "a plate very sensitive to the dark ray," of course you mean a very sensitive plate; but do not use them for interior work, as you will get very little density. You can only tell your exposure by trial (halve your ¼-plates with a jeweller's diamond); the interior of a church with white glass windows and a poor light may take less time than a well lighted church with stained windows. For instance, the Abbey Church, Shrewsbury, 12 a.m., June, in sunshine, takes 3½ minutes with F. 27 and slow plate; St. Mary's, Shrewsbury, under like conditions, 25 minutes, and St. Michael's, Coventry, three hours. Always use a small stop (about F. 32) and give plenty of exposure. If you use open lens you certainly gain time but spoil your pictures, as any objects near the camera will be out of focus, such as the pews nearest to you in a church. You have a lens that will turn out good work—look out not only for intensity, but also quality of light.

Derfla.

[68840.]—**Flat Mirror for Newtonian.**—I trust that "F.R.A.S." will not object to my pointing out to him and to "Solar Focus," whose query (68840) appeared on page 312, relative to the proper size of flat mirror for a 12¼ mirror of 14ft. focus, that one of 3in. in minor axis is needlessly large, and that one of 2½in. is large enough, even to take the image of the sun or moon, assuming that the flat will be placed 12in. within the focal plane of the large mirror.

Ramsgate. J. C. Linscott.

[68848.]—**Coupling Dynamos.**—You are quite welcome to any assistance I can give you. Of course, extra care is required in laying high-tension leads and extra high insulation. In reply to the above question, you should most certainly couple the two series machines in series, not in parallel. This is obvious, since by coupling in parallel you lose the great advantage of series working—viz., saving in weight of leads. If you couple in parallel for any reason, you must not only couple the machines as a whole, but also connect the brushes together, or there will be a danger of the machines reversing.

Govan. Engineer.

[68849.]—**A 150c.p. Dynamo.**—To Mr. Bottone.—Supposing that you run eight lamps of 20c.p. and 50 volts, you would need to get at least 3lb. No. 16 wire on the armature. You cannot balance this as shunt, series, and compound with only one length of one-size wire; but you can make a compromise, and put from 15lb. to 20lb. of No. 20 on the fields. You will not get this amount on in four layers; but if you coil it so as to bring the four ends at the top, and have a terminal board with four terminals, you can connect up in one length, when you want to run the machine as a shunt machine, or connect the two limbs in parallel, when desired to run it as a series machine. The armature must be laminated. The speed will be about 2,000 to 2,500 revs. per minute, the voltage will be about 60 volts, the current about nine ampères. Horse-power required, about ¾.

S. Bottone.

[68852.]—**Bacon.**—Soak in soft water.

F. W. Mason.

[68853.]—**Neat's-foot Oil.**—Cool your oil so as to render all the stearine insoluble; then run it through felt bags. You will find your filtrates as bright as salad-oil. Derfla.

[68854.]—**Corn Solvent.**—Salicylic acid 60gr., extract of Indian hemp 8gr., flexible collodion ½oz., sulphuric ether ¼oz. Mix the latter two, and dissolve the acid and extract. Derfla.

[68854.]—**Corn Solvent.**—A reliable preparation may be made in the following manner:—Take of salicylic acid 30 parts, extract cannabis 5 parts, flexile collodion 240 parts. Dissolve.

Frederick Davis.

[68854.]—**Corn Cure.**—Extract of Indian hemp. 5 parts; salicylic acid, 30; collodion (methylated), 240. Rub the extract and acid with a little collodion in a mortar until well mixed, then transfer to a stoppered bottle, and shake well until dissolved. If this does not adhere to the flesh well, add a small quantity of powdered gum mastic. Vooght.

[68860.]—**Dynamo.**—To Mr. Bottone.—This type, which is certainly one of the best, is known by many as the "Simplex." The only fault in your drawing is that the diameter of the F.M. core is rather scarce. I should prefer to let it be 2½in. diameter, and take a trifle away from the thickness of the pole pieces near the horns. You will not find in trade any laminations of 4in. in diameter, so you will do well to make your armature of the 4½in. diameter Pacinotti's punchings, bore out your tunnel to 5in. diameter about 3in. wide. Wind the armature with 3lb. No. 20 d.c.c. Wind the field magnet core with 10lb. No. 24. Connect up as a shunt machine, drive at about 2,000 revs. per minute. At this speed the machine should give 5 volts and 5 or 6 ampères, and should light well 5 or 6 lamps of 48 volts each. It will need from ¼ to ¾H.P. to drive, according to the softness of the iron core, and the care with which the armature and field magnet have been wound. S. Bottone.

[68861.]—**Testing Lubricating Oil.**—To do this properly our querist must have some knowledge of chemistry; but if he has, I shall be pleased to give him details. F. W. Mason.

[68861.]—**Testing Lubricating Oil.**—To test for the "body" and volatility of the oils, take a glass sheet inclined at an angle of about 30, place a drop of each of the different oils at the summit, and leave for a day or so. The oil that traverses the farthest has least "body." That which has least left of it is the most volatile. To select the best lubricants. First, those that have a moderate amount of body from first experiment. This quality of course is important, for it means less waste of lubricant. Also one that is not too volatile and has a good body is a good oil. To test lubricating properties of oils selected from first test, a Thurston oil tester can be used. This is a machine with a spindle running in two bearings with a smooth-turned nose at one end, on which rests perpendicularly an arm fitted with two brasses adjustable to various pressures by means of a thumbscrew and spring. This is placed below the brass. At the top there is a thermometer. The oil is placed on this journal, and a certain pressure applied; the journal is then rotated at some constant speed, and the arm which contains the brasses goes out of the perpendicular, and remains at an angle which is read off an arc fixed to the machine. These are the true tests of lubricating oils, which test to be timed, temperatures taken, and readings the arc; these will afford a fairly exact coeffici of friction for each oil. The makers of this machi are Bailey, of Salford; cost, about £9.

H. D. Robinson.

[68862.]—**Animal Charcoal.**—Use furnace a retorts similar to those used in gasworks, a charge with well cleaned and dry bones.

F. W. Mason.

[68863.]—**Electro-Motor.**—For general desi see sketch in query 68860. Let the armature 6in. diameter and 4in. deep. Wind this with 4 No. 18, and the core with 4lb. No. 16. To dr this you will need about 25 cells, giving at least ampères of current at a pressure of 50 volts good chromic-acid cells, ½-gallon size, woul this. S. Botton

[68864.]—**Quadrant Link Governor.**—Messrs. Robey and Co., of Lincoln, used to make an arrangement whereby a powerful governor on the crank-shaft of the engine moved a wedge-like piece endways through the eccentric in such a way that it altered both the angular advance and the stroke, and was equivalent to moving an ordinary link-motion towards mid-gear. I do not know whether the governor proved powerful enough. I thought of the same thing myself when a pupil, but never tried it, because I thought the governor could not control it. There is only one slide-valve required, and no link. F. A. M.

[68865.]—**Essence of Vanilla.**—Vanilla pods (cut very small) 1oz., spirit of wine 10oz. Macerate for three weeks or a month, and filter through paper. If it is wanted colourless it may be distilled at about 200° F. Derfla.

[68865.]—**Essence of Vanilla.**—Macerate 1oz. of vanilla pods in 1 pint of rectified spirit for seven days, press, strain, and filter. The active principle of the vanilla pod is vanillin; this principle is very active. Three-quarter grain doses are frequently prescribed as an aid to digestion. Several cases of poisoning have occurred with essence of vanilla; this property is said to be due to a substance called "toxicodendron." Frederick Davis.

[68865.]—**Essence of Vanilla.**—Having been engineer at a large French confectionery firm, I have seen many gallons of essence made there. Their way of making was as follows:—The vanilla pods (not beans) were first cut up with a sharp knife into small pieces about the size of peas. This was put into large glass jars and covered with about six times the bulk of spirits of wine (not methylated) and allowed to stand about six weeks, stirring frequently. At the end of that time it was strained through linen and bottled off for use; the residue was then just covered with fresh spirits until they were making some more, when it would be added to the fresh stuff. The vanilla residue was finally dried, ground, and sold to the cocoa makers. I will give any further information "Cymro" may require. Jacques.

[68869.]—**F.M. for H Armature.**—Put about 4lb. No. 20 on the field-magnet core, and couple up as a shunt machine. This would give certainly sufficient E.M.F. and current to light three or four six-volt lamps. If the armature were rewound with No. 20, you would get 12 or 14 volts. The speed required will be about 3,000 to 3,500 revs. per minute. S. Bottone.

[68870.]—**Slide-Rest on Gap-Bed Lathe.**—You don't say what prevents the slide-rest from moving up close to headstock. I can only imagine that the slide-rest was made for a straight bed, and has the usual hand-screw underneath. Slide-rests for gap beds require a clamp or plate hinged to one side of the lower slide, the other side being cast with a lug, through which passes a capstan-headed bolt. This bolt screws into the free end of the clamp plate, and by turning which the slide-rest is secured on the bed. Sometimes a bolt replaces the hinge; in either case a special casting is required for bottom slide. If only the gap bridge is at fault, you must fit a new one, formed so as to allow the rests, &c., passing over it. A. F. Shakespear.

Lüttichaustr. 14, Dresden.

[68873.]—**Gearing Facile.**—Better sell it and buy a geared one, as very extensive alterations would be necessary before gearing could be fitted, and I doubt you being able to effect much of them yourself. A. F. Shakespear.

Lüttichaustr. 14, Dresden.

[68874.]—**Bichromate Batteries.**—Clean ends of carbons, and connect up with Daniell cell and depositing trough containing solution of copper sulphate, carbons to zinc of battery, and copper plate of trough to copper of cell, allowing ends of carbon to dip into solution, which will then after an hour or two become plated with copper. Clean copper and solder in usual way to brass of battery cap. H. D. Robinson.

[68874.[—**Bichromate Bottle Battery.**—You must "copper" your carbons—viz., deposit copper on your carbon plate in a sulphate of copper bath, with a little sulphuric acid added; making your bon plate the "cathode," and a sheet of copper "anode." This done, you must "tin" it with dering-iron and spirits of salts, then it is an atter to solder to the brass flanges. Some- they are screwed to the flanges; but this is good as soldering. An Ex-Watchmaker.

874.]—**Bichromate Bottle Battery.**—To Bottone.—Wash your carbons, by soaking in water until no longer coloured. Dry oughly. When dry, fit up a Daniell cell and ect the carbons to the negative pole, and im- se in a sulphate of copper bath to the depth of ut ½in. (or the same as the length of the flanges), coat with copper. Again wash thoroughly in an water. Dry. Clean up one face of the de- ited copper with emery paper, and "tin" the face pretty heavily with a little soft solder. Do likewise with the brass flange, leaving a little excess of solder on the flanges. Now hold the surfaces together over the flame of a spirit lamp until the solder melts; hold together till set. Now varnish over the points of junction with thick sealing-wax varnish. S. Bottone.

[68875.]—**Motive Power.**—"No Sig." seems not to comprehend what H.P. means. Now 1lb. raised 1ft. is 1ft.-lb. of work; 33,000ft.-lb. of work done in one minute is 1H.P. H.P. = $\frac{H \times W}{T \times 33,000}$

Where—

HP = horse-power.

H = height through which weight is raised in feet.

W = weight raised in pounds.

T = time taken in minutes.

In his first question no time is stated, therefore amount of work done can only be given. It is = 112 × 30 = 3,360ft.-lb. No work is done in holding up 1cwt. for 20min., although I am afraid "No Sig." might not think so during the experiment. Dumbarton Youth.

[68878.] — **Lightning Conductors.** —With a three-cell Leclanché and bell you might be able to roughly estimate whether the conductor was in good order or not; but for a practical and good purpose it would need a little more careful testing. If "Joiner" would like to know particulars, shall be pleased to give them. F. W. Mason.

[68878.] — **Lightning Conductors.** — Your proposed test would only show that the wire was continuous, and would not prove much. If every strand but one in conductor was broken, the bell would still ring. I, amongst others, no doubt, would be glad if some correspondent would tell us how to test a very low resistance. I have a Wheatstone's bridge, as described several times in "E. M.," and I find it very useful for testing; but on experimenting with a piece of electric-light cable, I found it was fairly sensitive if the length was altered; but if all the strands were cut but one, it did not seem to make much difference till the one strand was prolonged an inch or so. The bridge has very heavy copper connections and terminals; the cable was seven 16 B.W.G. wires. If some correspondents would tell us a means whereby a low resistance (as a lightning conductor earth) may be trustworthily found to be as low, or lower, than a piece of cable, say, that one would be satisfied with, which test need not, of course, be very accurate, they would be giving some valuable information. Practical.

[68878.] — **Lightning Conductors.**—Yes, a direct-reading bridge, which is very simple to make, is described on p. 14, "Practical Electrical Testing," by James Swinbourne, a book which I should advise you to possess yourself of (price 4s. 6d.) It is worked in exactly the same way as a metre bridge or ordinary type, and is direct reading, no calculation being required. An instrument of this type with a scale 1 metre long divided to mms. might be calibrated to read from 0·01 to 10 ohms by steps of 0·01 ohm, and I reckon that is near enough for lightning-rod work. If the Editor likes I will send in sketch and details of making, but cannot afford the time this week. As to testing your conductor, I understand that the main conductor, after leaving the top, continues down about half-way, and there branches into two, each to a separate earth. If so, it is an awkward one to test. You must solder a wire to the pinnacle, and best make a permanent job of this, taking it into some convenient place for testing. Just above the branch connection solder another wire (insulated of course), and carry this to the same place as the other. Find a separate "earth" to that used by the conductor, and disconnect one of the branch conductors at any convenient point within reach. Test between point wire and free end of branch. This should be of no appreciable resistance; if it is, test res. between point and wire above fork. If this tests about the same as before, the fault is in the connection of the conductor with the point, due probably to the weather acting on the lead-filling in the joint. If, however, this is all right, test between the lower wire, and you will find the fault at the fork connection. Next, test the resistance of the "earth," using the "earth" connection of the branch you have cut. This should be under 2 ohms; if it is not, test between the subsidiary "earth" and each conductor "earth" in succession; one will be of higher resistance than the other. The fault is there; see to it. Next, remake the joint in the branch you have cut, and clamping a wire to each side of it, test the joint. You should find it almost impossible to get a balance, it should be so low; if not, you must remake it. Of course, you may say that this is very complicated, and that you may just as well test to earth without cutting either branch; and so you may, but then you have no guarantee that both "earths" are right—one may be practically disconnected and the other good, and the conductor as a whole test right. If it is worth while to put in two earths, it is worth while to make sure both are right. Of course, you must allow for resistance of leads to testing instruments. An ordinary electric-bell and battery would be of little use. Suppose the bell rings with 0·2 ampères, and the resistances of its coils 5 ohms, then the total maximum res. = 9 ohms, and the E.M.F. necessary (allowing 2 ohms for a No. 2 Leclanché) = 0·2 × 11 = 2·2 volts—say 2 Leclanché cells. If then the bell rings the whole circuit is about right; but there is no guide as to the actual state of the earth, for the earth may be good and yet the bell not ring, owing to a fault in battery, and if you have the means of testing the battery and bell properly, you had best test conductor right away. And further, it is obvious that the bell will ring with different currents, according to adjustments.

Govan. Engineer.

[68879.] —**Accumulators.**—I would strongly recommend "T. D. H." to read Salomon's "Management of Electric Light Installations and Accumulators"; or Reynier's work on "Secondary Batteries" (see my advertisements). The way to make Planté's spiral form is to make a paste with strong oil of vitriol, specific gravity 1·840, and ordinary red lead; spread this on the scored lead plates, and roll the plates up while the mixture is still moist. Allow this now to dry quite hard, before immersing in the cell. The E.M.F. of the accumulator is as nearly as possible 2 volts per cell. S. Bottone.

[68881.]—**Link Motion.**—What you suppose to be an imperfection is really one of the great advantages of link motion. What you suggest would be true if the link rocked on its centre, so that the block had no motion in mid-gear. When the link is moved towards mid-gear the lead of the valve will slightly increase or gradually disappear, according to the way the eccentric rods are crossed. Don't refer to "Bourne on the Steam Engine" to see which way they should cross—his diagram is wrong; but, if you want to understand the subject, get an American book by Auchincloss, and have a fortnight or three weeks at it. If the eccentric rods cross when the eccentrics point away from the link, the lead will increase towards mid-gear, at which point the engine will get some steam; but it will come in as much before the end of the finishing stroke as at the beginning of the next—i.e., the lead becomes equal to the admission. If the eccentric rods cross when the eccentrics point towards the link, the lead will disappear towards mid-gear, and the engine will get no steam. The first arrangement is usually the best, but the last is best on a steam winch. F. A. M.

[68882.]—**English Concertina.**—The bowing-valve (a patent) of the English concertina occupies a position similar to what is known as the "wind-key" of the German instrument. When the thumb is inserted in the strap, the lever of the valve, projecting about ½in. above the keyboard, just touches the back of the thumb, a slight curl of which at once opens the valve. Both valves are on the non-return principle—i.e., they only pass air one way. The one on the right side of the instrument admits air to the bellows, while the one on the left side passes air from the bellows without the necessity of pressing any of the ordinary keys. The effect of a passage played on the concertina while the bellows is being drawn out is the same as that produced by the down bow of a violin; and, in the same way, a passage played by an up bow on the violin has the same effect as one played on the concertina while pressing the bellows. Suppose, for instance, you are going to play a few bars in *staccato.* It is impossible, with the ordinary instrument, to get that sharp "snick, snick" which contrasts so well with the *legato* style, and which is hardly any trouble to the violinist. But the bowing-valve being kept open while the passage is being played admits to the bellows, after every note, just the amount of air which the vibration of the reed has deprived it of, thus keeping a steady balance of wind, and insuring to each note a likeness of expression exactly resembling its fellow. In short, the bowing-valve enables every motion of the violinist's bow to be accurately copied by the concertinist's bellows. It gives you full command over the wind, and enables you to fill or empty the bellows in a second, without having recourse to the sounding of an unnecessary chord. If you live in London, try to hear Mr. Alsepti. If you have not already heard him, you will be surprised at the perfection to which he has brought concertina playing. I believe you can generally find him at Messrs. Keith, Prowse, and Co., in Cheapside. With respect to your last request, I have not got your original communication by me; but I think it referred to the improved effect produced by reversing the position of the instrument. I have not given the matter much consideration, nor have I even tried it, but should presume that the improvement is due to the position of the thumb-straps giving a greater command over the bellows. Practice will give the same effect when the instrument is held in the ordinary way, only the practice must be conscientious and thorough. I do not think there is much room for improvement in the modern arrangement of the keyboard, especially when your have sixty keys to deal with. I shall be pleased to give you any further information. Regondi.

[68886.]—**Converting Verge Watch into Lever.**—To answer this query fully would require quite an article. "Young Watchmaker" had better defer such an attempt until he is more learned in his craft. Turns, burnishers, and files are little use unless he knows how to use them. A depthing tool is, of course, indispensable. Calculate your new train not less than 16,200. You must "bridge" over your present third wheel, shortening its pinion so as to work under it. Your contrate pinion will want a new wheel, which now becomes your fourth wheel. Your escape wheel and pinion, with pallets and lever, must be planted between your bridge and the top plate. You can buy any size and number of wheel you may require ready for mounting. Failing in your hard soldering is through want of practice. Try again; have your pieces thoroughly clean, and well bound together with iron wire; direct your flame so as to "draw" the solder, and not "at" it, as most beginners do. If you want more particulars, ask again.

An Ex-Watchmaker.

[68887.]—**Gnats, and Other Insects.**—Equal parts of powdered ipecacuanha, rectified spirit, and sulphuric ether. For outward application only.

R. P. G.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Sandy Dunn" has replied to 68312.

68324.	Rebronzing Urn, p. 140.
68333.	Force of Explosions, 140.
68354.	Mensuration, 140.

68572	Power of Eyepieces, p. 227.
68573	Patterns for Ashpan Bars, 227.
68591	Tramway Gauge, 227.
68600	Annual Winding Clock, 228.
68603	Organ at St. Thomas, Salisbury, 228.
68616	Force of Explosives, 228.
68619	Measuring Time, 228.
68620	What is it? 228
68626	Incubator Regulator, 228.

USEFUL AND SCIENTIFIC NOTES.

Fuel Value of Coals.—At a recent meeting of the Manchester Section of the Society of the Chemical Industry, Mr. W. Thompson read a paper on "The Heat-producing Powers of Twelve Samples of Coal," determined by burning in oxygen—in the apparatus devised by him—compared with their theoretical values as calculated from their chemical composition. The coal which he found to give the highest results as regards heat producing was anthracite, which gave 8,340 centigrade units of heat. Next came Pendleton coal, with 7,736 units; then Wigan coal, 7,552; and the lowest of the twelve came from near Atherton, with 6,448 units. The results obtained by experiment were higher in two coals than the calculated results obtained by determining by heat units given by the combustion of the carbon, hydrogen, and sulphur found by analysis, but deducting the hydrogen, which appears always to be in combination with the oxygen present, so that its hydrogen does not produce heat on burning. In two coals the heat found by calculation and that found by experiment were the same, and in seven coals the heat found by calculation was greater than that found by experiment.

The Geographical Bureau of the Home Department of the Japanese Government established some time ago a full meteorological service. Tri-daily telegraphic weather reports are gathered from the whole of the empire, and for some months past these have been published in the daily newspapers. The number of reporting stations in Japan is thirty-one, and from these, together with five stations in Corea and China, with less frequent exchanges from Manila in the Phillippines and Vladivostock in Siberia, the reports are made up. The apparatus used in the central observatory, which is situated at the highest point within the old castle of Tokio, is of the finest and most sensitive kind from Europe and the United States, supplemented by special instruments of native manufacture. Direct magnetic observations have been carried on for several years, with self-registering and other apparatus. The subject of marine meteorology and that of seismic disturbances is also attended to. The official Government work is supplemented with great popular benefit by the Meteorological Society. Thus far about 70 per cent. of the forecasts made in Tokio have proved correct. In addition to the value of the cautionary signals displayed from 49 stations, the results of the system of observations are frequently inquired for by architects, engineers, medical men, and surveyors.

QUERIES.

[68890.]—**Cutting Wheels.**—Is it possible to cut gear wheels for clocks in any other way than in the lathe? I wish to make a simple clock for experimental purposes, like the one described recently, but with a few gear wheels. The pinions (of the lantern form) I can easily make, and the dividing I can do by attaching the blank to the middle arbor of a clock where it projects through the frame, stopping it at the required places by a pin through the teeth. Also by what rule is the diameter of one circle calculated with regard to the other, so that the divisions in each shall coincide? Thirdly, how can I divide circles into prime numbers. I know there is some rule for this, based on the relation of the base of an isosceles △ to the side.—Lux.

[68891.]—**Magneto Machine.**—To Mr. Bottone.—What sized electro-magnet and what wire (in ounces) should I use for above, having a 6in. magnet?—Bobbin.

[68892.]—**Franklin's Experiment.**—Will some reader kindly tell me how to construct Franklin's experiment, the three bells that ring by induction by the influence of atmospheric electricity?—M. A. C.

[68893.]—**Wet-Plate Photography.**—Will any of our photographic friends kindly help me in the above process? I have failed in all my endeavours to get a good picture. I have first of all flowed the glass with collodion, and before letting the plate get dry plunged it into silver bath, and then exposed it for about five seconds, or according to the light of day. After exposing, flowed over the developer, washed it off when picture showed itself, then applied the fixer, but my pictures have looked when dry very pale, and sometimes blue. What is the cause? Should the plate be washed after leaving the silver bath before exposing, or should a spirit lamp be used in drying? I have let the plates dry in the sun. Have found the picture more distinct on wrong side of picture, and when the black varnish is painted on the picture becomes almost extinct. The camera I use, an ordinary ¼-plate. I have a red glass glass fitted in dark-room window, with buff curtain. Is that the right light to use? Any information on the above subject will much oblige.—One in Trouble.

[68894.]—**Frosted Silvér.**—I have a brooch formed into a rose with two buds half-closed, and one centre piece imitating full-blown rose with six frosted leaves. It has gone quite dull. Can some kind reader tell me how to clean it?—Thanks.

[68895.]—**Accumulators to Drive ½H.P. Motor One Hour.**—Can some one kindly give an idea of the time it would take to charge them with a powerful hand dynamo, and the cost at a given time if driven with a chromic-acid battery?—J. H.

[68896.]—**Telephone.**—During the recent thunderstorm the exchange telephone for a circuit of 20 Gower-Bell instruments started ringing, although no annunciators dropped. 1. What part of apparatus is affected, and how? 2. How can the damage be rectified? 3. How can the accident be prevented in the future?—A. B.

[68897.]—**Constant Current Batteries for Medical Purposes.**—I use these batteries, sometimes of 20 small elements, sometimes 40 or 50. Can Mr. Bottone or any other reader of experience advise as to the best kind of element? I may say that I have tried for years to get a tolerably sustaining element, which will not get out of order, without success. The best I ever had were among the first Leclanchés about 10 or more years ago. I can get none now as good as those were. I have tried the new dry cells and am very disappointed. Can anyone help me?—Const. Med. Bat.

[68898.]—**Engine Query.**—Would some of your numerous correspondents kindly tell me whether it makes any difference (theoretically or practically) which crank in a triple expansion (or compound) engine be made the leading crank?—Bermuda.

[68899.]—**Engine Driving.**—Will some of our engineering friends that have had a fair experience of driving low-pressure engines give me a little instruction? I have been working high-pressure engine for a long time, and should now like to take a vacancy—that of a land draining engine, or something of the sort. The one I should like to take is a 16H.P. The only thing that I am rather at a loss to understand is the condenser and the vacuum gauge, but I feel even by a little help I could get over these points. Will some one be kind enough to give a sort of table, so that I might find out the mean pressure at the different lengths of stroke. I have been told that there is a table of that kind I can manage to find out H.P. of high-pressure engine at some parts of the stroke. How am I to find out the H.P. of low-pressure engine (indicated H.P., I mean)? Will "T. C., Bristol," or some of our readers kindly help?—Willing to Learn.

[68900.]—**Small Water Motor.**—Can any of "ours" in me as to the best way of making the above? I have water from the main at high pressure, and I want a small motor to drive a model dynamo. Can this be done? If so, a sketch and measures to obtain a certain result will oblige. The dynamo has to be driven at 2,500 revs., and I want to know if it can be driven direct from the motor. —L. E. E.

[68901.]—**Dog Muzzle.**—Would feel much obliged by description of the best form of dog muzzle which would allow the animal to breathe freely. The usual mouth-closer appears to be a cruel and dangerous plan, well calculated to produce rabies.—D. A.

[68902.]—**Bending Light Tires.**—I shall be glad if any reader would inform me how to make a machine for bending iron for light tires.—One that Don't Know.

[68903.]—**Pigs in Clover.**—The *Electrical World* quoted in the *Scientific American* of June 1st, makes mention of a puzzle called as above, invented by Mr. Crandall, who, for twenty years past, has had his mind on the availability of the rolling of marbles for a toy, which, after experiment ultimately took the form and dimensions of the hand toy now so familiar, of which 300 gross have been turned out daily for some time, while the demand has not yet been met by the supply, &c. Can any of "ours" describe this toy?—D. A.

[68904.]—**Finings.**—Could any reader tell how to prepare above for clarifying beer and ales?—Home Ale.

[68905.]—**Horn.**—To "Woodford."—Can you oblige me by stating where you saw the accounts of M. Alexis Rochon's interesting experiments and discoveries? Is there any account of his life published?—Victor.

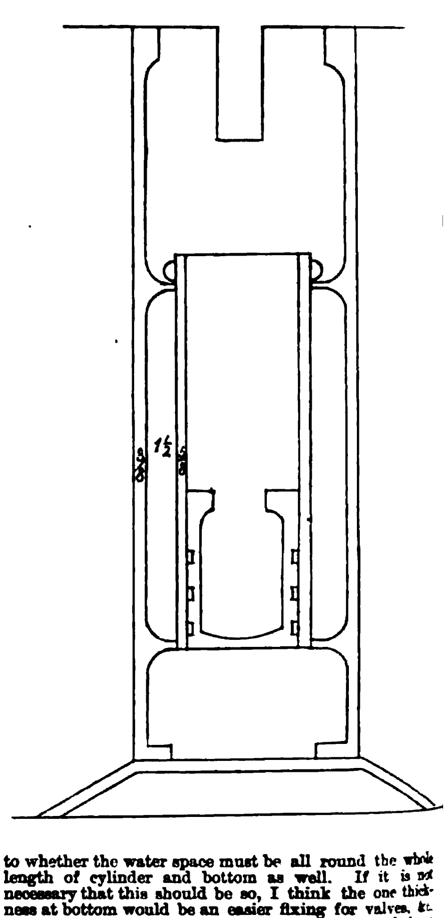
[68906.]—**Tricycle Rattling.**—What is the cause of a front-steering Premier tricycle making a most unpleasant noise when running? I have one which makes a continuous rattle the whole time—so loud as almost to make it impossible to be heard when speaking. The front wheel is the greatest sinner—it makes an abominable racket. What is the cause?—and is it possible for me to stop it without sending it to be repaired?—R. A. R. Bennett.

[68907.]—**Gold Leaf.**—Will some kind reader tell me how to put on gold leaf on Royal coat-of-arms so it will stand the weather? How is the leaf taken from the book?—G. P. O.

[68908.]—**Scotia Camera.**—Can any of our readers say what kind of lens is required for above, and about what cost. I have followed the description given lately, and am making it the full size.—Young Amateur.

[68909.]—**Piston.**—Would some reader kindly explain the following:—I am in charge of a pair of engines, and there is one of our h.p. cylinders gives me a lot of trouble by water accumulating on the piston head, also down about the rings, which are a very good fit. What I want to know is, how does it get there, and how shall I stop it? When the cylinder is quite hot the water is still there. I find that the junk ring is not bearing properly on the piston head. Would that cause it?—Jim.

[68910.]—**Gas-Engine.**—To "Yarg."—I am thinking of making a gas-engine, about the size of the one described on p. 301, Vol. XLVIII., but thought of making the outer shell and bearings all in one, with the working barrel let in, as per sketch, but am in doubt as to whether the water space must be all round the whole length of cylinder and bottom as well. If it is not necessary that this should be so, I think the one thickness at bottom would be an easier fixing for valves, &c. I should like "Yarg's" advice on this matter, and if not asking too much would feel greatly obliged if he would give me the drawings and hints he offers to give a correspondent on p. 384, Vol. XLVIII.—D. G. T.



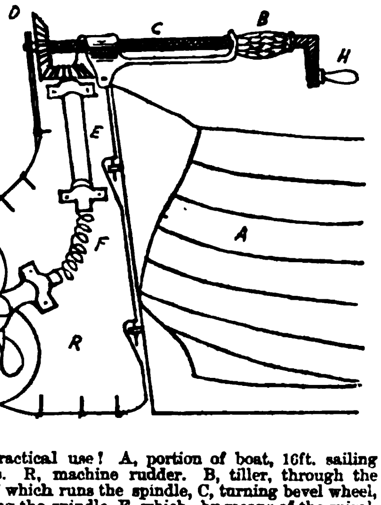
[68911.]—**Dead-Centre.**—The early locomotives by Trevithick had, for the most part, only one cylinder, a fly-wheel carrying the crank over the dead-centre. It is stated by Wood in his work on "Railroads" (183[illegible]) that an engine of this kind applied on the Wylam railroad was found very troublesome, and its action very uncertain, as when the engine was stopped while the crank was on the dead-centre it had to be moved by levers until the centre was passed. Now, the steam-roller so much used in large towns is simply a Trevithick engine very much modernised, and applied to rolling. As we are now so accustomed to two-cylinder engines, I would ask if any, and what, provision is made in these rollers should the crank stop on a dead-centre, or is the engine "dodged" or "humoured" by the driver to avoid this occurring? The same query applies to single-cylinder marine-engines such as used on the Clyde and in the American river steamers.—Gab End.

[68912.]—**Screw-Cutting Lathe.**—Would "T. C., Bristol" or some other readers give me a sketch, with dimensions, of the way to take up end-motion of a [illegible] centre screw-cutting lathe, with hollow mandrel [illegible] conical bushes ([illegible] bore) the body of mandrel is 1[illegible]in., [illegible] bearing is 1[illegible]in. long, and is 1½ taper down to [illegible] where [illegible] two nuts and wash- [illegible] motion. I want [illegible] the cross-piece [illegible] for screw-cutting when I can afford it. What dia. and what breadth should the small wheel on mandrel end be, and what distance from the head should be the mandrel? Is ⅞ dia. where wheel goes on. How is gap-piece kept in a lathe-bed by a bolt?—Apprentice Mechanic.

[68913.]—**Locos. at Paris Exhibition.**—As there seems to be such a large quantity of foreign locos.—though few English ones—at this exhibition, I think it would be of interest if "Vandal" or any other could give us dimensions and sketches of some of the more interesting specimens of the lot, as we seldom get any accounts about "foreigners" in this paper.—J. A.

[68914.]—**Naphtha.**—Will some reader be kind enough to explain the following? How can I, by calculation, convert pounds of coal tar naphtha into gallons, and vice versâ? Also, how can I, by calculation, reduce the percentage of benzole. For instance, supposing I have 100gal. 50—90 benzole testing 53 per cent. 100° C., how can I reduce it to 50 per cent. 100° C. by calculation?—E. J. C.

[68915.]—**Auxiliary Screw.**—Can any reader of the "E. M." tell me if the screw, as per sketch, can be made



of any practical use? A, portion of boat, 16ft. sailing boat class. R, machine rudder. B, tiller, through the handle of which runs the spindle, C, turning bevel wheel, D, working the spindle, E, which, by means of the spiral, F, turns the screw, G. One turn of the handle, H, ought to give two or three turns of the screw. This is not meant to supersede oars, but for a convenience on calm days or narrow rivers. The sketch is meant to show the general bearings of the contrivances.—Tredagh.

[68916.]—**Model Dynamo.**—To Mr. Bottone.—According to your kind instructions as to sizes and amounts of wire to be used, I constructed a dynamo from some castings which I purchased, and which you said should, if made properly, give about 12 volts difference in potential. As far as I am able to make out, I have followed very carefully all your instructions, both from your book and in the "E. M.," in answer to my inquiries; but have not been able to obtain any current at all. There is no short-circuit anywhere. The connections are right and properly joined up. I had this result some time ago, and wrote to you through the "E. M.," and you said that the iron of the castings might be too hard for the success of the dynamo. I have since then unwound and made the castings red-hot, and placed them in sand to allow them to cool very slowly. After rewinding I have made no better result. The brushes are in the right position, and I cannot make out what is the matter. It works all right with three Bunsens as a motor.—L. E. E.

[68917.]—**Gas-Making from Benzoline.**—Can any of our readers inform me how many feet of gas one gallon of benzoline contains, generated free from air?—George Clark.

[68918.]—**Wire Gauges.**—Could Mr. Bottone kindly give Browne and Sharpe's wire gauge, the numbers and diameters in decimals of an inch? What is the difference between the above gauge and the American gauge? I see that the Board of Trade have issued a new wire gauge. Does this do away with the B.W.G.?—Elektron.

[68919.]—**Absorption and Radiation of Heat.**—Could any of your correspondents oblige us with an idea of the comparative amount of heat which is absorbed by the following—viz., 1lb. of zinc, copper, cast-iron, and earthenware? Also the comparative power of radiating heat possessed by 1ft. superficial surface of each?—J. and W. Kirkwood.

[68920.]—**Ammonia Motor.**—Could any reader give a description of the ammonia motor that was used on one of the Manchester trams? The pressure gauge showed 140lb. pressure at the start of the run, at the far end it showed 120, and when it was going into the shed it again showed 140 per square inch.—Elektron.

[68921.]—**Organ Pedals for Piano.**—Will one of our readers be kind enough to describe to me how to connect the pedals to the keyboard for organ practice? I could not see how they were connected, as the front board was not removed. I have the size of pedals and frame. A sketch would greatly help me.—J. T.

[68022.]—**How are Thimbles Made?**—"Father, how are thimbles made?" "My boy, I can't tell you, but I will ask the English Mechanic." I am ashamed to say, Sir, that I do not know by what process either steel, brass, or silver thimbles are made. If one of your readers will kindly inform us, I think he will very likely gratify many an inquiring youth as well as—An Old Father.

[68923.]—**Crystals.**—Will anyone tell me an easy practical way of [illegible] the system to which any crystal might [illegible] to me how it can be proved [illegible] hexagonal, and not to the cub [illegible] manner?—Ignoram[illegible]

[68924.]—**Explosives.**—Can any of "ours" give me short list of materials, or mixture of materials (non-firing), such as lime and water, for instance, with their relative forces if possible?—X. Z.

[68925.]—**Watch Holes.**—I have a set of Fort's drills and stocks. Would any of "ours" be kind enough to give me instructions what I should have, or how to make frame, or anything that would enable me to drill holes straight in watch plates and arbors for pivots?—Clock Jobber.

[68926.]—**Dynamics.**—The detection of the fallacy of the following argument is a good exercise for what may be called dynamical instinct. Can anybody expose it? Two engines on a train are no better than one; for if the first engine is working at a greater power than the hinder engine, it has to drag the hinder engine, which is, therefore, to say the least of it, no good. Again, if the hinder engine is working at the greatest power, it has to push the front engine, which is, therefore, in this case, of no good.—Ignotus.

[68927.]—**Pump Valves.**—Would "T. C., Bristol," or any reader tell me what size I should make the valves of a pump? The ram is 8in. Also size of pipes.—Reader.

[68928.]—**Leaky Boat.**—What is the best way to tighten seams of a clinker-built boat, and also the cracks or shakes in the boards? Is there a good cement made for this purpose?—Oar.

[68929.]—**Small Black Boot Buttons.**—Will some one kindly inform me what substance the heads of boot buttons are made of?—if it is vulcanite. Is it moulded or pressed into shape? How is the vulcanite softened or prepared, as I want to make a few special buttons myself? Please let me know the ingredients to go about the operation.—Rapier.

[68930.]—**Planet Crossing Sun's Disc.**—About the end of April, 1884, at 5.30 a.m., happening to look at the sun just rising, I saw quite plainly, a small black speck crossing sun's disc, which, to my eye, was like a black pea. I only saw it for a few minutes, and lost it as the sun got brighter. Previous to this the sun had been a dull red colour. Can anyone tell me if it was Mercury I saw, or what planet, and whether it is a common thing to see such as I have described?—Rapier.

[68931.]—**Rotary Engines.**—One of your correspondents sent lately an excellent article, and promised to continue more, on rotary engines. Might I ask that gentleman to do so, as I enjoyed his letters very much, and am sure that many of our readers did also? I will consider it a relief to the everlasting queries of how to light 5c.p. lamps and batteries to work the same, varied with railway engines and "sketches" of them.—Rapier.

[68932.]—**Deafness.**—Having seen in the *Glasgow Herald* a paragraph to the effect that a remedy for deafness has been hit upon, in the shape of a miniature telephone which fits inside the ear, and being myself a sufferer from partial deafness, may I ask if any reader can, and will, oblige me with any information upon this important matter to a large section of the community? In my case, deafness has been hundreds of pounds out of my way, since it was just sufficient to cause me to give up my paper reporting; and I am always looking forward for some such invention as that above referred to.—Aural.

[68933.]—**Electrical.**—Would any of "our" readers tell me the best plan for rendering the surface of moulds metallic in the process of electrotyping. Have tried the phosphorus and silver, but it leaves the mould so rough after applying same; and blacklead takes such a long time before it gets covered; and besides that, one cannot brush it into the crevices properly.—Ignoramus.

[68934.]—**Electric Tricycle.**—Will Mr. Bottone or some other reader kindly inform me (1) what would be the probable initial cost of constructing the above machine to travel about eight miles without recharging? (2) What would be the approximate cost of recharging it? (3) What would be the least troublesome, and at the same time, the most economical method of driving it?—by accumulators or battery? (4) Is the Highway Locomotive Act strictly enforced in the case of these machines, especially as regards speed, and the necessity of having a man to precede it?—T. W. B.

[68935.]—**Model Engine.**—Will some of my fellow readers kindly send me particulars of a small horizontal force pump for a slide-valve engine, 1¼in. bore, piston 2½in. stroke; namely, diameter and stroke of plunger, size of inlet and outlet pipes. Is the plunger packed in any way? Also, under engine I have a tank 11 by 4½ by 2½in., which I intend to keep partly filled with water. The exhaust is discharged into this about ⅜in. from the bottom. I am told it will only condense the exhaust steam until the water gets warm. What is the simplest remedy?—namely, to keep the water cold?—Subscriber.

[68936.]—**Nickel Crucibles, etc.**—I find that a nickel crucible will not stand caustic alkalis. There seems to be an insoluble residue after solution of fusion in H_2O. What is your experience? Why is $K_2Cr_2O_7$ fused before making volumetric solution for sampling iron? How can I separate iron and manganese oxides in their native state? In passing H_2S through a hydrochloric solution of a mixture of two inorganic acids and two common bases after Pb was partly removed, a vermilion ppt. formed, which was ultimately obscured by the ppt. of remaining Pb. What was this metal?—Pachys.

[68937.]—**Test Solution.**—To "W. G." and "Sm."—Please give method of making and using soap-test for hardness of water; also Tate's method of detection of cotton-seed oil. How can I make a solution of molybdate of ammonia in HCl? I find molybdic acid is pptd. I have prepared a solution of nitroferrocyanide of soda, and find it gives the characteristic blue coloration with Am_2S; but not with other alkaline sulphides, such as K_2S. How is this?—Pachys.

[68938.]—**Electrical Heating.**—It is desired to heat to a temperature not exceeding 150° Fahr. a series of twelve brass stamps, half an inch diameter, on the face, and which form the lower ends of short brass tubes. Can the warming be done economically by means of electricity—dynamo or battery cells?—and the temperature easily controlled? A descriptive arrangement of an installation suitable to such a purpose would, perhaps, be of interest to more than—One Half Informed.

[68939.]—**Lithanode.**—Would Mr. Charles Penruddocke (letter 30041) kindly give a few more particulars as to this substance?—whether it requires forming, as in the Planté type, and if so brief directions? In one part of his letter he says it can be used with spongy lead as an accumulator, and with zinc may form the elements in a single-fluid primary battery. Later on he describes the running of a small lamp with two Lithanode zinc secondary cells. This is somewhat puzzling to me, and possibly to others, and an explanation would much oblige.—B. W. G.

[68940.]—**The Fratton.**—Can any of your correspondents give me any information about the engine Fratton, on the L.B.S.C.R.? Have there ever been any locos. on the Brighton line named Vauxhall or Pulborough? Particulars will oblige.—C. F. Dendy Marshall.

[68941.]—**Case-Hardening.**—Having some light ironwork to case-harden, I cannot manage to bring it out straight. It is always twisted and bulged. I have looked up back numbers of the "E. M." where I see a good deal on case-hardening, but nothing in reference to twisting and bulging? Could any brother mechanic enlighten me on the subject?—Magazine.

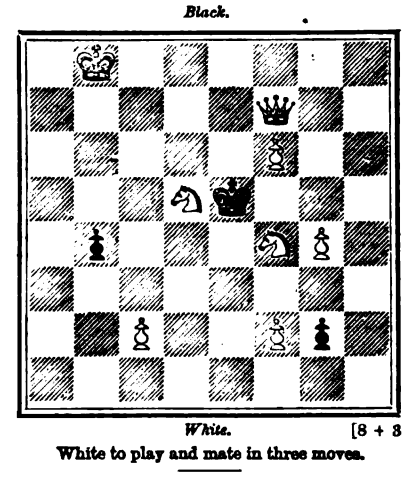
[68942.]—**Centrifugal Force on the Moon.**—I thank "F.R.A.S." for his kindly intended answer to my last query, although he has not named a single writer on the subject of the effect of forces on the moon. I want to read up this question, but cannot tell where to turn. I presume the conditions on the moon are very similar to what they would be were the earth at rest, as far as motion is concerned, and this is the way I should like the subject dealt with: the earth as a centre, with one planet revolving round it in, say, 28 days, always keeping one face turned towards that centre, and travelling an orbit of about 1,500,000 miles in that time. Would it not follow that any atmosphere which might appear on the moon would be driven to the outside furthest from us by the force which I am not allowed to call centrifugal? Then, without atmospheric pressure on this side, water would rise and be carried away in vapours to the off side, away from observation, leaving on this side barren sterility to reign supreme. Thus it strikes me that the exact appearance of our satellite may be accounted for, and yet beyond our view may be zones of life and beauty equal to any we can boast of on earth. Again I would ask introduction to the latest writings on the subject.—Wm. Hosken.

CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLIV.—By V. Schiffer.

Black.



White. [8 + 3

White to play and mate in three moves.

Solution to 1,152.

White.	*Black.*
1. B-Q B 4.	1. Any.
2. Q, B, R, or P mates.	

(Five variations.)

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,152 by Litho (very pretty), J. C. B., A. Dean, E. Retchford, E. Sanders, A. W., J. G. Hankin, Fr. Fernando, J. E. Price, H. V. Tattersall, Mendelssohn, J. Kilbee, H. Warren, J. W. Read, and F. C. Cook; to 1,151 by Litho (very pretty), Bernard Green, W. L. Martin, J. Bryden (this problem is in B Tourney only), W. Jay, Mendelssohn, Othello, H. G. Walsh, J. E. Price, J. G. Hankin, E. Sanders, E. Retchford, H. Warren, J. C. B., H. Fellows, and A. Fellows.

H. V. Tattersall.—If in 1,151, 1. Q-B sq, Kt-K B 5 prevents the mate. In 1,152 you have not put which B goes to B 4.

J. Kilbee.—We should have numbered 1,150. The solution is right if 1. R takes Q, 2. Kt mates.

H. and A. Fellows.—You have put in your solution to 1,152 B-*K* B 4; it should be Q B 4.

Problems received with thanks from J. Keeble, F. C. Cook (direct and sui), and J. A. Miles.

Correspondents are requested not to send telegrams, as one shilling extra has to be paid for porterage.

The *Shoreditch Citizen* offers a prize of half-a-guinea for the best original direct three-mover, and the same sum for the best two-mover. Problems must be sent before August 17. Judge, Mr. Frankenstein.

A Two-Move Tourney is started in *Pen and Pencil*. Problems must be sent in by June 29.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 19, and unacknowledged elsewhere:—

Crux.—Dum Spiro.—Hall.—H. Booth.—Loco.—C. W. H. —R. J. Briggs.—Eureka.—Nitram.—Wire Jack.—David Booth.—W. Perren Maycock.—F. W. H.—John Bone.—Charles North.—G. T. B.—A. Dewsnap.—W. E H.—Inquirer.—C. L. R.—C. E. Stretton.—Elag. —A Fellow of the Royal Astronomical Society.—C. Gaudibert.—S. Bottone.—H.

A. F. Durrant. (Automatic couplings for railways are as plentiful, metaphorically speaking, as blackberries, and we think if you search at the Patent Office you will find your device has been anticipated. As there is little chance of the railway companies adopting it, the device is of little interest to our readers. See the automatic couplings already illustrated in our pages—notably those tried at Nine Elms, and illustrated in No. 1100.)—Draughtsman. (You are answered as soon as possible, and referred to many previous replies in back volumes. The simplest way in the case of all such engines is to copy a good example, of which many have been given. It would be simply waste of space, to say nothing of expense, to engrave the drawings of the cylinder and valves in order that someone might tell you whether they are right.)—Whitesmith. (You were answered as soon as possible after the receipt of your query; but we cannot insert questions on the same subject week after week. You want only a small electric lamp, which you can possibly procure from the Edison-Swann Company, and a battery to supply current to excite it. All details will be found in back volumes.)—Bamboozled. (You must settle your dispute about the speaking-tube yourselves, as we can make neither head nor tail of the query. The usual way is to blow through, which sounds the whistle at other end; then when whistle is blown at first end, that should be an intimation that someone is attending to the other end of the tube.)—Elec., M.P. (Apparently a battery arrangement; but certainly of no interest to our readers.)—Loco. (Without some more definite information, it is useless to guess. Perhaps it may be the Westinghouse pump, the valves of which make a "click click" in shifting; but if, as you say, the noise occurs "whilst running" it may be connected with the speed-gauge which Mr. Stroudley has fitted to several of the engines designed by him. 2. We hope that all the engineers on board even short-trip boats are "gentlemen"; but presumably you mean to ask whether people with money "ever go into marine works for the purpose of becoming engineers on board?" Possibly they do; but they must conform to the rules, which, as a primary qualification for a certificate, require three years in the shops and one year in the engine-room on the watch: or four years at sea "on the watch"—that is, actually employed in handling the engines.)—A. F. Shakespear, Dresden. (You can procure a B.W.G. (Birmingham Wire Gauge) from any of the tool dealers advertising in our columns; but we suspect your difficulty arises from the fact that there are different wire gauges—for instance, music wire gauge being different to that of iron wire. It is best to order by the standard gauge. The sizes of B.W.G. are given in the pocket-books, especially in those relating to electrical matters.)—William Barker. (Could not say without seeing the glasses. Try rubbing well with a piece of soft silk.)—Anti-Nicotine. (We do not concern ourselves about infringements of patents. We simply record inventions and describe novel devices: hence the suggestion to compare one with another.)—Third Standard Boy. (You want a textbook on Mensuration.)—J. Tunn. (See previous answer. Cannot afford space for mere sums, unless there is something special about them.)—A Country Bloke. (Indian ink can be obtained from any dealer in artist's colours. Tattooing is generally done with gunpowder.)—Stone. (See indices about stammering. Practise saying monosyllabic words.)—Mariner. (You must really search at the Patent Office or elsewhere.)—Being Had. (The case may be one for a civil action: you should consult a solicitor, but there is no ground for "prosecution.")—Armorial Bearings. (No tradesman is entitled to put up the Royal Arms unless he is appointed by Royal Warrant to supply the Queen. Ordinary letters patent confer no such right.)—Ignorance. (We decline to express or invite opinions about the United Telephone Company or other similar companies.)—W. Cowan, Bermuda, W. Taylor, One Informed. (In type.)

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Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

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Haydon and other Cutter Bars for Metal Turning. Guaranteed to work efficiently under all circumstances. New Cutter Bar List free per post.—EDWARD HINES, Griffin Works, Norwich.—[Advt.]

Holloway's Ointment and Pills.—Ever useful—The Ointment will cure all descriptions of sores, wounds, bad legs, sprains, eruptions, erysipelas, rheumatism, gout, and skin affections. The Pills never fail in correcting and strengthening the stomach, in restoring a deranged liver to a wholesome condition, and in re-establishing the natural healthy activity of the bowels.

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Several volumes of "**Spectator**," over 100 years old, good condition, very rare; also two Vols. "Lord Chesterfield's Letters," in exchange for Electrical or other Apparatus to value 40s.—G. Larner, Darenth, Dartford.

Rock Ballot Certificates, over £6 paid, sell or exchange, Lathe, Drilling Machine, anything useful to whitesmith, electrician, &c.—Watson, Ironmonger, Woodford, Essex.

Wanted, a good **Book** on the Crimean War, in exchange for four of Pitman's Shorthand Books, the Teacher, Key, Phrase, and Manual.—Sapper Cooper, 23rd Company Royal Engineers, Chatham.

Last six volumes "**English Mechanic**," for Vice, Drilling, or Screwing Tackle.—J. Tunn, 10, Boston-street, Dorset-square, N.W.

Brand new genuine Coventry Rover-type **Safety**, latest 1889 improvements. Exchange Gold Albert in part payment, or sell at a sacrifice for cash.—2, Ansford-road, Castle Cary, Somerset.

Electrical.—Six Incandescent Lamps, 50 volt, 20c.p., new; two 8 volt, 8c.p., six pint size Smee Cells, with silver plates and zincs perfect.—Offers to 40, Windmill-road, Croydon.

Vever's **Portable Distillery**, for distilling water, &c., new and complete; 3in. Circular Saw and Emery Wheel. Exchange offers to 40, Windmill-road, Croydon.

"**Engineering**" for 1887 and 1888, unbound, few numbers missing; also set of two-man power Gas Engine Patterns and Drawings.—Offers to Expert, 70, Balcombe-street, Dorset-square.

Will exchange 1H.P. [illegible] Launch, or Circular Saw [illegible] —[illegible], Windsor-roa

Powerful **Medical Coil**, with insulated handles and large bottle bichromate battery, draw tube, regulator, and terminals for primary and secondary currents. Offers requested.—Cader

Monocular Microscope, four achromatic objectives, two eyepieces, stand, condenser, live-cage, forceps, &c., in mahogany cabinet. Offers to Geo. Harris, 11, York street, Nottingham.

Pair of **Telephones** for two stations, with call bells and automatic switch boards, for exchange, or cheap for cash.—[illegible] Canonbury-lane, Islington, N.

Wimshurst Influence Machine, 15½ glass discs. Wanted, in exchange, Air Cane, Gem Air Gun, or Elipse Cane.—J. Smith, 1, Chomeley-road, Reading.

Three **Circular Saws**, spindle and bearings, in exchange for a 3ft. Circular Saw.—Cox, Wells, Somt.

Engineering, Mechanics, and Architectural Books. Exchange only. Write for list.—R. Massey, Clifton, Cork.

Vertical or **Launch Engine**, cylinder 2¼in. by 3¼in., lagged, metallic packing, reversing gear, new, value £4. Exchange ½H.P. Boiler.—Waller, 55, East-road, Stratford, E.

Exchange an **Incubator**, heats by hot water, holds 35 eggs, with Rippingille's apparatus that acts as brooder. Will give information for using. Wanted, 52in. or Safety Bicycle.—G. Pease, Kensington-road, Reading.

Watchmaker's **Jacot Pivoting Tool**, pivot gauge, Cylinder Height Tool, Scapewheel Height Tool, Balance Wheel Height Tool, Bench Vice. Offers, stamp.—245, Manchester-road, Bradford.

Quarter-plate mahogany folding **Camera**, instantaneous shutter and lens, double dark slide, set Waterhouse diaphragms, ash tripod, 35s. or useful exchange.—55, Fisherton, Salisbury.

100 "**Family Herald**" **Supplements** and Novelettes; three years' "Girl's Own Paper," in parts. Exchange for models (moving preferred).—Wilks, Burnley.

Three **Hen Canaries** and one Linnet, 5s.; a good Street Coil, in splendid condition; and Perambulator, everything complete.—See below.

20-keyed **Concertina**, new; a two-way Switch, several numbers "E.M.," Vol. XLVIII., unbound.—See below.

Pint and Quart **Bunsen's Batteries**, a new 3in. Electric Bell. Want Tricycle to carry box.—Coxe, 11, Clifton-road, South Norwood.

3¾ **Electric Bell**, new, except bells, also Muzzle-loading Pistol, barrel 8in. long, 9-16in. bore, for any Musical Instrument value 12s.—J. Harcourt, Fords Water, Zeals, Wilts.

Will exchange 5in. **Face-plate** and **Melodian** for an Air Gun.—G. Fox, 34, Goodge-street.

Copper Tubing, 6in. dia., 15in. long; another, 8in. by 20in., galvanised. Exchange for anything Electrical except batteries.—G. Bendall, 27, Gladstone-street, Battersea Park-road.

Bicycle, 52in., nearly new, by Coventry Co. Wanted, Tricycle, American Organ, or offers.—Pearce, Kent House, Crystal Palace-road, Dulwich.

Electric Motor (small), bell and battery in walnut case, Electric Engine, and other things. Useful offers wanted.—Pearce, Kent House, Crystal Palace-road, Dulwich.

Sewing Machine (hand), splendid lock stitch, nearly new. Wanted, Rover Bicycle or useful offers.—Pearce, Kent House, Crystal Palace-road, Dulwich.

Telescope, very good one, by Cunaugh, London, day or night, also other things, for Silver Watch or offers.—Pearce, 57, Crystal Palace-road, Dulwich.

Lathe Bed, 5ft., iron standards, 14in. headstock, T and tailstock, for wood turning, power. Exchange offers to—W. Smith, Bilston-road, Wolverhampton.

Lathe Wheel, Crank, and Treadle, 6in. Slide-rest, lot Bicycle Rims (Avery's), 4cwt. Platform Machine, lot Perambulator Wheels, 20in. axles, complete. Offers.—William Smith

Wanted, semi-Model **Engine and Boiler**, about 2¼in. bore cylinder, with governors and pump, all bright engine work, for shop-window coffee-grinding. Valuable exchange. Send photo.—279, St. Philip's-road, Sheffield.

Grand, bright, copper riveted loco-type **Model Boiler**, with fittings, tubes, and firebox complete; also Model Beam [illegible] good workmanship, 2in. bore cylinder. Exchange to value £ [illegible] St. Philip's-road, Sheffield.

8¼in. **Lathe-Heads** and few Tools, 7s. 6d.; also 2½c.p. Lamp and Battery. Exchange offers.—C. G., 5, Winton-terrace, Stoke-on-Trent.

Exchange for Harmonium, or offers, 32-hole **Electric** Bell Indicator, thorough working order, highly-finished movements and case.—A. Ford, 1, Gate-street, W.C.

What offers, muzzle-loading **Gun**, also strong Model Engine on iron bed, 1⅛in. bore, 3in. stroke. Glazier's Diamond or Slide-rest preferred.—Shelton, Alexandra-street, Kettering.

Handsome patent **Electric Light Standard**, new, cost 30s.; also ten 8c.p. 22 volt, new Lamps; also two good Switches, one wall attachment and fuse, and two Swan Lampholders. Exchange small iron Lathe (good), with chucks, gut band.—Letters, X., 164, Tufnell Park-road, Holloway, N.

Large **Bottle Bichromate Battery**; small Fan, suitable for blowing or heating, Medical Coil, Printing Press, Lineman's Quantity and Intensity Galvanometer, Resistance Coil fitted with movable key, 9 to 195 Ohms.; some Turning and Engineers' Tools. What offers in cash or exchange? Want Air Gun, [illegible] Organette, or Hot-air Engine.—Read, 31, Salisbury-row, Walworth, S.E.

Horizontal **Engine and Boiler**, half-horse, in good order, beautifully made and finished, together or separate. Offers. Particulars, stamp.—56, Victoria-road, Tunbridge Wells.

Galvanometer, Astatic, best, movable, ebonite coil frame, adjustable suspension, best make, new. Offers.—E. W., 11, Ferme Park-road, Finsbury Park.

English Lever Watch, offers, splendid timekeeper, cost £7 7s. Electric Bell, complete, as new. Offers. Cost [illegible]—Below.

Organ Pipes, quantity wood and metal. Also 6 slide soundboard, keys and bellows for same. What offers? Camera wanted, or sell cheap.—Below.

"**English Mechanic**," 25 vols., 18 bound in boards, 7 sewn and cut. What offers in exchange?—G. H. Mason, 4, Anger's-road, Totterdown, Bristol.

Æolian Harp, Model Vertical Engine (unfinished), cylinder 1¼ by 2¾; fine light Dry Gas Meter, 30 hour striking Clock, brass cased weights, six-cell Smee Battery. Wanted, Bottle Corking Machine, Glazier's Diamond, small Files, Insulated Wire, Calliper Gauge, good singing Canary, or other bird.—Hall, 14, Broad-street corner, Birmingham.

Whitney, The Scientific Exchange, 117, City-road, near Old-street. Scientific Apparatus of all kinds Bought, Sold, Lent, and Exchanged.

Quinine (Howard's), medicinal, in ounce bottles. What offers in exchange?—W. Thompson, 17, Henry Nelson-street, South Shields.

Portable Workshop, 7ft. by 4ft. 6in., 7ft. high, [illegible] mechanic, gardener, glass all round, [illegible] beds, floor, separate [illegible] Exchange £3 10s.—Watson, [illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 28, 1889.

A NEW VENTILATOR AND DUST COLLECTOR.

THE proper collection and disposal of dust becomes a problem which increases in importance and difficulty in direct proportion to the advance of civilisation in any nation. Dust has long ago been described as "matter in the wrong place," a dictum which nobody will dispute. It is the great enemy to contend with in domestic economy, and a serious factor in local government. The doctors inform us that dust is a great vehicle for the transmission of those germs which generate disease. It is a well-known fact that if a solution of sugar or beef-juice be exposed freely to the atmosphere, in a very short time a multitude of curious organisms will people it.

Within recent years we have seen examples of the importance of dust in some unexpected directions. Those terrible explosions which took place in some American flour-mills have been proved to have been caused by the presence of minute particles of flour in the atmosphere, for, by properly saturating the air in a suitable vessel with fine flour, the conditions may be imitated, and a miniature explosion produced.

There is no doubt that the force of some of those terrible disasters in coalmines has been very materially augmented by the presence of coal-dust in certain proportions in the atmosphere of the mine. This form of dust is a constant source of danger to a large body of those workers who daily minister to our requirements, especially when the mines are dry.

Mr. R. H. Scott, the secretary to the Council of the Meteorological Society, presented to the Royal Society two memoirs, in which this subject of explosions in coal-mines increased in intensity by the presence of coal-dust, was dealt with. An experiment illustrating this increase of explosive effect of inflammable gases can readily be arranged. The violence of such an explosion is said to be many times that of the ordinary firedamp.

But there is another aspect of the dust question which is probably as serious as any of these mentioned, especially on account of the insidiousness of its action. In our great national industries thousands are daily employed who have to breathe an atmosphere not merely vitiated by the exudations from their own systems, but loaded with every conceivable form of minute matter due to the character of the work they are engaged upon. There is no doubt that great advances have been made in the science of ventilation, and manufacturers are well aware of the importance of attending to its laws; but still there is room for much improvement, whether it be at the loom, in the mill, the workshop, or in any of those confined occupations in which our toilers are engaged.

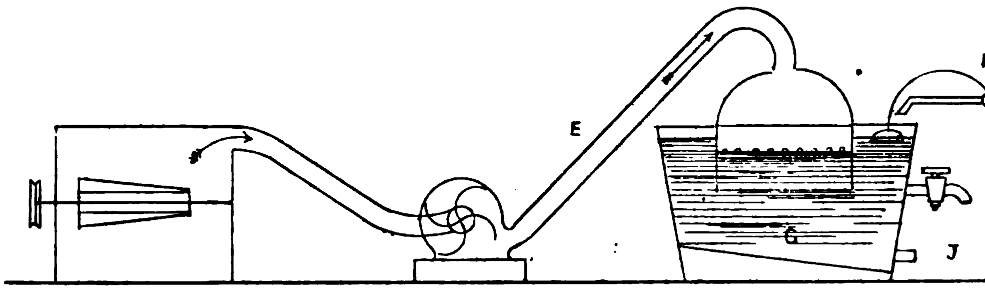
A glance at the statistic tables which are periodically published, showing the percentages of mortality amongst certain trades, is often productive of startling results. We little dream the price that is paid for some of those things we deem necessary for our personal comfort and convenience. Those trades especially suffer where the workmen have to labour in an atmosphere that may contain fine metallic particles, dry mineral matters, or chemicals. Phthisis, or pulmonary consumption, is said to be frightfully common amongst certain classes of artisans, and various lung-complications are bound to result from the constant inhalation of a dust-laden atmosphere. If once the lungs become affected, the rest of the system soon suffers.

Now, the action of dust is not only insidious, but extensive. It affects not merely the health of the workmen employed, but, being capable of diffusing, so to speak, through the atmosphere after the manner of a gas, it may cause great inconvenience to the health of an entire neighbourhood. Although the effects of inhaling dust may be small in themselves at the time, yet these effects are cumulative and dangerous to a great degree.

It is generally considered effectual to drive out dust from the atmosphere of a workshop by means of strong currents of air. That may be all right as far as that particular workshop is concerned, but it is evidently not sufficient, for no provision is made by such a method against vitiating the air of the neighbourhood.

A new process has recently been patented which involves not merely the expulsion of injurious dust, but its subsequent safe collection. It is the invention of M. Juanny, a manufacturer of tinted papers at Paris.

In the course of his paper-making, he has occasion to use various mineral and metallic powders with which the paper is tinted. His workmen experienced much personal inconvenience and bad health owing to the floating about of these powders, and he himself suffered considerable loss, for the usual systems of ventilation did not provide for the recovery of the powders present as dust in the atmosphere of the factory. Moreover, the usual method—viz., energetic ventilation—could not cope with the quantities of fine matter with which the air became filled. He therefore devised a very powerful apparatus, a section of which is shown in the figure, which has for its chief feature the collection of the driven-out powder in a liquid.



The apparatus consists essentially of the following: A hemispherical bell, F, made of sheet iron, and fixed in the upper part of a vat, G, full of water. At the top of the bell a pipe E is joined on, through which the air charged with the dust is led or forced by a ventilator. At a distance of three centimètres from the lower edge of the bell its wall is pierced with small holes, each six millimètres in diameter, and at distances of three centimètres from each other. A ball-cock supplies water at H, and keeps the level at a little distance above this circlet of holes. At J is a kind of sluice for removing the deposits which accumulate on the inclined bottom of the cistern. The rest of the apparatus needs no further description.

When the ventilator is set going the pressure lowers the level of the water in the interior of the bell as far as the circle of holes, while the level of the water outside the bell is higher. The dust-charged air escapes by the small holes in a stream of fine bubbles, which then part with the fine powder with which they are laden; this powder either sinking to the bottom of the vat or rising to the surface according to its density.

This machine has been subjected to a very trying series of experiments in the workshop of M. Bourdon, a mechanical engineer, and in all cases it was found equal to the work required of it. For instance, the air was charged successively with fine starch, various coloured powders, with ground plaster, mica, and with bronze powder. All these powders are caught by the water in the cistern, and as far as could be perceived, not a particle was allowed to escape into the air.

Various filamentous and pulverulent powders were also successfully experimented upon—e.g., fine soot, chopped cloth, wool, and paper-making materials. But in the case of such substances as those which are difficult to wet, the best results were obtained by introducing into the vat a certain quantity of mineral oil, forming a layer on the top of the water. This layer completely retained the matters experimented upon.

When pigments are used, the amount collected by this apparatus forms a considerable increase in the profits, for by the old system everything is lost, or, rather, scattered abroad, to the detriment of the health of the neighbourhood.

ASTRONOMICAL NOTES FOR JULY, 1889.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 3 36·29 P.M.	6 42 31	23 5 35	6 38 55·06
6	0 4 30·23 ,,	7 3 8	22 39 35	6 58 37·85
11	0 5 14·69 ,,	7 23 35	22 3 46	7 18 20·64
16	0 5 47·81 ,,	7 43 51	21 18 30	7 38 3·42
21	0 6 8·39 ,,	8 3 55	20 24 11	7 57 46·21
26	0 6 15·32 ,,	8 23 44	19 21 18	8 17 28·99
31	0 6 7·49 ,,	8 43 19	18 10 24	8 37 11 77

The method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 348 of Vol. XLVIII.

Up to and including July 20th, there is no real night in any part of the British Islands.

At 9h. p.m. on July 1st the sun is said to be in Apogee. In other words, the earth is at that instant at that point of her Orbit which is the most distant from him. Accepting the Equatorial Horizontal Parallax of the Sun as 8·848″ (the quantity adopted in the *Nautical Almanac*), a distance of 93,941,975 miles will then separate the centres of the Sun and Earth. As regards Spots, the Sun's disc is practically an absolute blank.

The Moon

Enters her First Quarter at 5h. 58·8m. in the early morning of July 6th, and is Full on the

VOL. XLIX.—No. 1,266.

Occultations of Fixed Stars by the Moon.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
6	80 Virginis	6	8 5 p.m.	Dark	141	124	9 12 p.m.	Bright	277	250
8	σ² Libræ	6	7 48 ,,	Dark	101	105	8 59 ,,	Bright	308	300
11	B.A.C. 6343	6	11 43 ,,	Dark	48	43	12 36 a.m.	Bright	314	301
12	26 Sagittarii	6	1 16 a.m.	Dark	122	103	2 11 ,,	Bright	232	207
12	B.A.C. 6699	6½	‡7 22 p.m.	*Dark	96	133	8 23 p.m.	Bright	268	299
12	53 Sagittarii	6	9 12 ,,	Bright	117	143	10 12 ,,	*Dark	243	261
12	B.A.C. 6727	6½	9 19 ,,	Bright	117	142	10 21 ,,	*Dark	241	258
13	17 Capricorni	6	10 8 ,,	Bright	139	166	10 46 ,,	Dark	205	228

‡ Moon has not risen. * Apparently bright. An illustrated description of the construction and use of the above table will be found on p. 349 of Vol. XLVIII.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	*II*	*Tr I*	3	17	A.M.	11	II	Sh E	10	10	P.M.	22	I	Oc D	8	18	P.M.
2	*II*	*Oc D*	9	22	P.M.	14	I	Oc D	12	6	A.M.	22	I	Ec R	11	12	11,,
					A.M.	14	*I*	*Tr I*	9	13	P.M.	23	*I*	*Sh E*	8	23	,,
3	II	Ec R	12	23	17	14	I	Sh I	9	42	,,	24	IV	Sh I	11	30	,,
					P.M.	14	I	Tr E	11	30	,,	25	IV	Sh E	1	12	A.M.
3	*III*	*Ec R*	8	34	47	14	I	Sh E	11	59	,,	25	II	Tr I	11	15	P.M.
6	I	Tr I	1	3	A.M.	15	I	Ec R	9	17	28,,	26	*II*	*Sh I*	12	42	A.M.
6	I	Sh I	1	19	,,	17	*II*	*Oc D*	1	53	A.M.						P.M.
6	I	Oc D	10	22	P.M.	17	III	Oc D	11	30	P.M.	27	II	Ec R	9	29	56
					A.M.	18	*II*	*Tr I*	8	57	,,	28	III	Sh E	10	30	,,
7	I	Ec R	12	54	7	18	II	Sh I	10	6	,,	29	*I*	*Tr I*	12	45	A.M.
7	I	Tr E	9	45	P.M.	18	II	Tr E	11	37	,,	29	I	Oc D	10	4	P.M.
7	I	Sh E	10	5	,,	19	II	Sh E	12	46	A.M.						A.M.
8	*IV*	*Tr I*	2	53	A.M.	21	*I*	*Oc D*	1	52	,,	30	*I*	*Ec R*	1	6	59
9	II	Oc D	11	37	P.M.	21	I	Tr I	10	59	P.M.	30	*I*	*Sh I*	8	0	P.M.
					A.M.	21	I	Sh I	11	37	,,	30	I	Tr E	9	28	,,
11	III	Ec R	12	35	27	22	*I*	*Tr E*	1	15	A.M.	30	I	Sh E	10	18	,,
11	II	Tr E	9	20	P.M.	22	*I*	*Sh E*	1	54	,,						

Ec, Eclipse; Oc, Occultation; Tr, Transit of Satellite; Sh, Transit of Shadow; D, Disappearance; R, Reappearance; I, Ingress; E, Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

12th at 9h. 1·8m. p.m. Tolerably High Tides may be looked for about this time. She will enter her Last Quarter at 7h. 44·9m. in the evening of the 19th, and be New 30 seconds after Midnight of the 27th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	3·1	2 35·8 p.m.
6	8·1	6 27·0 ,,
11	13·1	11 9·6 ,,
16	18·1	3 10·0 a.m.
21	23·1	6 59·7 ,,
26	28·1	10 54·7 ,,
31	3·5	2 53·2 p.m.

The Moon is in conjunction with Saturn at 7h. p.m. on the 1st (Saturn 2° 3′ S.); with Jupiter at 2h. p.m. on the 11th (Jupiter 0° 52′ S.); with Venus at 9h. p.m. on the 23rd (Venus 0° 41′ S.); with Mercury at 8h. p.m. on the 26th (Mercury 0° 19′ S.); with Mars at 11 o'clock the same night. (Mars 0° 1′ S.); and once again with Saturn at 7h. a.m. on the 29th (Saturn 2° 16′ S.) There will be

A Partial Eclipse of the Moon

on July 12th, the latter portion of which will be visible at Greenwich; but the first contact with the shadow will occur before the Moon rises at all. The details of the actually observable phenomena are then

Greenwich Mean Time.
Middle of the Eclipse July 12 8h. 54·0m. p.m.
Last Contact with the Shadow .... ,, ,, 10 4·9 ,,
Last Contact with the Penumbra .... ,, ,, 11 12·6 ,,

Magnitude of the Eclipse (Moon's diameter = 1), 0·480.

The last contact with the Moon's shadow will happen at 45° from the northernmost point of the Moon's limb towards the West as seen with the naked eye. The Moon does not rise at Greenwich until 8h. 14m. p.m.

At noon on July 1st the Moon is on the confines of Cancer and Leo, crossing into the last-named constellation about 2½ hours later. She remains in Leo until 11h. 30m. a.m. on the 4th, when she quits it for Virgo. Her passage over Virgo terminates at 7h. 30m. p.m. on the 7th, and she then enters Libra. As she journeys across Libra, she arrives, at noon on the 9th, on the western edge of the narrow Northern spike of Scorpio, which she crosses by 9 o'clock the same evening to come out in Ophiuchus. She remains in Ophiuchus until 7h. a.m. on the 11th, and then passes into Sagittarius. She leaves Sagittarius at 11 a.m. on the 13th for Capricornus, and Capricornus, in turn, for Aquarius at 3h. a.m. on the 15th. By 4h. a.m. on the 17th her path over Aquarius is traversed, and she passes into Pisces. As she travels through Pisces, she arrives, at 6h. p.m. on the 17th, on the confines of Cetus. Into this she then plunges, to re-enter Pisces at 3h. a.m. on the 19th. After traversing another portion of Pisces she for the second time enters Cetus at 11h. p.m. on the 19th; and when she finally quits Cetus, at 3h. p.m. on the 20th, it is to come out in Aries. At 5h. 30m. p.m. on the 21st she leaves Aries for Taurus, through practically the whole length of which constellation she is travelling up to 8h. 30m. p.m. on the 24th, when she arrives on the edge of the extreme northerly part of Orion. She has crossed this by 11h. o'clock that night, and emerged in Gemini. She remains in Gemini until 5h. a.m. on the 27th, and then enters Cancer. She has completed her journey through Cancer at 9h. p.m. on the 28th, and entered Leo. She continues in Leo until 4h. 30m. p.m. on the 31st, when she leaves it for Virgo. She is obviously in Virgo when our Notes terminate.

Mercury

Is an Morning Star throughout July, attaining his greatest elongation West of the Sun (20° 37′ at 10 a.m. on the 12th. He may be well seen a little to the N. of E. before sunrise now. His angular diameter dwindles from 10·2″ on the 1st of the month to 5·2″ by the end of it.

Day of Month.	Right Ascension.	Declination. North.	Souths.
	h. m.	° ′	h. m.
1	5 35·2	18 51·3	10 56·4 a.m.
6	5 40·2	19 32·7	10 41·8 ,,
11	5 54·3	20 34·6	10 36·2 ,,
16	6 17·4	21 38·8	10 39·5 ,,
21	6 49·0	22 22·6	10 51·4 ,,
26	7 27·7	22 21·6	11 10·3 ,,
31	8 10·6	21 18·0	11 33·5 ,,

It will hence be seen that at the beginning of July, Mercury is in Taurus somewhat to the South-east of the 3½ magnitude star ζ, and that hence he travels right across Gemini into Cancer. He will be rather over 1° south of η Geminorum on the 14th, and much in the same position with reference to μ Geminorum the next day. On the 24th he will be very close to δ Geminorum. He will be in conjunction with Mars (0° 14′ South of that planet) at 5h. am. on the 28th.

Venus

Is a morning star all through the month, and is a very conspicuous object before sunrise, although her angular diameter steadily diminishes from 26″ on July 1st to 19″ on the 31st. She attains her greatest elongation west of the Sun (45° 38′) at 8h. a.m. on the 10th. Towards the end of the month her figure becomes slightly gibbous.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 31·4	15 31·7	8 53·0 a.m.
6	3 49·6	16 33·4	8 51·5 ,,
11	4 8·8	17 33·7	8 51·0 ,,
16	4 28·9	18 30·5	8 51·4 ,,
21	4 49·9	19 21·7	8 52·7 ,,
26	5 11·6	20 5·4	8 54·6 ,,
31	5 34·0	20 40·0	8 57·3 ,,

The path indicated in the above ephemeris is wholly in Taurus. On the morning of the 12th Venus will be rather more than 2° North of γ Tauri, and on that of the 14th some ¾° South of ε in the same constellation. On the 16th she will be a little more than 2° North of Aldebaran. Finally, on the 30th, she will be about ½° North of ζ Tauri. She will be in conjunction with Neptune (1° 48′ South of him) at 4h. a.m. on the 11th.

For the purpose of the observer, MARS, SATURN, URANUS, and NEPTUNE are all invisible, and the night sky would be a blank, but for

Jupiter,

Who is the one Evening Star, but about as badly placed for observation as he possibly can be. In fact, as we said last month, he ought to be observed as close to the meridian as possible to be even moderately well seen. His angular equatorial diameter decreases almost insensibly from 43·8″ at the beginning of the month to 42″ by the end of it.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	18 10·8	23 16·7	11 30·0 p.m.
6	18 8·1	23 18·0	11 7·6 ,,
11	18 5·5	23 19·2	10 45·4 ,,
16	18 3·1	23 20·2	10 23·3 ,,
21	18 0·9	23 21·0	10 1·5 ,,
26	17 58·9	23 21·7	9 39·8 ,,
31	17 57·1	23 22·4	9 18·4 ,,

The retrograde arc thus shown lies in a [illegible] of Sagittarius destitute of any conspicuous [illegible]

Minima of the Variable Star Al[illegible]

Will occur at 3h. 19m. a.m. on the [illegible] 8 minutes after the midnight of the 12[illegible] at 8h. 57m. p.m. on the 15th; as well as on other occasions, when the phenomenon will be invisible.

Shooting Stars

May be watched for from the 17th to the 20th, and between the 25th and 30th. Fireballs appear during the first week, in the middle, and again at the end of the month.

Greenwich Mean Time of Southing of Seven of the Principal Fixed Stars on the Night of July 1st, 1889.

Star.	Souths. h.	m.	s.	
β^1 Scorpii	9	19	33·71	p.m.
Antares..	9	42	7·31	,,
α^1 Herculis	10	28	58·49	,,
α Ophiuchi	10	49	6·94	,,
γ Draconis	11	13	18·38	,,
Vega	11	52	20·79	,,
ζ Aquila	*12	19	25·75	,,

* Early morning of July 2nd.

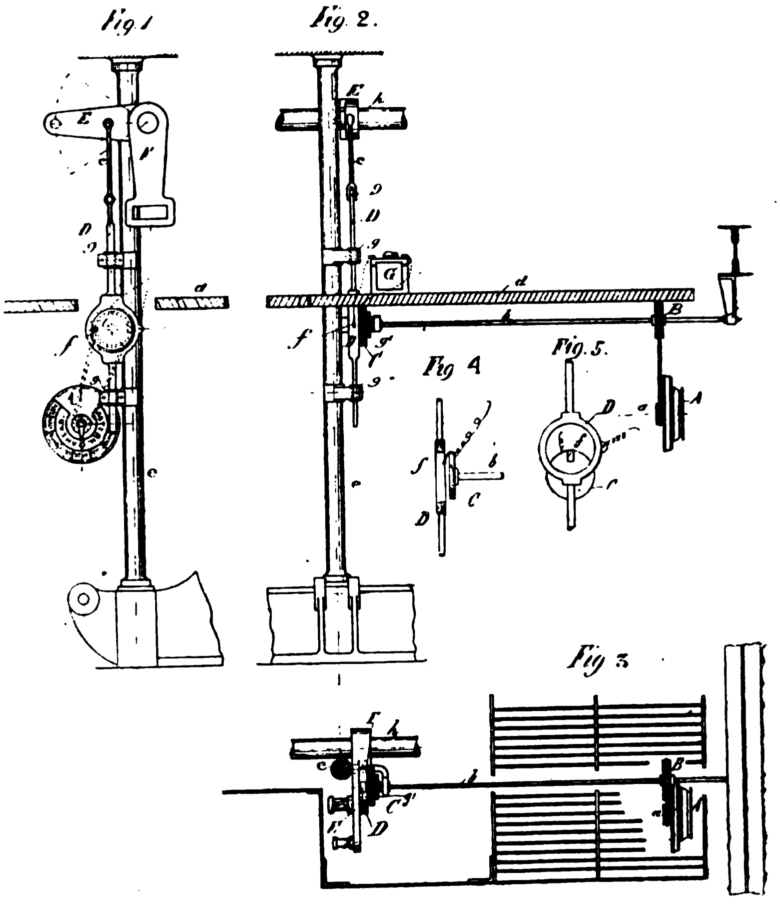
The method of finding the Greenwich Mean Time of Southing of either of the other stars in the above list for any other night in July, as also that of determining the Local instant of its Transit at any other station, will be found on p. 350 of Vol. XLVIII.

SHERLOCK'S ELECTRIC "TELL-TALE."

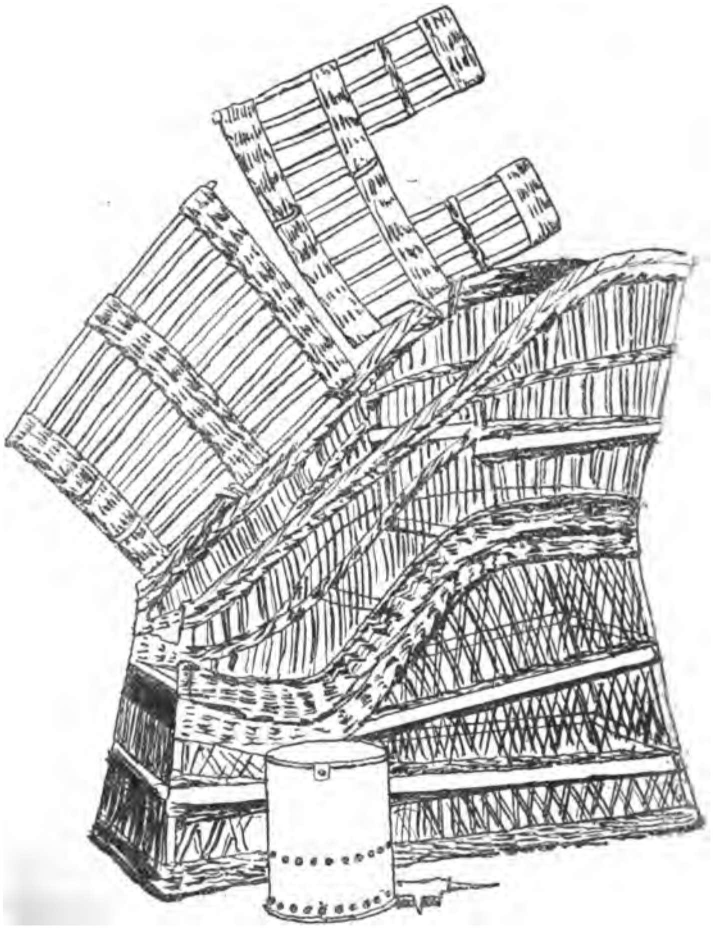
THE invention illustrated below is a device patented by Mr. H. P. Sherlock, of St. George's-square, Upton, Essex, which has been in actual use by the Eastern Telegraph Co., of which Mr. Sherlock is the superintending engineer. The invention was devised with the object of instantly announcing to the officer or person in charge of a steamship when an order, transmitted by means of the ordinary ship's telegraph to the engine-room, has been mistaken or wrongly interpreted by the engineer, and thus provide a means of insuring that, in every case, the direction of motion of the engines shall coincide with the actual order given by the person in charge of the vessel.

In carrying out his invention the patentee proceeds as follows:—To the back of an ordinary ship's telegraph, A, is secured a small pulley, *a*, Fig. 2, connected by means of a band, cord, or other equivalent to a pulley, B, actuating the intermediate shaft *b*, and pulley or disc, C, which latter is in electrical communication with one side of a bell and battery, G. Upon the disc C is fixed at an angle of 90° from a vertical line a contact piece or spring, *f*. In front of the disc C is arranged the sliding arm D, moving in insulated bearings, *g g*, which latter are secured to the engine column *e*, the back of the disc C being insulated as shown at g^1. The sliding arm D is in electrical communication with the other side of the bell and battery, G; thus it will be seen that if the sliding arm D, and the contact piece, *f*, are brought into contact the circuit will be closed. The sliding rod is connected to the lever E by means of the link *c*, the reversing lever E being keyed to the weigh-shaft *h*, which also carries the reversing link F in connection with the eccentrics of the engine.

The action of the device is as follows:—When the ship's telegraph is turned to "go ahead," or "go astern," the contact piece *f* on the disc C is carried upwards or downwards respectively by means of the connections described. Now, to start the engine in accordance with the first-named order "go ahead," the reversing lever E, is raised, carrying with it the sliding arm D by means of the link *c*, which is attached to the reversing lever E, thus it will be seen, on referring to the drawings, that no electrical contact will be made between the contact piece *f* and sliding arm D, as the engines being started in accordance with the order given, the sliding arm D is moved away from the contact piece *f*, until the latter assumes the position shown at Fig. 5. Should, however, the engine be started in a direction at variance with the above-named order, "go ahead," the reversing lever E, and with it the sliding arm D, will be lowered, which will bring the ring in its c… …rical contact with the piece *f* of th… …g the electrical circuit of … …, causing the bell to ring an… in charge the error which … the foregoing it will be so… circuit can only be closed, … ring, by the engines being … contrary to the orders give…



graph; thus it will be obvious that the person in charg… …he time being is immediately made awa… …ce or ringing of his bell, as the … …her the orders telegraphed have … out, or a mistake has been … …n end elevation; Fig. 2 a … 3 is a plan; and Fig. 4 a … …n of the sliding arm and



PORTABLE WICKER OR CANE BATH FOR HOT AIR, STEAM, OR SULPHUR.

MESSRS. CONSTANTINE AND SON, of Oxford-street, Manchester, of the Convoluted Stove notoriety, who have contributed materially to the efficient heating and ventilation of Turkish baths, have patented this bath, which will be a valuable addition to any household, especially when sickness occurs.

In modern as well as in ancient times it would seem that there must be a Constantine prominently connected with the Turkish bath. Mr. Constantine, sen., has had over forty years' experience as bath proprietor, and has frequently been engaged by the medical profession to give sweating baths to patients in the sick-room. He has felt the need of such a bath as this one. The cane-bottom chair has frequently been made use of. Now and again a rough framework—a sort of crinoline—has been utilised: necessity has ever been the mother of invention. The advantages of this bath are:—

1. It may be used in any bedroom, or in an ordinary bath-room, and may be removed to a spare room, it being of light weight.

2. The patient, while undergoing the sweating process, is in an easy reclining position. Sitting erect in a box for twenty or thirty minutes wearies a patient.

3. The feet are elevated sufficiently from the floor to allow the heat to get well to them. If the circulation is promoted in the feet, and they are made to perspire equally with other parts of the body, a rush of blood to the head is prevented, and this is important.

4. The heat being delivered well about the feet, it ascends and plays equally on all parts of the body.

As this bath will not only be effective for producing perspiration, but cheaper than any others now in the market for this purpose, it ought to be in great demand.

WALKER'S SUBSTITUTE FOR STEP CONES IN LATHES.

THE device shown in the annexed illustration has been patented by Mr. J. Walker, of Beeston-road, Leeds, as a substitute for step-cones in lathes and other machines. The invention consists in having a movable plate, worked by a worm and wheel so as to allow for different size wheels, for getting different speeds, also having a wheel and socket on spindle in the place of a cone which can be worked on the lathe spindle, loose. When the back gear is in, by having a large flange on one end, it can be fixed to the spindle when required. The movable plate has also a slot in it to allow for tightening the belt by a screw which is fixed to a stud in the slot. This stud has a movable socket, so as to turn on the stud to which is fixed a belt pulley, and also the change pinions for getting the different speeds. This socket having a keyway double the width of key for half the length of pinion, and the pinion having a key only half its length fixed to it, holds itself on the socket by getting into the broad part of keyway.

Fig. 1 is an end elevation, and Fig. 2 a plan. A, is the movable plate with the slot for tightening belt; B, is the stud it radiates on to put in different size pinions; C, the worm for moving the plate to position required; D, is stud for socket, to work on with pulley and pinion; E, is the belt pulley; F, is change pinion; G, is socket on lathe spindle in place of cone with spur wheel; H, the flange for fixing to back gear wheel when required; I is loose socket on stud with pinion and pulley fixed on. The parts marked are the portions to which the device is affixed; J, the gantry; K, the lathe head-stock; L L L L, back gear wheels.

FIG. 1

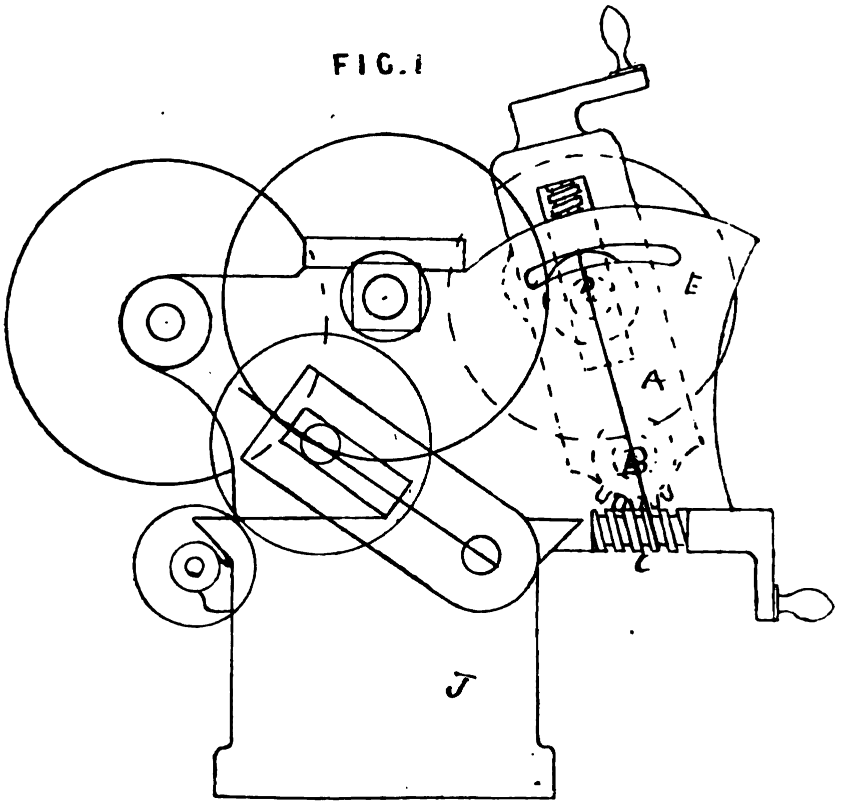
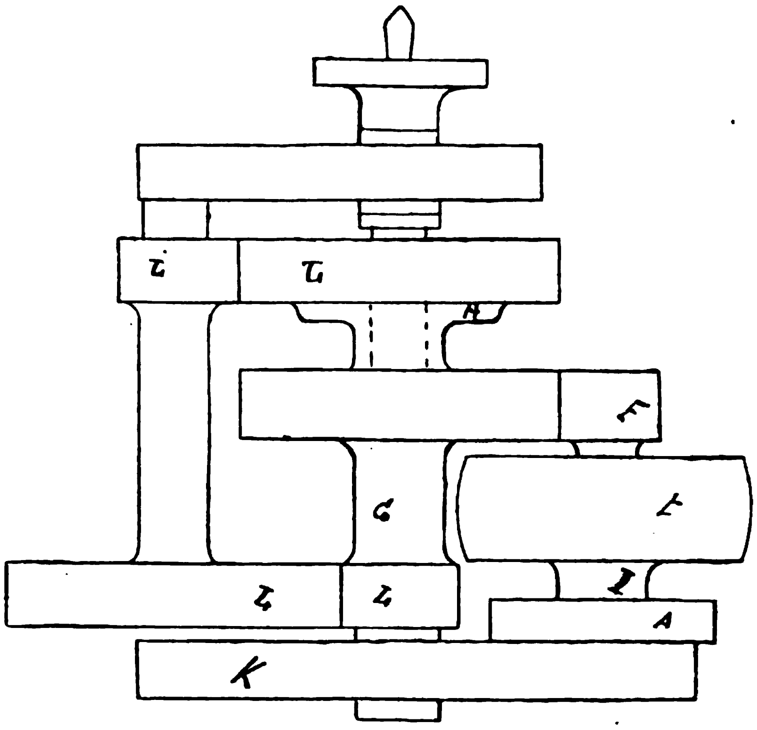


FIG. 2.



ON MODERN VIEWS WITH RESPECT TO THE NATURE OF ELECTRIC CURRENTS.*

By Prof. H. A. Rowland.

WERE I to trace the history of the views of physicists with respect to electric currents it would include the whole history of electricity. The date when the conception of an electric current was possible was that when Stephen Gray, about 170 years ago, first divided bodies into conductors and non-conductors, and showed that the first possessed the property of transmitting electric attractions to a distance. But it was only when the Leyden jar was discovered that the idea of a current became very definite. The notion that electricity was a subtle fluid which could flow along metal wires as water flows along a tube was then prevalent, and, indeed, remains in force to-day among all except the leaders in scientific thought. It is not my intention to depreciate this notion, which has served, and still serves, a very important purpose in science. But for many years it has been recognised that it includes only a very small portion of the truth, and that the mechanism by which energy is transmitted from one point of space to another by means of an electric current is a very complicated one.

Here, for instance, on the table before me are two rubber tubes filled with water, in one of which the water is in motion and the other at rest. It is impossible by any means now known to us, to find out, without moving the tubes, which one has the current of water flowing in it and which has the water at rest. Again, I have here two wires, alike in all respects, except that one has a current of electricity flowing in it, and the other has not. But in this case I have only to bring a magnetic needle near the two to find out in which one the current is flowing. On our ordinary senses the passage of the current has little effect; the air around it does not turn green or the wire change in appearance. But we have only to change our medium from air to one containing magnetic particles to perceive the commotion which the presence of a current may cause. Thus this other wire passes through the air near a large number of small suspended magnets, and, as I pass the current through it, every magnet is affected, and tends to turn at right angles to the wire and even to move toward it and wrap itself around it. If we suppose the number of these magnets to become very great and their size small, or if we imagine a medium, every atom of which is a magnet, we see that no wire carrying a current of electricity can pass through it without creating the greatest commotion. Possibly this is a feeble picture of what takes place in a mass of iron near an electric current.

Again, coil the wire around a piece of glass, or, indeed, almost any transparent substance, and pass a strong current through the wire. With our naked eye alone we see no effect whatever, as the glass is apparently unaltered by the presence of the current, but, examined in the proper way by means of polarised light, we see that the structure of the glass has been altered throughout in a manner which can only be explained by the rotation of something within the glass many millions of times every second.

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* Extracted from a lecture given at the College of the City of New York, May 22, 1889, before the American Institute of Electrical Engineers.

Once more, bring a wire in which no current exists nearer and nearer to the one carrying the current, and we shall find that its motion in such a neighbourhood causes, or tends to cause, an electric current in it. Or, if we move a large solid mass of metal in the neighbourhood of such a current we find a peculiar resistance unfelt before, and if we force it into motion we shall perceive that it becomes warmer and warmer, as if there was great friction in moving the metal through space.

Thus, by these tests, we find that the region around an electric current has very peculiar properties which it did not have before, and which, although stronger in the neighbourhood of the current, still extend to indefinite distances in all directions, becoming weaker as the distances increase.

How great, then, the difference between a current of water and a current of electricity. The action of the former is confined to the interior of the tube, while that of the latter extends to great distances on all sides, the whole of space being agitated by the formation of an electric current in any part. To show this agitation, I have here two large frames with coils of wire around them. They hang face to face about 6ft. apart. Through one I discharge this Leyden jar, and immediately you see a spark at a break in the wire of the other coil, and yet there is no apparent connection between the two. I can carry the coils 50ft. or more apart, and yet, by suitable means, I can observe the disturbances due to the current in the first coil.

The question is forced upon us as to how this action takes place. How is it possible to transmit so much power to such a distance across apparently unoccupied space? According to our modern theories of physics there must be some medium engaged in this transmission. We know that it is not the air, because the same effects take place in a vacuum, and, therefore, we must fall back on that medium which transmits light, and which we have named the ether—that medium which is supposed to extend unaltered throughout the whole of space, whose existence is very certain, but whose properties we have yet but vaguely conceived.

I cannot, in the course of one short hour, give even an idea of the process by which the minds of physicists have been led to this conclusion, or the means by which we have finally completely identified the ether which transmits light with the medium which transmits electrical and magnetic disturbances. The great genius who first identified the two is Maxwell, whose electro-magnetic theory of light is the centre around which much scientific thought is to-day revolving, and which we regard as one of the greatest steps by which we advance nearer to the understanding of matter and its laws. It is this great discovery of Maxwell which allows me, at the present time, to attempt to explain to you the wonderful events which happen everywhere in space when one establishes an electric current in any other portion.

In the first place we discover that the disturbance does not take place in all portions of space at once, but proceeds outwards from the centre of the disturbance with a velocity exactly equal to the velocity of light. So that when I touch these wires together, so as to complete the circuit of yonder battery, I start a wave of etherial disturbance which passes outward with a velocity of 185,000 miles per second, thus reaching the sun in about eight minutes, and continuing to pass outwards for ever or until it reaches the bounds of the universe. And yet none of our senses inform us of what has taken place unless we sharpen them by the use of suitable instruments. Thus, in the case of these two coils of wire, suspended near each other, which we have already used, when the wave from the primary disturbance reaches the second coil, we perceive the disturbance by means of the spark formed at the break in the coil. Should I move the coils further apart, the spark in the second coil would be somewhat delayed; but the distance of 185,000 miles would be necessary before this delay could amount to as much as one second. Hence the effects we observe on the earth take place so nearly instantaneously that the interval of time is very difficult to measure, amounting in the present case to only 1-150,000,000th of a second.

It is impossible for me to prove the existence of this interval, but I can at least show you that waves have something to do with the action here observed. For instance, I have here two tuning-forks mounted on sounding-boxes, and tuned to exact unison. I sound one and then stop its vibrations with my hand; instantly you hear that the other is in vibration, caused by the waves of sound in the air between the two. When, however, I destroy the unison by fixing this piece of wax on one of the forks the action ceases.

Now, this combination of a coil of wire and a Leyden jar form a vibrating system for electricity, and its time of vibration is about 10,000,000 times a second. This second system is the same as the first. and therefore its time of vibration is the same. You see how well the experiment works now because the two are in unison. But let me take away this second Leyden jar, thus destroying the unison, and you see that the sparks instantly cease. Replacing it, the sparks reappear. Adding another on one side and they disappear again, only to reappear when the system is made symmetrical by placing two on each side.

This experiment and that of the tuning forks have an exact analogy to one another. In each we have two vibrating systems connected by a medium capable of transmitting vibrations, and they both come under the head of what we know as sympathetic vibrations. In the one case we have two mechanical tuning forks connected by the air; in the other, two pieces of apparatus, which we might call electrical tuning forks, connected by the luminiferous ether. The vibrations in one case can be seen by the eye or heard by the ear; but in the other case they can only be perceived when we destroy them by making them produce a spark. The fact that we are able to increase the effect by proper tuning demonstrates that vibrations are concerned in the phenomenon. This can, however, be separately demonstrated by examining the spark by means of a revolving mirror, when we find that it is made up of many successive sparks corresponding to the successive backward and forward movements of the current.

The fact of the oscillatory character of the Leyden jar discharge was first demonstrated by our own countryman, Henry, in 1832; but he pursued the subect only a short distance, and it remained for Sir William Thomson to give the mathematical theory and prove the laws according to which the phenomenon takes place.

Thus, in the case of a charged Leyden jar whose inner and outer coatings have been suddenly joined by a wire, the electricity flows back and forth along the wire until all the energy originally stored up in the jar has expended itself in heating the wire or the air where the spark takes place, and in generating waves of disturbance in the ether which which move outward into space with the velocity of light. These ethereal waves we have demonstrated by letting them fall on this coil of wire, and causing the electrical disturbance to manifest itself by electrical sparks.

A ready means of experimenting on the waves, obtaining their wave-length, and showing their interferences, has hitherto been wanting. This deficiency has been recently overcome by Prof. Hertz, of Carlsruhe, who has made a study of the action of the coil, and has shown us how to use it for experiments on the ethereal waves whose existence had before been made certain by the mathematics of Maxwell.

I scarcely know how to present this subject to a non-technical audience and make it clear how a coil of wire with a break in it can be used to measure the velocity and wave-length of ethereal waves. However, I can but try. If the waves moved very slowly, we could readily measure the time the first coil took to affect the second, and show that this time was longer as the distance was greater. But it is absolutely inappreciable by any of our instruments, and another method must be found. To obtain the wave length, Prof. Hertz used several methods, but that by the formation of stationary waves is the most easily grasped. Mr. Ames holds in his hand one end of a spiral spring, which makes a very heavy and flexible rope. As he sends a wave down it, you see that it is reflected at the further end, and returns again to his hand. If, however, he send a succession of waves down the rope, the reflected waves interfere with the direct ones, and divide the rope into a succession of nodes and loops, which you now observe. So a series of sound waves, striking on a wall, form a system of stationary waves in front of the wall. Indeed, we can use any waves for this purpose, even ethereal waves. With this in view Prof. Hertz established his apparatus in front of a reflecting wall, and observed the nodes and loops by the sparks produced in a ring of wire, somewhat resembling the coil I have been using on the present occasion, but much smaller. It is impossible for me to repeat this experiment before you, as it is a very delicate one, and the sparks produced are almost microscopic. Indeed, I should have to erect an entirely different apparatus, as the waves from the one before me are nearly a quarter of a mile long, the time of vibration of the system being very great—that is, 1-10,000,000th of a second. To produce shorter waves, we must use apparatus tuned, as it were, to a higher pitch, in which the same principle is, however, employed; but the ethereal waves are shorter, and thus several stationary waves can be contained in one room.

The testing coil is then moved to different portions of the room, and the nodes are indicated by the disappearance of the sparks, and the loops by the greater brightness of them. The presence of stationary waves is thus proved, and their half-waves length found from the distance from node to node, for stationary waves can always be considered as produced by the interference of two progressive waves advancing in opposite directions.

However interesting a further description of Prof. Hertz's experiments may be, we have gone as far in that direction as our subject carries us, for we have demonstrated that the production of a current in a wire is accompanied by a disturbance in the surrounding space; and although I have not experimentally demonstrated the ethereal waves, yet I have proved the existence of electric oscillations in the coils of wire and the ether surrounding it.

Our mathematics has demonstrated, and experiments like those of Prof. Hertz have confirmed the demonstration, that the wave disturbance in the ether is an actual fact.

The closing of a battery circuit, then, and the establishment of a current of electricity in a wire, is a very different process from the formation of a current of water in a pipe, though, after the first shock, the laws of the flow of the two are very much alike. But even then the medium around the current of electricity has very strange properties, showing that it is accompanied by a disturbance throughout space. The wire is but the core of the disturbance, which latter extends indefinitely in all directions.

One of the strangest things about it is that we can calculate with perfect exactness the velocity of the wave propagation and the amount of the disturbance at every point and at any instant of time; but as yet we cannot conceive of the details of the mechanism which is concerned in the propagation of an electric current. In this respect our subject resembles all other branches of physics in the partial knowledge we have of it. We know that light is the undulation of the luminiferous ether, and yet the constitution of the latter is unknown. We know that the atoms of matter can vibrate with purer tones than the most perfect piano, and yet we cannot even conceive of their constitution. We know that the sun attracts the planets with a force whose law is known, and yet we fail to picture to ourselves the process by which it takes our earth within its grasp at the distance of many millions of miles and prevents it from departing for ever from its lifegiving rays. Science is full of this half knowledge, and the proper attitude of the mind is one of resignation towards that which it is impossible for us to know at present and of earnest striving to help in the advance of our science, which shall finally allow us to answer all these questions.

The electric current is an unsolved mystery; but we have made a very great advance in understanding it when we know that we must look outside of the wire at the disturbance in the medium before we can understand it—a view which Faraday dimly held 50 years ago, which was given in detail in the great work of Maxwell, published 16 years since, and has been the guide to most of the work done in electricity for a very long time, a view which has wrought the greatest changes in the idea which we have conceived with respect to all electrical phenomena.

So far we have considered the case of alternating electric current in a wire connecting the inner and outer coatings of a Leyden jar. The invention of the telephone, by which sound is carried from one point to another by means of electrical waves, has forced into prominence the subject of these waves. Furthermore, the use of alternating currents for electric lighting brings into play the same phenomenon. Here, again, the difference between a current of water and a current of electricity is very marked. A sound-wave, traversing the water in the tube, produces a to and fro current of water at any given point. So, in the electrical vibration along a wire, the electricity moves to and fro along it in a manner somewhat similar to the water, but with this difference. The disturbance from the water motion is confined to the tube, and the oscillation of the water is greatest in the centre of the tube, while, in the case of the electric current, the ether around the wire is disturbed and the oscillation of the current is greatest at the surface of the wire and least in its centre. The oscillations in the water take place in the tube without reference to the matter outside the tube, whereas the electric oscillations in the wire are entirely dependent on the surrounding space, and the velocity of the propagation is nearly independent of the nature of the wire, provided only that it is a good conductor.

We have then in the case of electrical waves along a wire, a disturbance outside the wire and a current within it, and the equations of Maxwell allow us to calculate these with perfect accuracy and give all the laws with respect to them.

We thus find that the velocity of propagation of the waves along a wire, hung far away from other bodies and made of good conducting material, is that of light, or 185,000 miles per second; but when it is hung near any conducting matter, like the earth, or inclosed in a cable and sunk into the sea, the velocity becomes much less. When hung in space, away from other bodies, it forms, as it were, the core of a system of waves in the ether, the amplitude of the disturbance becoming less and less as we move away from the wire. But the most curious fact is that the electric current penetrates only a short distance into the wire, being mostly confined to the surface, especially where the number of oscillations per second is very great.

The electrical waves at the surface of a conductor are thus, in some respects, very similar to the waves on the surface of water. The greatest motion in the latter case is at the surface, while it diminishes as we pass downwards, and soon becomes inappreciable. Furthermore, the depth to which the disturbance penetrates into the water increases with increase of the length of the wave, being confined to very near the surface for very short waves. So the disturbance in the copper penetrates deeper as the waves and the time of oscillation are longer, and the disturbance is more nearly confined to the surface as the waves become shorter.

Prof. O. J. Lodge has recently, in the *B. A.*, drawn attention to another application of these results—that is, to lightning rods. Almost since the time of Franklin there have been those who advocated the making of lightning rods hollow in order to increase the surface for a given amount of copper. We now know that these persons had no reason for their belief, as they simply drew the inference from the fact that electricity at best is on the surface. Neither were the advocates of the solid rods quite correct, for they reasoned from the fact that electricity in a state of steady flow occupies the whole area of the conductor equally. The true theory we now know indicates that neither party was entirely correct and that the surface is a very important factor in the case of a current of electricity so sudden as that from a lightning discharge. But increase of surface can best be obtained by multiplying the number of conductors, rather than making them flat or hollow, and, at the same time, Maxwell's principle of inclosing the building within a cage can be carried out. Theory indicates that the current penetrates only one-tenth the distance into iron that it does into copper. As the iron has seven times resistance of copper, we should need seventy times the surface of iron that we should of copper. Hence I prefer copper wire about ¼in. diameter, and nailed directly to the house without insulators, and passing down the four corners, around the eaves and over the roof, for giving protection from lightning in all cases where a metal roof and metal down-spouts do not accomplish the same purpose.

Whether the discharge of lightning is oscillatory or not does not enter into the question, provided it is only sufficienty sudden. I have recently solved the mathematical problem of the electric oscillations along a perfectly conducting wire joining two infinite and perfectly conducting planes parallel to each other, and find that there is no definite time of oscillation, but that the system is capable of vibrating in any time in which it is originally started. The case of lightning between a cloud of limited extent and the earth along a path through the air of great resistance is a very different problem. Both the cloud and the path of the electricity are poor conductors, which tend to lengthen the time. If I were called on to estimate as nearly as possible what took place in a flash of lightning, I would say that I did not believe that the discharge was always oscillating, but more often consisted of one or more streams of electricity at intervals of a small fraction of a second, each one continuing for not less than 1-100,000sec. An oscillating current with 100,000 reversals per second would penetrate about $\frac{1}{30}$in. into copper and $\frac{1}{300}$in. into iron. The depth for copper would constitute a considerable proportion of a wire ¼in. diameter, and, as there are other considerations to be taken into account, I believe it is scarcely worth while making tubes, or flat strips, for such small sizes.

It is almost impossible to draw proper conclusions from experiments on this subject in the laboratory, such as those of Prof. Oliver J. Lodge. The time of oscillation of the current in most pieces of laboratory apparatus is so very small, being often the 1-100,000,000th of a second, that entirely wrong inferences may be drawn from them. As the size of the apparatus increases the time of oscillation increases in the same proportion, and changes the whole aspect of the case. I have given 1-100,000th of a second as the shortest time a lightning flash could probably occupy. I strongly suspect it is often much greater, and thus departs even further from the laboratory experiments of Prof. Lodge, who has, however, done very much towards drawing attention to this matter and showing the importance of surface in this case. All shapes of the rod with equal surface are not, however, equally efficient. Thus, the inside surface of a tube does not count at all. Neither do the corrugations of a rod count for the full value of the surface they expose, for the current is not distributed uniformly over the surface; but I have recently proved that rapidly-alternating currents are distributed over the surface of very good conductors in the same manner as electricity at rest would be distributed over them, so that the exterior angles and corners possess much more than their share of the current, and corrugations on the wire concentrate the current on the outer angles and diminish it in the hollows. Even a flat strip has more current on the edges than in the centre.

For these reasons, shape, as well as extent of surface, must be taken into account, and strips have not always an advantage over wires for quick discharges.

The fact that the lightning rod is not melted on being struck by lightning is not now considered as any proof that it has done its work properly. It must, as it were, seize upon the discharge, and offer it an easier passage to the earth than any other. Such sudden currents of electricity we have seen to obey very different laws from continuous ones, and their tendency to stick to a conductor and not fly off to other objects depends not only on having them of small resistance, but also on having what we call the self-induction as small as possible. This latter can be diminished by having the lightning rod spread sideways as much as possible, either by rolling it into strips, or, better, by making a network of rods over the roof with several connections to the earth at the corners, as I have before described.

Thus we see that the theory of lightning rods, which appeared so simple in the time of Franklin, is to-day a very complicated one, and requires for its solution a very complete knowledge of the dynamics of electric currents. In the light of our present knowledge the frequent failure of the old system of rods is no mystery, for I doubt if there are a hundred buildings in the country properly protected from lightning. With our modern advances, perfect protection might be guaranteed in all cases, if expense were no object.

So much for the rod itself, and now let us turn to other portions of the electrical system, for we have seen that, in any case, the conductor is only the core of a disturbance which extends to great distances on all sides. Were the clouds, the earth, and the streak of heated air called the lightning flash all perfect conductors, we could calculate the entire disturbance. It might then consist of a series of stationary waves between the two planes, extending indefinitely on all sides, but with gradually decreasing amplitude as we pass away from the centre. The oscillation once set up would go on for ever, as there would be no poor conductors to damp them. But when the clouds and the path of the lightning both have very great resistance, the energy is very soon converted into heat and the oscillations destroyed. I have given it as my opinion that this is generally the case, and that the oscillations seldom take place, but I may be wrong, as there is little to guide me except guess work. If they take place, however, we have a ready explanation of what is sometimes called a back stroke of lightning—that is, a man at the other end of the cloud a mile or more distant from the lightning stroke sometimes receives a shock, or a new lightning flash may form at that point and kill him. This may be caused, according to our present theory, by the arrival of the waves of electrical disturbance which might themselves cause a slight shock, or even overturn the equilibrium then existing and cause a new electric discharge.

We have now considered the case of oscillations of electricity in a few cases, and can turn to that of steady currents. The closing of an electric current sends ethereal waves throughout space, but that after the first shock the current flows steadily without producing any more waves. However, the properties of the space around the wire have been permanently altered, as we have already seen. Let us now study these properties more in detail. I have before me a wire in which I can produce a powerful current of electricity, and we have seen that the space around it has been so altered that a delicately suspended magnetic needle cannot remain quiet in all positions, but stretches itself at right angles to the wire, the north pole tending to revolve around it in one direction, and the south pole in the other. This is a very old experiment, but we now regard it as evidence that the properties of the space around the wire have been altered rather than that the wire acts on the magnet from a distance.

Put, now, a plate of glass around the wire, the latter being vertical, and the former with its plane horizontal, and pass a powerful current through the wire. On now sprinkling iron filings on the plate they arrange themselves in circles around the wire, and thus point out to us the celebrated lines of magnetic force of Faraday. Using two wires with currents in the same direction, we get these other curves, and, testing the forces acting on the wire, we find that they are trying to move toward each other.

Again, pass the currents in the opposite directions, and we get these other curves, and the currents repel each other. If we assume that the lines of force are like rubber bands which tend to shorten in the direction of their length and repel each other sideways, Faraday and Maxwell have shown that all magnetic attraction and repulsions are explained. The property which the presence of the electric current has conferred on the luminiferous ether is, then, one by which it tends to shorten in one direction and spread out in the other two directions.

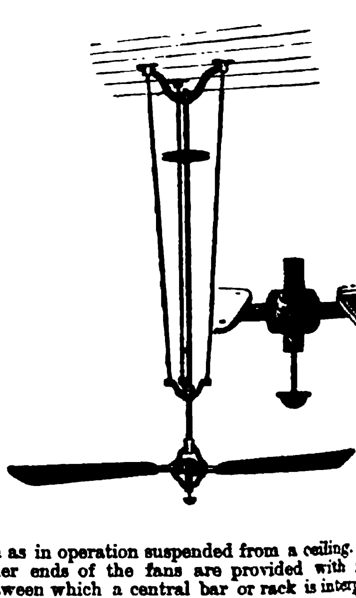
We have thus done away with action at a distance, and have accounted for magnetic attraction by a charge in the intervening medium as Faraday partly did almost fifty years ago. For this change in the surrounding medium is as much a part of the electric current as anything that goes on within the wire.

To illustrate this tension along the lines of force, I have constructed this model, which represents the section of a coil of wire with a bar of iron within it. The rubber bands represents the lines of force which pass around the coil and through the iron bar, as they have an easier passage through the iron than the air. As we draw the bar down and let it go, you see that it is drawn upward and oscillates around its position of equilibrium until friction brings it to rest. Here, again, I have a coil of wire with an iron bar within it with one end resting on the floor. As we pass the current and the lines of magnetic force form around the coil and pass through the iron, it is lifted upwards, although it weighs 24lb. and oscillates around its position of equilibrium exactly the same as though it were sustained by rubber bands as in the model. The rubber bands in this case are invisible to our eye, but our mental vision pictures them to us as lines of magnetic force in the luminiferous ether drawing the bar upward by their contractile force. This contractile force is no small quantity, as it may amount, in some cases, to one or even two hundred pounds to the square inch, and thus rivals the greatest pressure which we use in our steam engines.

Thus the luminiferous ether is, to-day, a much more important factor in science than the air we breathe. We are constantly surrounded by the two and the presence of the air is manifest to us all; we feel it, we hear by its aid, and we even see it, under favourable circumstances, and the velocity of its motion, as well as the amount of moisture it carries, is a constant topic of conversation with mankind at large. The luminiferous ether, on the other hand, eludes all our senses, and it is only with imagination, the eye of the mind, that its presence can be perceived. By its aid in conveying the vibrations we call light we are enabled to see the world around us, and by its other motions which cause magnetism the mariner steers his ship through the darkest night when the heavenly bodies are hid from view. When we speak in a telephone, the vibrations of the voice are carried forward to the distant point by waves in the luminiferous ether, there again to be resolved into the sound-waves of the air. When we use the electric light to illuminate our streets, it is the luminiferous ether which conveys the energy along the wires as well as transmits it to our eye after it has assumed the form of light. We step upon an electric street-car and feel it driven forward with the power of many horses, and again it is the luminiferous ether, whose immense force we have brought under our control, and made to serve our purpose. No longer a feeble uncertain sort of medium, but a mighty power, extending throughout all space and binding the whole universe together, so that it becomes a living unit in which no one portion can be changed without ultimately involving every other portion.

THE NEW SYRACUSE FAN.

THE accompanying illustration represents a fan the blades or arms of which can be readily turned so as to displace more or less of the air of a room, or to throw the air upwards or downwards as desired. It is manufactured by the Tuerk Water Meter Co., of Syracuse, N.Y. The view shows the fan as in operation suspended from a ceiling. The inner ends of the fans are provided with gears, between which a central bar or rack is interposed, as shown in Fig. 2, by moving which up or down, the angle at which the fans are set can be readily



changed. This can be quickly done while the fan is in motion by taking hold of the pendent oil cup and moving the rack as desired. The company also supply these fans to be operated on standards, when they receive their power from beneath the floor instead of from shafting overhead, in which case there is a small handle projecting from the side of the standard, by means of which the inclination of the fan blades can be regulated.

A SIREN FOR MEASURING VELOCITIES.*

In this instrument advantage is taken of the well-known fact that for every tone a resonator may be provided that will respond to and re-enforce the vibrations producing that tone. The length of a closed resonant tube is one-fourth that of the sound wave to which it responds. The length of an open resonant tube is one half that of the sound wave to which it responds. It is obvious that a telescopic tube may be adjusted to respond to different pitches. Knowing the number of vibrations required per second to produce a certain pitch, it is comparatively an easy matter to determine the rate of any series of regular air vibrations by adjusting the tube to such a length as to cause it to respond to the vibrations.

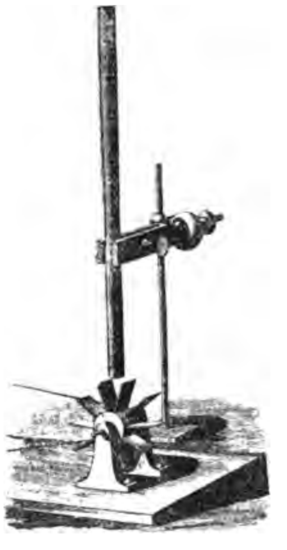


Fig. 1.—Determining Speed by Resonance.

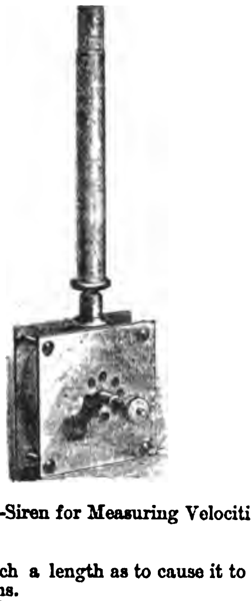


Fig. 2.—Siren for Measuring Velocities.

In Fig. 1 is shown a resonant tube supported over a small fan wheel. The fan has ten blades, so that during one revolution it sends ten puffs of air up the tube. By gradually increasing the velocity of the fan a speed will be reached at which the tube yields a low but distinct musical tone. If, for example, this tone corresponds to middle *c*, it is known that 261 puffs of air are made in the tube, and that since there are ten blades to the fans, the number of revolutions of the fan shaft must be $\frac{261}{10}$ = 26·1 per second, or 1,566 revolutions per minute.

In Fig. 2 is illustrated a siren constructed on this principle. The parts of this instrument are shown in detail in Fig. 3. It consists of a circular casing containing a rotary fan which draws in air at the centre and discharges it through an opening in the top of the casing. The blades of the fan are arranged radially upon opposite sides of the disc, and the fan is encircled by a perforated rim, which fits the circular casing and acts as a valve in controlling the escape of air. The perforations of the rim correspond in number and position with the fan blades.

The discharge opening of the casing is provided with a socket for receiving a resonator. The resonator shown in Fig. 2 consists of a pair of tubes made to slide telescopically one within the other, the inner one being graduated to indicate the different lengths required for different pitches, and consequently for different speeds. As the fan revolves, the air drawn in through the holes at the centre of the casing is thrown outward by centrifugal force, thus maintaining a pressure of air at the periphery of the fan. The holes in the rim of the fan allow the air to escape in regular puffs, the frequency of which depends upon the velocity of the fan. These puffs produce sounds varying in pitch and intensity with the speed of the fan, and the resonating tube re-enforces the particular note to which it is tuned, so that when a speed is reached corresponding with the adjustment of the tube, the fact is known by the superior strength of that particular note. Any change of speed may be detected by the lessening of the intensity of the sound and the change of pitch.

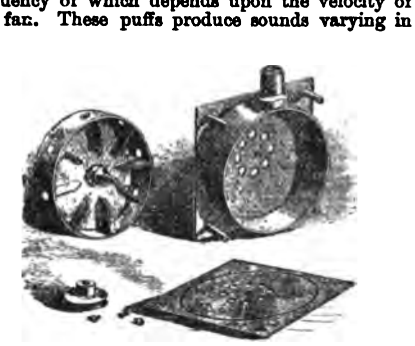


Fig. 3.—Details of the Siren.

The siren is shown in Fig. 4 in connection with mechanism for driving it by hand. It is provided with a revolution counter and with a trumpet-shaped resonator. It is designed to be used in the same manner as the siren of Cagniard Latour, and, like that instrument, yields sounds under water.

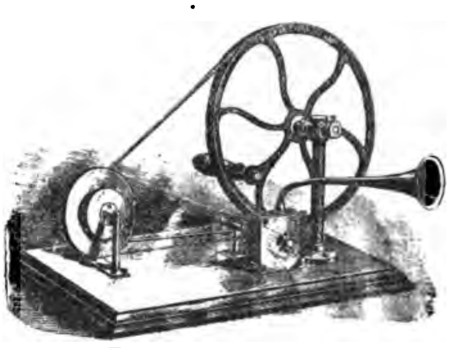


Fig. 4.—Centrifugal Siren.

A NEW PHOTOMETER.

The apparatus described by the *Zeitschrift für Instrumentenkunde*, as designed by Drs. O. Lummer and E. Brodlum, is designed to replace the ordinary photometer disc by a true optical combination. Fig. 1 shows a cross section of two glass prisms, A and B. B is an ordinary totally reflecting prism, with a perfectly even face as its hypothenuse, while in the prism A, only the circular face *r s*, is perfectly even, the other portions, *q r* and *s p*, forming the zone of a sphere. Both prisms are so intimately pressed together at *r s* that all light falling on this plane of contact passes through it without loss. An eye placed at O receives light from *l* only through the contact surface *r s*; on the other hand, from λ only such rays as are totally reflected from *a r* and *s b*. If *l* and λ represent surfaces illuminated by diffused light, and if the eye is fixed on the plane *a r s b*, it generally perceives a sharply-defined bright or dark elliptical spot in an equally illuminated field. If both sources of light are equal, this spot disappears completely. Other similar apparatus have been partially investigated, which have yet in part to be tested. So far the arrangement just described has given the best results.

In Fig. 2 the disposition of the photometer is sketched as utilising the foregoing principle. The screen *i k* stands vertical to the axis of the photometer bar *m n*. It consists of two sheets of paper, between which tinfoil is secured. The diffused light from the screen *i k*, falls on the mirrors *e* and *f*, which reflect it vertically upon the faces *c b* and *d p* of the prismatic combination, as shown in Fig. 2.

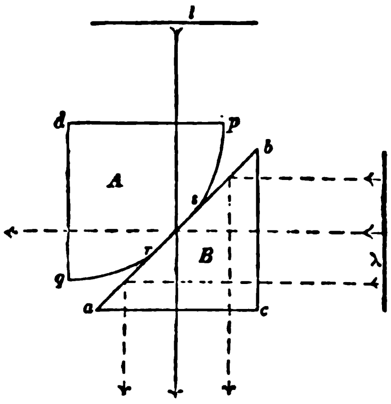


Fig. 1.

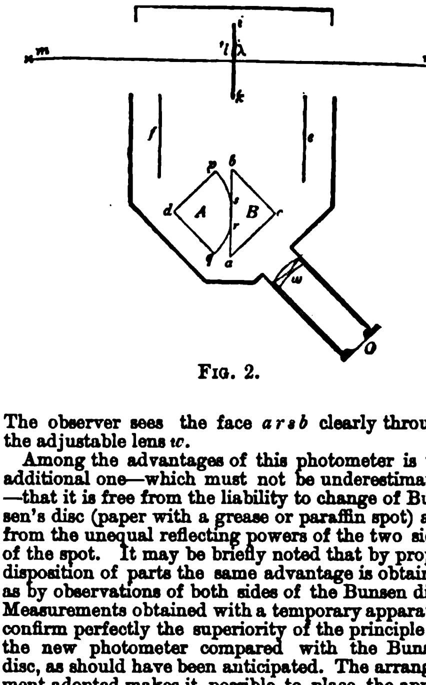


Fig. 2.

The observer sees the face *a r s b* clearly through the adjustable lens *w*.

Among the advantages of this photometer is the additional one—which must not be underestimated—that it is free from the liability to change of Bunsen's disc (paper with a grease or paraffin spot) and from the unequal reflecting powers of the two sides of the spot. It may be briefly noted that by proper disposition of parts the same advantage is obtained as by observations of both sides of the Bunsen disc. Measurements obtained with a temporary apparatus confirm perfectly the superiority of the principle of the new photometer compared with the Bunsen disc, as should have been anticipated. The arrangement adopted makes it possible to place the apparatus in the place of Bunsen's disc upon the bar of any photometer.

Birds That Destroy Insects.—The following birds are to be classed among the most helpful kinds in the general warfare against insects:—Robins (cut, and other earthworms), swallows, night hawks, purple martins (moth-catchers), pewees (striped cucumber bugs), wood thrushes and wrens (cut worms), cat birds (tent caterpillar), meadow larks, woodpeckers, crows (wireworms), blue-throated buntings (canker worms), black, red-winged birds, jays, doves, pigeons, and chippies (strawberry pests), quails (ching bugs, locusts), whip-poor-wills (moths), hawks, all night birds, owls, &c., tanagers and black-winged summer red birds (curculios), nut-crackers, fly-catchers, chimney swifts, indigo birds, chipping and song sparrows, blackbirds, mocking birds, titmouses, vireas, orchard orioles.

For the purpose of giving effect to the provisions of the Patents, Designs, and Trade Marks Act, 1888, relating to the registration of patent agents, the Board of Trade, by virtue of the said Act, have issued a set of rules, twenty-three in number. These rules determine, *inter alia*, the register to be kept and its contents, the registration of persons who were patent agents prior to the passing of the Act, the final qualifying examination for registration, exemptions of pupils, inquiry by Board of Trade before erasure of name from register, and directions as to appeals.

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* By Geo. M. Hopkins, in the *Scientific American*.

SCIENTIFIC SOCIETIES.

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ROYAL METEOROLOGICAL SOCIETY.

THE last meeting of this Society for the present session was held on Wednesday evening, the 19th inst., at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., president, in the chair. Mr. T. J. Moss-Flower, Mr. A. H. Halder, Mr. R. A. Naylor, and Mr. C. B. Penlington were elected Fellows.

Mr. W. Marriott gave a very graphic and interesting account of the recent thunderstorms which have prevailed over this country. On Sunday, June 2nd, a thunderstorm passed across the country in a northerly direction from Wiltshire about 3 a.m., and reaching Edinburgh by 10.44, it travelled at the rate of about 50 miles an hour. It is possible that this storm travelled still further north, and reached Kirkwall at 3·37 p.m. A severe thunderstorm prevailed over the neighbourhood of the Tweed between 11 a.m. and noon, and was accompanied by hail of very large size, some of the stones being 5in. in circumference. A very destructive storm occurred over the whole of the north-west of England and South of Scotland during the afternoon, much damage was caused by lightning, and very large hail fell over an extensive area. Some of the hailstones measured 7in. in circumference, and weighed 7oz. During the night of the same day, a severe thunderstorm prevailed over Norfolk, which was also accompanied by very large hailstones, some of which were 5in. to 6in. in circumference. On Thursday, the 6th, thunderstorms prevailed during the afternoon over all of the south-east of England—that which passed over the metropolis about 9 o'clock was remarkable for the brilliant and continuous display of lightning. During the same night, and in the early morning of the following day, a very destructive storm prevailed over the eastern counties, much damage being done by the lightning in the north-west of Norfolk. Severe hailstorms occurred between 2 and 3 a.m., both at Margate and Ipswich. During the afternoon of the 7th, destructive thunderstorms prevailed over the whole of the southern counties, much damage being done by lightning; while at Tunbridge Wells there was a most remarkable hailstorm. One of the hailstones which was weighed was actually ¾lb. in weight. An interesting collection of over 40 photographs of lightning taken during the storm on June 6th was also exhibited to the meeting. In addition to the sinuous, ribbon, and meandering flashes of lightning, several photographs showed knotted, multiple, and dark flashes.

The following papers were also read:—"The Climate of British North Borneo," by Mr. R. H. Scott, M.A., F.R.S.; "On the Variation of the Temperature of the Air in England during the Period 1849 to 1888," by Mr. W. Ellis, F.R.A.S., F.R.Met.Soc.; "Atlantic Weather and Rapid Steamship Navigation," by Mr. C. Harding, F.R.Met.Soc.; "Meteorological Phenomena Observed during 1875-87 in the Neighbourhood of Chelmsford," by Mr. Henry Corder; "Rainfall in China, and Meteorological Observations made at Ichang and South Cape in 1888," by Dr. W. Doberck, F.R.Met.Soc.

The United States Fish Commission.—From the U.S. Fish Commission we have four volumes descriptive of the history and methods of the fisheries of the States—three being text, and one consisting of plates. These volumes describe the fisheries and the fishermen of the United States in the most elaborate and careful manner, and give abundant evidence of the wise manner in which the Government of the United States spends money in the collection and publication of information which will be useful for all time. The halibut, the menhaden, the cod, the herring, and the sardine fisheries are fully described and illustrated, and apart from their present interest, the volumes are of lasting value.

THE Natural History Museum has at length succeeded in obtaining a rare bird. This, says a London correspondent, is a specimen of the Fregilupus, the extinct bird of the Island of Reunion. It formed part of and was the chief treasure in the great collection at Vetry-la-Ville, which had been amassed by the Counts du Riocour during three generations, and of which the best and most valuable specimens have now, together with the Fregilupus, found their way to the British Museum in Cromwell-road. Many of them are rendered still more interesting by having labels and descriptions attached in the handwriting of many famous French naturalists of the early part of the century. The extinct bird is of the starling family, yellow billed and yellow legged, with a curious crest-like adornment. At one time it was exceedingly common in the Island of Reunion, but being, like the dodo, the auk, and other extinct birds, of a stupid and unsuspicious character, it was soon extirpated, and only about a dozen specimens are now known to exist.

SCIENTIFIC NEWS.

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THE phenomena of variable stars have latterly attracted a good deal of attention from both amateur and professional astronomers; but nothing very definite will be known, we suspect, until the systematic charting of the heavens has been completed and a series of photographs taken. Mr. S. C. Chandler, who has devoted much time and ability to the variables, contributes to *Gould's Astronomical Journal* his results so far as he has worked them out. He divides the variable stars into two great groups—those of short and those of long period—i.e., those of less than 90 days, and those of more than 120 days. There do not seem to be any very definite characteristics to distinguish the classes; but it appears that the "redder the tint the longer the period" is invariably the case. The periods, however, vary, and there seems to be nothing of proportionality about them. As to the distribution of variables, nothing can be stated with positiveness, except that there is an aggregation of short-period variables near the plane of the Milky Way.

All old students of the School of Mines will regret to hear of the death of Dr. John Percy, the famous metallurgist and admirable teacher. John Percy was born in 1817 at Nottingham, and was placed at an early age in the medical school of the University of Edinburgh, where he took his degree of M.D. at the age of 21. Dr. Percy also studied in the medical schools of Paris, and while in France undertook a botanical tour in the Pyrenees. He established himself in practice in Birmingham, where he became physician to the Queen's Hospital. In 1844 he communicated to the Zoological Society a paper "On the Management of Monkeys in Confinement," and the following year read before the British Association some "Contributions to the Chemistry of Diabetes." His residence in Birmingham led him to take much interest in the chemical principles involved in metallurgical operations; and when the Government School of Mines was established in 1851, De la Beche selected Percy for the post of lecturer on metallurgy, a position which he held for 28 years. Abandoning the practice of medicine, he settled in London, and devoted himself to scientific research, taking special interest in the early development of photography. His great object, however, seems to have been the production of an exhaustive treatise on metallurgy, and after years spent in the accumulation of material, his first volume was given to the world in 1861. This dealt mainly with the subjects of fuel, copper, and zinc. It was followed in 1864 by a voluminous treatise on iron and steel, and in due course other volumes appeared, dealing more or less completely with lead, silver, and gold. But this great work—the worthy object of an active life—was destined to remain incomplete, and after his retirement from the Royal School of Mines in 1879 its completion became practically impossible. So widely, however, was its value recognised that the successive volumes as they appeared were translated into both French and German. In 1877 the Iron and Steel Institute recognised Dr. Percy's services to metallurgy by the award of the Bessemer medal; and only shortly before his death he held the presidency of that institute, and, notwithstanding his failing health, discharged the duties of the chair with characteristic ability. Dr. Percy held the post of superintendent of ventilation in the Houses of Parliament up to the time of his death; but it is as the professor of metallurgy, the teacher of nearly every assayer in the country, that he will be best remembered.

A memorial tablet has lately been affixed to the house at Neuss, in Rhenish Prussia, in which Theodor Schwann, the originator of the cell theory, was born. Before publishing his epoch-making work on the cell, he wrote to the Archbishop of Malines, to whose diocese his native place belonged, stating his new theory, and begging his opinion whether it was at variance with the doctrines of the Catholic Church. The prelate found nothing heretical in it. It was published in Berlin in 1839, under the title "Microscopic Investigations Regarding the Harmony in the Structure and Growth of Animals and Plants." Schwann was at that time assistant in the Berlin Anatomical Museum.

The Departmental Committee appointed by the Treasury to inquire as to the best plan upon which to allocate the Government grant of £15,000 in aid of University Colleges, have, it is said, decided to recommend grants to be made to University and to King's College, London; the colleges of Victoria University; the University Colleges of Bristol and Nottingham; Mason's College, Birmingham; the Dublin College of Science; the Newcastle-upon-Tyne College, and the Firth College, Sheffield.

Dr. Frithjof Nansen read his promised paper before the Royal Geographical Society last Monday, and in the course of his remarks said that since Greenland was discovered it had been for 900 years an interesting mystery as to the nature of its interior, which early explorers had described as a sheet of snow and ice. Dr. Nansen's expedition has corroborated the views of the early voyagers. He and his party embarked on board a Norwegian sealing ship on July 17, and left her in their two boats at a distance of ten miles from the land, near Cap Dan (65° 30' N. lat.). They reached the land at Anoritok (61° 30' N. lat.) on July 29. On August 15 they disembarked, and without delay commenced their inland journey. Dr. Nansen said that the scientific results of the expedition had not yet been fully worked out; the observations made related to questions of a geographical, geological, and meteorological nature. There were, however, some few important points that even now might be mentioned. The expedition, he believed, had proved that the whole of the interior of Greenland is covered by an immense shield-shaped cap of ice and snow, which in some places must have a thickness of at least 5,000ft. or 6,000ft. The investigation of this immense ice and snow field would no doubt yield results of the greatest importance to the study of glacial theories. Another point of great interest was the very low temperature found in the interior, which did not seem to agree with the received meteorological laws. He thought that this low temperature might throw a good deal of light on the much-discussed question, the cause of the great cold of the glacial period in Europe and North America, which at that time were covered with an ice sheet similar to that we now see in Greenland. He thought the best way of solving the problems of the great Ice Age was to go and examine the places where similar conditions were now found, and no better place could be found than Greenland. But Greenland was a vast region. His expedition was the first to cross it, but he hoped it would not be the last.

At a recent meeting of the Linnean Society, Mr. D. Morris exhibited specimens of the fruit of Sideroxylon dulciferum, the so-called "miraculous berry" of West Africa, belonging to the Sapotaceæ. Covered externally with a soft sweet pulp, it imparts to the palate a sensation which renders it possible to partake of sour substances and even of tartaric acid, lime-juice, and vinegar, and to give them a flavour of absolute sweetness. The fruit of Thaumatococcus (Phrynium Daniellii), possessing similar properties, was also shown. Living plants of both have lately been received at Kew from Lagos, through Governor Maloney. Mr. Thomas Christy exhibited growing plants of Antiaris toxicaria (the Upas tree), and Strophanthus Kombe, both of them poisonous, to show the similarity of the foliage.

The inflorescence of the gigantic aroid (*Amorphophallus Titanum*) discovered in Sumatra by the Italian traveller Beccari, has been fully expanded at Kew in the Victoria-house (No. 10). Its gradual development has taken about a month, and it reached nearly 7ft. in height. The plant has been grown at Kew from a small tuber, and has taken ten years to arrive at the flowering stage.

Mr. G. H. Verrall, F.E.S., commenting on some statements made in the daily press, says:—There are about a hundred species of mosquitoes in the world, occurring in all climes. Eight or ten species have been known to inhabit England for more than fifty years—in fact, since they were first studied. No new species to Britain has been recorded for more than fifty years. No special Tropical species has ever been recorded as having occurred in Britain, but one of our well-known British species has recently been recorded from Mexico. Most, if not all, of our British species bite in very hot weather, when, apparently, like their betters, they require more liquid refreshment. Finally, mosquitoes, as well as [illegible] flies, are as common in England as white [illegible] flies.

Prof. Sylvester is going to deliver, early in the October term, a public lecture at Oxford [illegible].

sufficiency of Barbier's principle to furnish a universal and geometrical solution of a celebrated problem of chances originated by Buffon, whose solution of it, as also that of Laplace, was limited to the two simplest cases and involved the use of the integral calculus.

M. Pasteur has sent to the Paris Academy of Sciences a statement of the number of persons treated at the Institute from May 1st, 1888, to May 1st, 1889. There were inoculated 1,673 persons bitten and suspected to be affected with rabies, among whom there were 186 foreigners and 1,487 French. Ten subjects bitten in the face and hands died during the treatment; three died after the treatment. Strictly speaking, the proportion of deaths, notwithstanding the treatment, is therefore 3 per 1,673, or 1 in 554 persons treated. In other words, the proportion of deaths being 13, there would be 1 death pér 128 persons treated or under treatment.

M. Planté has left the Paris Academy of Sciences a sum sufficient to pay for a prize of 3,000fr. in alternate years to be awarded to a Frenchman who makes some discovery helping the progress of electrical science. His house and fine garden at Bellevue, near Paris, are left in trust to be used as a retreat for poor students of science. That a man who never made, or sought to make, money by establishing companies should act in the manner described is, perhaps, what might have been expected.

The New Park Theatre, Philadelphia, now being erected, is to be fitted with 900 incandescent and ten arc lights, besides those for the stage effects. The stage regulator and switches, as well as all the cut-outs in the building, are to be entirely fire and moisture proof, and every light is to be under the control of a separate switch. Triple-covered white core wire will be used. The contract specifies that every wire in the building must be so placed that it will be easily accessible. All wires supplying lights on solid walls will be placed in a water and fire-proof non-metallic tube placed under the plaster. It will be the first building in the city wired in this manner. A large portion of the electric lights of the incandescent plant are to be used in connection with the decoration of the building. A number will be concealed at the back of ornamental glass and metal work, so as to produce an artistic effect. The arc lights will be used for outside illumination exclusively.

The deputation of the London Chamber of Commerce and the Institution of Electrical Engineers which waited upon the President of the Board of Trade last week, in order to induce the Government to establish an electrical standardising laboratory, will no doubt get what they want, although Sir M. Hicks-Beach was not able o do more than say that there were "very good rounds" for the request, and that he would ook "very carefully" into it. As the deputaion pointed out, if the Electric Lighting Act is o be worked, it is important that proper stanlards, verified by disinterested officials, should be vailable. They might be placed, as in other ases, under the care of the Warden of the Standards. The electricians want to be able to end their instruments to a Government department and have them certified just as weights and measures, chronometers, barometers, &c., are ertificated. Lord Rayleigh read a letter written y Lord Crawford, and with the assistance of Sir W. Thomson, put a very strong case before the resident of the Board of Trade.

Dr. Puluj has recently shown some interesting xperiments at Prague with MM. Deckert and Homolka's microphone for long-distance telehony. The instrument consists of a round ibrating plate of carbon and of a thick carbon late, into which notches are cut; between these wo, little balls of platinised carbon are placed, hich serve to conduct the current from one late to the other. The results obtained are said be better than those given by any microphone itherto constructed.

The Society of Chemical Industry holds its nnual meeting on July 10 in the theatre of the oyal Institution at 11 a.m. In the evening the resident will hold a reception and conversazione t the Grosvenor Gallery.

The 57th annual exhibition of the Royal Cornwall Polytechnic Society will open on September at Falmouth. Full particulars with the prize st can be obtained from the secretary, Mr. E. itto, Falmouth.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

A DOUBTFUL AUTHORITY—MERCURY AND THE DAYLIGHT HAZE—VISIBILITY OF LIGHT: THE CORONA, &c.—THE ASTRONOMICAL SOCIETY OF THE PACIFIC — USING BAD LANGUAGE—"QUEMQUE SUO MODULO"—PROF. JUDD AND LUNAR VOLCANOES — FLAT FOR NEWTONIAN TELESCOPE — PLANET (?) CROSSING SUN'S DISC—CENTRIFUGAL FORCE ON THE MOON.

[30075.]—Should this meet the eye of Mr. Arman (letter 29792, p. 110, &c.) and "Autolycus" (letter 29318, p. 131), I should like to suggest to them the perusal of the numbers of that capital American serial the *Sidereal Messenger* for April and May of the present year. On pp. 162 and 163 of the April part, and 232 and 233 of the May one, they may find some of the grounds set forth in which their idol is distrusted on the other side of the Atlantic. Certainly, in this country its cult is followed in direction proportion to the ignorance of its devotees.

I, like Mr. Clapham (letter 30031, p. 325), have often failed to see Mercury, owing to the interposition of some opaque illuminated matter; and as this phenomenon was very apparent in the years succeeding the Krakatao eruption, I should have been tempted to refer the opacity of the atmosphere to impalpable volcanic dust in the higher regions of the atmosphere, but for one circumstance—viz., that the haze was always in the neighbourhood of the sun, and had a fairly well defined edge or termination at some distance from him, bright stars being visible in other parts of the sky. It seems to me that, had the Krakatao dust permeated the higher atmosphere, that *nothing* should have been visible in any part of the daylit heavens. The difference of visibility of objects in sunlight at different times is very puzzling. This very day I wholly failed to see Regulus in a 2¾in. transit instrument, albeit the sky was of a cerulean blue. By the way, a pretty strong north-east wind, conjoined with a hot sun, caused considerable undulation, though.

If by "atmosphere," in letter 30035 (p. 326), Mr. Penny means the spheroidal envelope of oxygen and nitrogen surrounding the earth, then do I assert, quite unhesitatingly, that it *is* invisible—totally so. It of course contains particles of matter floating in it, and it is the light reflected from these that we see—certainly not the atmosphere itself. Tyndall showed this beautifully by transmitting a beam of electric light through a mass of air, first in its normal state, and then after the floating particles had been burned out of it; the ray under the circumstances last particularised being absolutely invisible. Furthermore, he repeated the experiment with air confined in a box with glass sides, which, when first closed up, showed the track of the electric light distinctly enough; but after a few days' interval, when its contained floating matter had subsided to the bottom of the box, appeared perfectly dark when the electric beam traversed it. As for that most mysterious and paradoxical entity, the æther, whose undulations, under certain circumstances, affect our vision as light, it will suffice to say here that were it itself illuminated, instead of, as it is, *illuminating*, our night would be as light as day, surrounded as we are by millions of stars, from which light is radiating in all directions. Mr. Penny talks of the illumination of the æther itself as though it were something outside of and beyond the medium whose undulations produce the sensation of light; much as some people wonder why we do not see objects inverted—as if we had another eye behind the retina! Finally, in connection with the structure of the Solar Corona, I would again urge my brother correspondent to obtain and read Vol. XLI. of the R.A.S. *Memoirs*—or, in fact, anything on that subject by Mr. Ranyard that is procurable.

The preliminary Presidential Address delivered by Prof. Holden before the Astronomical Society of the Pacific, may be perused with profit by everyone interested in astronomy. Assuredly if the very practical advice it gives be taken, and the hopes and expectations it expresses be fulfilled, the Association to which it was primarily addressed can scarcely fail to become a power in the astronomical world. Commencing with a succinct account of the condition of English astronomy in the year 1820, it goes on to trace the inception and rise of the Royal Astronomical Society, quoting from its first printed paper the statement of the ends and aims proposed by its founders, as, in some sort, models for the imitation of the infant society in California. It then proceeds to classify the work peculiarly suitable to, and ordinarily undertaken by, amateurs, and concludes by showing how this may be most effectively performed by those to whom it more immediately appeals. Incidentally Dr. Holden gives lists of astronomical publications, which he considers the Society's library should include, together with others the individual possession of which he recommends to its members. With reference to these lists I would venture to make one or two remarks. The first is that among "astronomical journals" he includes *Nature*, and omits any mention of the English Mechanic! On this side of the Atlantic this will merely excite derision. Why, I venture to think that more that is of enduring value to the astronomer appears in these columns in one month than is contained in those of your contemporary in an annual volume. Again, with reference to Prof. Holden's "List of some Books of Reference in Astronomy," while most properly giving that treasure-house for the advanced mathematician, Chauvenet's classical "Spherical and Practical Astronomy," he altogether omits Loomis's smaller "Practical Astronomy," than which, for the purpose of the ordinary amateur, nothing better has ever appeared in any language. Among the list of which I am speaking, too, might well have been included Lord Grimthorpe's "Astronomy without Mathematics," Young on "The Sun," in the International Scientific series, and Neison on "The Moon," a work indispensable to the selenographer. I should have added the "Old and New Astronomy" of the late R. A. Proctor, but that it is not yet completed. Having said which, however, I can find no further fault whatever (even admitting, which I do not, what I have said to be fault-finding) with Prof. Holden's admirable discourse.

The use of technical terms is, of course, to save circumlocution, and in the vast majority of cases this end is effectually attained. Modern chemists, however, have invented a cacophonous nomenclature which is the veriest *reductio ad absurdum*. As an illustration of this, I find in the current number of the *Journal* of the Royal Microscopical Society a précis of a paper by Dr. H. Griesbach, on staining microscopical sections, in which among the media employed are given "phenylamidobenzolmetasulphonate of soda," "tetraazoditolylbetanaphthodisulphonate of soda," "hydrochloride of hexamethylpararosaniline," "alphaazonaphthallindisulfobetanaphthol of soda," tetraazodiphenyldinaphthylamindisulphonate of soda," and "bisulfoxylnatronbetaoxynaphthalin azo ortho metoxylbenzol"!!! How's that, Umpire?

Unfortunately, before these lines can meet the eye of any of my brother readers, the chance of obtaining a facsimile of the Cosmos will be over and gone; for, as I learn from an advertisement sent to me by a friend, it was on the 19th instant that there was to be sold by auction in Belfast a "Large Model of the Universe"! With reference to this astonishing reproduction, the advertisement informs us that "This is the *only* Model *ever* made showing the connection between the Known and Unknown Universe." I should, I must confess, have much liked to see that part of the Model representing the *unknown* Universe; but there is a geographical difficulty which stands in the way of a speedy visit to the North of Ireland from the locality whence these lines are written, and by this time the precious possession has either been disposed of, after a keen competition, or its maker has bought it in, and, as he "is going abroad," one's chance of knowing all about it seems to be but a feeble one. But what, I would in all seriousness ask, can be thought of the diffusion of sound astronomical information when one-third of a column of a high-class newspaper is occupied by an advertisement of such stuff as this? As the reporters say, "it is needless to add" that this invaluable piece of mechanism has a theological significance as well as a cosmographical one.

In connection with letter 30058 (p. 349), I have only to say that I have not the pleasure of Mr. Judd's personal acquaintance; but I have no doubt that a letter addressed to him to "The Normal School of Science, South Kensington, London, S.W.," would meet with a courteous response. Speaking for myself, I wholly fail to see that, because air and water are now absent from the visible surface of the moon, they cannot have existed at the time when volcanic action proceeded on her surface on so stupendous a scale. It is difficult to understand how anyone can make a careful telescopic examination of the boundaries of the Mare-Imbrium, the Sinus Iridum, the Mare Serenitatis, &c., &c., on the lunar surface without being struck with their precise agreement with sea margins as they now exist on our own earth.

I would make two remarks in connection with reply 68840, on p. 354. The first is that I never recommended a flat of "3in. in minor axis" to my querist at all. By a 3in. flat I understand one having a major axis of that length. In the next place, I purposely mentioned a size which would enable "Solar Focus" to take in the whole disc of the sun or moon, and leave a margin around it; or would permit him, with a low power, to enjoy a view of such a glorious object as H VI. 33 and 34 Persei. If he be content to confine himself to observations of double stars and planets, a very much smaller flat will answer all his purpose.

Whatever "Rapier" (query 68930, p. 357) may have seen on the sun's disc "about the end of April, 1884," it wasn't a planet; as Mercury attained his greatest eastern elongation from the sun at 2 p.m. on the 25th of that month, and Venus hers at 6 p.m. on May 2nd. Is he absolutely sure that it was not a spot of dust on one of the lenses of his eyepiece (if he had a telescope), or a minute cloud, if he was observing with the naked eye?

I am rather afraid that, prior to entering upon the question he has mooted, Mr. Hosken (query 68942, p. 357) requires to read up some very elementary work indeed on mechanics. There is no literature of the subject in the form in which he treats it; as astronomers are too busy a race to be able to devote their time to paradoxes. Let me just say this. The moon's diameter is 2163·06 miles, and her mean distance 238,840·25 miles; hence, supposing her to revolve round the earth in 27·3217 days, a point when the radius vector produced emerges from, what we may call, her outer surface would travel some 20·73 miles an hour faster than that at which such radius vector penetrates her inner surface—i.e., less than $\frac{1}{104}$th of her diameter. Mr. Hosken can calculate at his leisure how far the "centrifugal force" thus generated would conduce to the production of "zones of life and beauty equal to any we can boast of on earth"! He may read Proctor's "Moon" with some advantage.

A Fellow of the Royal Astronomical Society.

VISIBILITY OF VENUS'S CRESCENT BY NAKED EYE.

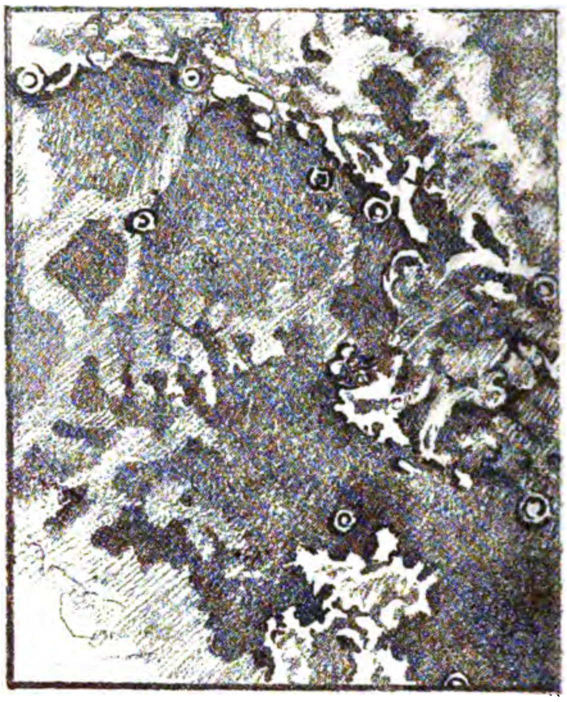
[30076.]—"W. S." (letter 30033, page 325) is, of course, correct. By some stupid mistake, I assumed that a halfpenny measured ½in. across, instead of 1in. Of course on April 27th Venus subtended the same diameter as a halfpenny viewed at 99 yards distance, not 48 yards. I much regret that, when revising the proofs of the last edition of "Celestial Objects," I did not ask my old friend where he obtained the information with regard to the observations of the crescent of Venus with the naked eye in America.

H. S.

AN INTRODUCTION—"LINNE" 100 YEARS AGO—PROBLEM.

[30077.]—In addressing this, my first letter to you, may I introduce myself as a regular subscriber for nearly 20 years, and for all that period a devoted student of science? Moreover, may I explain that being compelled to take an *ægrotat* degree at Cambridge, my mathematical attainments might be doubted did I not mention that mathematics procured me a scholarship at Trinity, and have formed an important part of my study ever since. I have now lately put up an observatory which is at present equipped with an excellent 4in. refractor equatorially mounted, supplied me by Mr. P. Vallance, an astronomer well-known to readers of the "E. M.," and who, among other contributions, described in an early volume his method of driving this same telescope by means of a bladder. To those who have tried this device it will very probably have occurred to substitute a lantern gas bag and pressure board; but with your permission I will in a future letter describe another form of clock I am completing, which promises to perform admirably, and for an indefinite time without attention.

I beg to submit to you a sketch which I lately sent to the R.A.S. described as "Linne" 100 years ago, about which I gave the following private information:—The sketch is somewhat enlarged from a 1ft. globe beautifully executed by John Russell, R.A. (completed in 1797) "from a long series of observations," the globe itself together with the telescope used (a 3⅝ Dollond) having been given to my grandfather, an intimate friend and brother Royal Academician, and now in my possession along with certain correspondence.



I had never noticed that a duplicate of my globe is among our R.A.S. collection, and I received an answer telling me this, and that it was the opinion of those who had examined my drawing that the crater I have marked L was not Linné, being too much misplaced. Now, as from the circumstances mentioned above, I perhaps know more than most of the work done by Russell, who was, of all men, a most consummate draughtsman, I think his evidence on this important point (positive or negative) should not be dismissed too hastily. It should be borne in mind that his telescope is only an alt-azimuth, and has no means of measurement; and it is, therefore, not to be wondered at if some of his features are misplaced. It seems to me that what he *must* mean for Messier is quite as much out of drawing as his Linné would be, and I venture to suggest that reference to both these problematical features would repay the attention of those who have access to the globe in question.

I note that a problem has descended to the U.Q. Will "Trial" see if he has not made a slight slip in transcribing?

Newbury. **J. M. Bacon.**

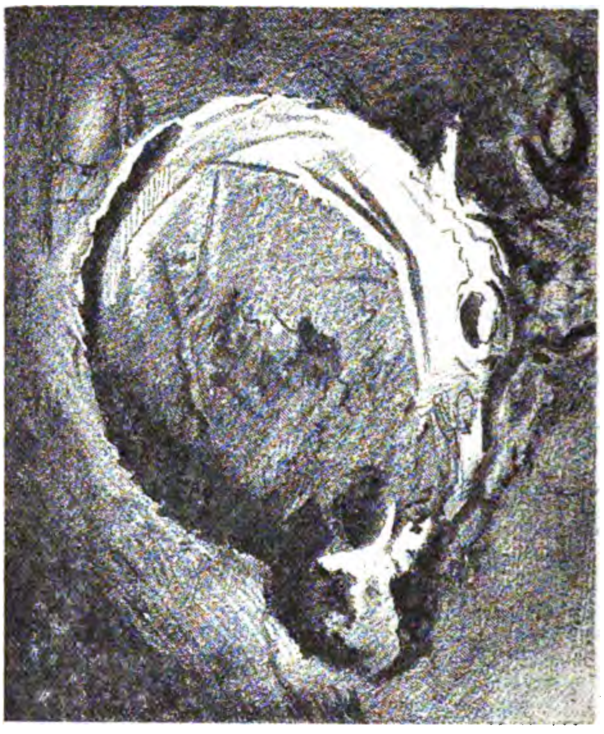
SEEING MERCURY BY DAYLIGHT.—GASSENDI.

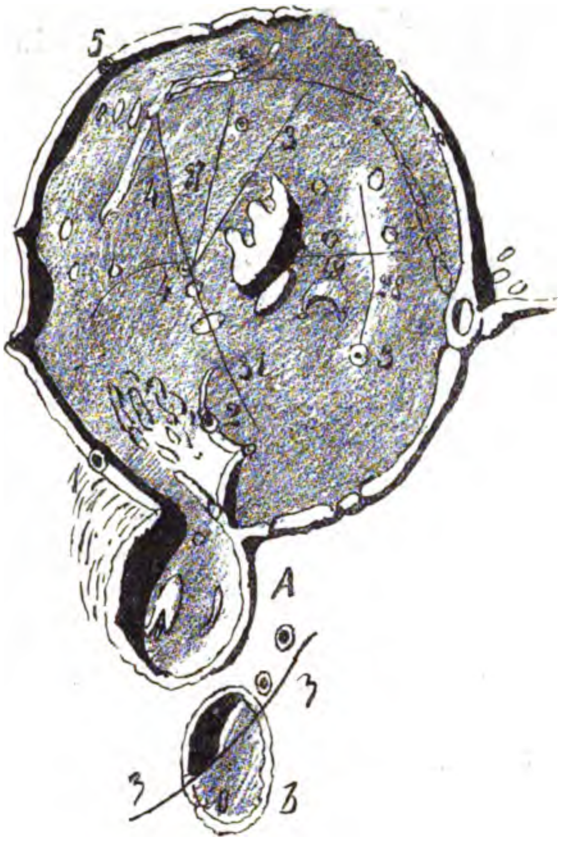
[30078.]—I quite agree with Mr. T. R. Clapham (30031) as to the necessary conditions for seeing Mercury by daylight. I may add that I have repeatedly seen Mercury by daylight with 3¼ equatorial, and as early as 3.40 p.m. on a July afternoon. I have two records of such occurrences: July 28, 1886, at 3.40 p.m., semi-diameter 3.3″, dec. 10° 58′ N., meridian passage 1.47 p.m.; June 4, 1887, at 4.40 p.m., semi-dia. 2.6″, dec. 24° 54′ N., meridian passage 0h. 39m.

On May 19 last I quite failed to see the planet during the afternoon, though carefully observing the conditions hereafter stated; at 7.30 p.m. I could see it, the semi-diameter being 3·6′, and the dec. being 25° 26′ N. Upon several other afternoons about this date I looked for the planet, but failed to find it.

The conditions of success with so small an aperture as 3¼ object-glass, according to my experience, are: 1st, a well and accurately-mounted equatorial with adjustments perfected, well graduated circles, reading to at least 10 seconds of time and a minute of arc; 2nd, time perfectly ascertained beforehand. 3rd, the instrument previously focussed on Venus, and the circles set for an appearance in the centre of the field at the given moment; lastly, a light-tinted glass upon the eyepiece to soften the glare, an observer with a patient and calm state of mind, without hurry or forgetfulness, which often causes the most obvious errors in the calculation of the hour-angle, will probably see Mercury even closer to the sun than this. I considered that the cau my failure on May 19 was some atmospheric c What about the corona? Could that have hin the seeing in any way?

Having lately published two very useful s of Gassendi, you may care to spare space to a





The inclosed is a copy of one I made on May 3rd, 1887, at 10.30 to 11 p.m., with a power of 150 on an 8¼ With mirror, which Mr. With in 1874 had pronounced "perfection." I have aimed in this sketch not only to accurately reproduce the details visible at the moment, but the general appearance of this wonderful formation, which is, to my mind, one of those typical structures that must be regarded carefully in any attempt to found a theory of lunar surfacing. The straight and angular appearance of the ridges on this floor suggest to me shrinkage under great variations of temperature. 200,000 years ago, when the eccentricity of the earth's orbit was ·565 instead of ·168 as now, the moon, whose internal heat must have also been greater than now, would have been much more affected by the semi-monthly variations of sun-heat. The breaking down of the north wall of Gassendi by the formation of the great ring plain A, evidently shows the solubility of the lunar material under the heat evolved in the process of new crater or ring formations. Mr. Peal's ice theory only goes, I think a partial way in explaining these phenomena. The low density of the moon's material and its subjection to great variations of external as well as internal heat, must be taken into account in the formation of a theory. Gassendi should be compared with Posidonius.

John Bone.

St. Thomas Vicarage, Lancaster, June 18,.

SELENOGRAPHICAL—GASSENDI—MORETUS.

[30079.]—The small crater shown by Mr. Herbert Ingall in your issue which reaches me this day is not the same as the one I found on the 11th May last. I send you the sketch I made on that evening, 8h. p.m., hoping it will prevent all misunderstanding.

At 1, on the N.W. wall of Gassendi, I show that crater. At 2, on the E. border of the rough ground, is the crater shown by Mr. Ingall, and discovered by the late Mr. Webb. At 3, is the crater E. of the central mountains known by all observers of Gassendi. These three craters are on a straight line, and are all about the same size.

I have again observed No. 1, on the 10th of this month, between clouds, and this is what I wrote: The craterlet is seen again this evening, though the terminator is as far as the E. side of Schickard. It is very easy with 6in. of aperture, and I believe it would be seen without difficulty with 4in. But instead of being dark as ink as on May 11th last, it is now of a deep grey colour. I consider the sketch of Mr. H. Ingall as of great importance. Made somewhat earlier than mine, p. 257, during the same evening, and giving particular attention to the west side of the plain with his well-known excellent 10in. refractor, powers 320 and 600, yet he shows no crater on the N.W. wall, but sees another crater, No. 2, of about the same size in the immediate neighbourhood. Looking myself carefully with my 10¼in. mirror along the crest of this wall, which struck me as being very thin, yet not the least trace of a crater was seen. On May 11, on the contrary, as soon as I had pointed a 9¼in. mirror by With, silvered that very day, whose definition is perfect, a crater dark as ink was seen at once, without seeking for or even thinking of one at all, and seen in such way that, as the saying is, it cut my breath away. As a matter of fact, I did not believe what I saw, and thought that a speck of dust on the field lens of the eyepiece must be the cause of it. But I soon saw the dark object was a fixture on Gassendi, following with it the diurnal movement of the earth. To make it more sure, however, I changed the eyepiece, and found the crater still there, as seen at first. When we remember that Gassendi has been observed so carefully and perseveringly during so many years by trained observers using, some of them, large and very perfect instruments, enabling them to discover on its floor some of the most delicate clefts of the moon; when we consider how many times the eye of the selenographer has closely followed every sinuosity of the walls of this formation, noticing every break, and even every speck on them, in order to make, in the best possible way, the numerous drawings which are in existence without noticing in the least the crater I speak of, and that now we can see that crater without difficulty with an aperture of 4 or 5in., are we not forced, as it were, to recognise the fact that between April 11th and May 11th, 1889, a really new crater has been formed on the top of the N.W. wall of Gassendi? I hope this new object will soon be seen by many of your readers, and bear my testimony out. On May 11 I also noticed for the first time the minute crater at 5 on the S.W. wall. The clefts shown in the sketch were also seen during that evening, and also cleft η crossing Gassendi *b* from S.E. to N.W. in a light curve, as shown.

I again call the attention of your selenographical readers to Moretus. On the 7th, 9th, and 10th of this month I again observed it, and was able to make a sketch every evening, watching the floor as the shadow retired westward. Every night the crater on the E. end of the central mountain was seen very easily; and on June 9th I found another but much smaller crater on the top of the hillock which clusters with that mountain on the S.W. It is about half the size of the crater on the E. The same night I saw two still smaller craters on the floor W. of the central mountain, having two hillocks between them and the peak N.W. of the larger mountain and one on the N. A shallow valley runs from the S.W. extremity of the floor, and abuts to these hillocks. Webb's crater N. of central mountain was a very easy object during all these observations, and one is certainly surprised that the larger crater on the central mountain was not seen by him or by Schmidt. But did that crater exist in their time?

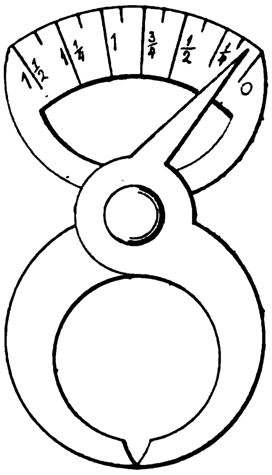
June 15. **C. M. Gaudibert.**

CALIPERS.

[30080.]—In No. 1,264 is a description of a pair of calipers, which is all but identical with a pair I have had nearly four years, and which were given to me by a gentleman who brought them from the U.S. of America, where he said they were very common. I inclose a rough drawing of them, full size. They are very useful and convenient, but it is rather unfortunate for Mr. Rickinson, the patentee, to find that he has been forestalled. Last year a great friend of mine tried to obtain a pair like mine at more than one noted tool house in London, but failed.

H. Booth.

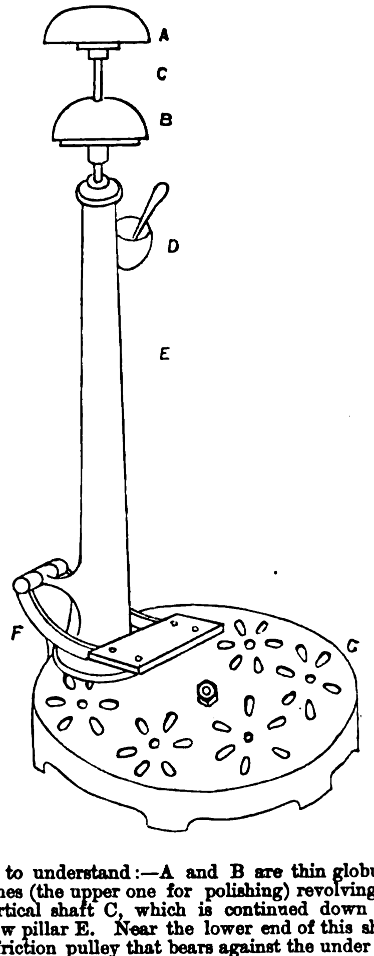
3, Cambridge-terrace, Otley, Yorks.



A BOOT-BLACKING MACHINE.

[30081.]—I send you a sketch of a boot-blacking machine, the mechanism of which is so beautifully simple and smooth in action that it has met with praise from every one who has seen it, and as it is applicable to many other purposes, especially in the trades, a description would no doubt be interesting to your readers.

The following particulars will no doubt make it easy to understand:—A and B are thin globular brushes (the upper one for polishing) revolving on a vertical shaft C, which is continued down the hollow pillar E. Near the lower end of this shaft is a friction pulley that bears against the under rim of a horizontal flywheel that revolves beneath the base-plate G. The treadle F gives motion to the flywheel, being connected by a very simple uni-



versal joint (not shown). These latter details are patented. It is the position of the flywheel that gives the smoothness and steadiness so characteristic of the machine. Being placed under the operator, there is no unstable equilibrium set up to produce vibrations or to interfere with the tendency of revolving bodies to maintain a fixed plane of rotation.

As a boot-blacker, this machine saves at least 60 per cent. of time and labour. **H. W. H.**

EXTRAORDINARY METEOR..

[30082.]—The meteor recorded by Mr. Ward at Belfast on May 29th, 10h. 44½m. G.M.T., is undoubtedly the same as the one seen by the writer at Leeds. The descriptions are given in letters 30004 and 30054, pp. 302 and 330 respectively. The bearings of the meteor are very interesting, and show that Mr. I. W. Ward carefully noted the path of the meteor as observed by him. That he did not observe the whole of the meteor's flight is evident from his friend's description, who, residing at another part of Belfast, saw the meteor in the S.E. sky. The Leeds observation shows that the meteor at its commencement would be visible in the S.S.E. heavens as seen from Belfast. Therefore these two observations (Mr. Ward's and his friend's) show that it is advisable to use the full length of the observed path as recorded at Leeds for the purpose of computation.

When first observed at Leeds it was over the Irish Sea, at a point about 22 miles W. by S. of the Calf of Man, and 156 miles almost due W. of Leeds. Its height at this moment above the earth's surface was nearly 60 miles, its course being directed to the Firth of Clyde, three miles off the S.E. coast of the Isle of Arran, where it would have fallen into the sea had it not been dissipated by our atmosphere. In the course of its flight Mr. Ward first saw it when nearly due E. from Belfast. It was at this instant 30 miles distant from that place, and was moving over the North Channel at a height of 36 miles, being midway between Ireland and the Mull of Galloway, Scotland. When last seen it was over a point of the earth's surface six miles due N. of Port Patrick, Wigton, Scotland, and was at a height of 24 miles. At this instant it was 41 miles from Belfast and 164 miles from Leeds.

The writer estimated the duration of the meteor as 9 seconds—probably a little over rather than under. The velocity of this body was, therefore, about 8½ miles per second.

It is somewhat noteworthy that there is apparently either one long continued radiant of meteors from the region near the radiant of this fireball (216½ – 6¼, as found by my computation), or else there are many streams giving similar radiants from April 7th to May 29th. Eleven separate deductions of meteor radiants since 1841 have the same R.A. within a radius of 6¼° (the average), whilst the Dec. S. is – 7° (average). I had formed an independent opinion that there was either one long-continued radiant here or many separate streams from my own observations. But I am indebted to Mr. Denning for the total number of radiants found in this part of the heavens since 1841.

Leeds, June 17. **David Booth.**

[30083.]—In reply to Mr. David Booth (see letter No. 30,004, English Mechanic of 7th inst.), I should like to state that, from a personal observation of a magnificent meteorite which passed over East Ham (Essex) parish church on Sunday evening, May 15, 1887, the following suggestions have occurred to me:

(1) That, generally speaking, so-called shooting stars and luminous meteors do not fall to the earth, but that they leap over or clear the earth, as it were, and pass on their way into interplanetary space.

(2) That their luminosity is not an indication of combustion, nor of their destruction by atmospheric contact.

(3) That, so far as regards proximity to the earth, there is no material difference between their initial and vanishing distances.

(4) That their distances should be reckoned, not by an atmospheric distance, but by lunar distances, which could be approximately ascertained by the position of the cone of the earth's shadow.

(5) That when shooting stars cover about 60° of the midnight or evening sky, they travel a visible course of 6,000 miles in about ten seconds of time, hence their velocity in space approximately exceeds something like thirty times that of the earth in her annual journey round the sun.

Evidence is not wanting to support the above suggestive propositions, if we merely look upon those meteorites and cosmic dusts which touch the earth's surface, as matter gone astray, or quantities too small to be taken into account.

Hitherto the heights of shooting stars have been approximately measured by the conjectural height of the atmosphere; hence seventy miles has been presumed to be the height of the highest of them, the supposed reason being that, when interplanetary bodies become luminous in the sky of night, they become so through ignition and almost instantaneous destruction, caused by contact with the terrestrial atmosphere. But as the remarkable sunsets and sunrises, with their extraordinary "fore- and after-glows," which occurred in 1883 (the very same year in which the great volcanic eruption of Krakatoa took place) were evidences that the height of the atmosphere which surrounds our globe has no permanent or stationary limit, but that it is subject to considerable, and sometimes extraordinary, fluctuations. We can undoubtedly infer that neither the conjectural light nor the actual height of the atmosphere can be criterions, so far as regards the distance of aërial bodies which assume luminosity whilst merely passing through the dark shadow which constitutes our terrestrial night.

In passing, it may be worth while to observe that the year 1883, in which the phenomenal coloured skies and volcanic disturbances occurred, would be midway—or, more correctly, the centre of time, as it were—between the great shooting-star showers of 1866 and the coming great shooting-star showers of 1899. It therefore comes within the range of possibilities that extraordinary fluctuations in the height of the terrestrial atmosphere may be due to abnormally great, if not periodic, influxes of interplanetary matter, which, by virtue of some attractive forces, tends to superficial terrestrial disturbances of a volcanic and gaseous nature. But presuming such influxes of matter take place, such matter must, according to Roche and Maxwell, crumble into dust within, and as far out, as two and eleven twenty-fifths of the earth's radius; therefore such matter cannot assume the form and luminosity of shooting stars, but descends to the earth's surface as nuclei of rain or hail or snow. But we approach ground much nearer to the subject when we remember that the radiating points of shooting stars are not peculiar to a single constellation, but occur to many, and as these radiating points are not, so to speak, governed by the shooting stars themselves, but by the positions of the cone of the earth's shadow, it becomes worth while to consider whether we cannot make the canopy of night perform more parts than one. Hitherto, it has practically been regarded but as a dark screen upon which meteoric displays take place; but would it not act as a better guide than the terrestrial atmosphere, and account in a more satisfactory manner for the varying distances, the velocities, the varying volumes, and the varying degrees of luminosity both as regards time and light of all meteoric bodies? As well as giving some reasonable basis for the interval of about 33 years, that occurs between the grand shooting-star showers, whose apparent radiating points are covered by the constellation Leo.

As the earth's shadow extends into interplanetary space in the form of a dark transparent cone, beginning with an initial diameter of about 8,000 miles and ending in a small narrow point close upon 860,000 miles away, there can be no doubt but that the capacity of this shadow is sufficiently great to enwrap within its folds all aërial bodies that may happen to cross the evening, the midnight, or the morning sky at the distance, or double the distance, or treble the moon's mean distance from the earth. Hence it is inferable that there is more room for accuracy in measuring the elevation of meteoric bodies by lunar distances which are known than by atmospheric heights which are unknown.

As meteoric bodies exist throughout all interplanetary space, and most probably throughout all interstellar space also, there can be no doubt but that they pass through the earth's shadow at all distances, the only consideration being whether they come within a visible range at all distances within the shadow so as to assume the aspect of shooting or falling stars.

Now, a visible range would require one or many conditions: (1) a night sky; (2) luminosity, self, or otherwise; (3) the greater the distance the greater the volume, otherwise less intensity of light.

If the moon ceased to fall towards the earth, and began rapidly moving away into space, it is obvious that her apparent size would soon begin to diminish, until, in the course of time, she would appear but as a faint star. If she accomplished the journey of, say, about four hundred millions of miles, she would become telescopically visible only, and then perhaps but as a small luminous object somewhere about the apparent size of a dew-drop.

On the other hand, if, instead of moving away, she became subject to some process of decay, and her present diameter decreased from over two thousand miles to about ten miles diameter, she would then appear to an observer upon the earth's surface but as a planetary star, and her brilliancy would hardly excel, if equalling, that of a shooting or falling meteor of, say, the first magnitude, as those meteors which travel about 60° across the sky of night.

Inferentially, if shooting stars enter our midnight sky at a distance from the earth equalling that of the moon, they must possess diameters of many miles, in order that their luminosity should come within a visible range. If they enter the sky at double the moon's distance, and are visible, their light will appear less brilliant than when they enter at a single lunar distance. So that it becomes almost a certainty that the varying degrees of luminosity, which is one of the most characteristic features of shooting stars, is due, not so much to varying volumes and varying diameters, but to varying distances.

It may be perhaps of great import to remember that at the moon's distance from the earth meteoric bodies crossing the sky of night would have a course of about 6,000 miles, providing they cut through and travelled horizontally through the central portion of the umbra of the earth's shadow. And at this distance, even according to Roche's limit (see Prof. Darwin's lecture in a recent issue of English Mechanic), meteoric masses need not necessarily be in a gaseous or vaporous condition. If, therefore, we consider them to be in a state of solidity akin to the large lustrous meteoric stones which have reached the earth, and if they are as luminous as a shooting star of first-class magnitude, the questions arise, From whence comes this luminous capacity? And with what diameters must they be possessed? To display and throw out such intense brilliancy through 240,000 miles means diameters many times larger than shooting stars are credited with. To travel 6,000 miles through the shadow of night in 10 or 12 seconds of time means a velocity in space exceeding thirty times that of our earth in her annual journey round the sun. Here we seem to have some basis towards accounting for the 33 years' intervals which have taken place from the time of Humboldt's South American observations in 1799.

Lustrous bodies, such as meteorites, constantly basking in the sun, continually absorbing solar light, rushing through space at the rate of sixteen thousand millions of miles in a terrestrial year—are they to be dimmed by a passage of twelve seconds of time through a planetary shadow, tempered with refracted light? Great indeed must be their absorption of light, and proportionately great must be their power of remitting light. Hence we may assume that shooting stars and meteorous substances need not necessarily assume a vaporous, gaseous condition for the special purposes of illuminating the terrestrial heavens.

At four hundred and eighty thousand miles away, or two lunar distances from the earth, luminous meteors would only have a course of four thousand miles, and in consequence thereof they would not only appear less brilliant than if they were at a single lunar distance, but they would cut through the shadow of night in less time, and they would not only appear but vanish also at a considerably higher altitude. Still less lustrous and shorter the journey of those which pass through the shadow at three lunar distances, as their visible course would be but two thousand miles, and the time occupied in their journey about three seconds. At four lunar distances meteoric bodies would be in the full power of the solar rays, and far beyond the apex of the shadow. The apex at its distance of eight hundred and sixty thousand miles describes a diurnal circle in space exceeding five millions of miles, consequently any aërial body passing adjacent to, but within this distance, would, if it pass through the terminal points of night, become luminous, but only for a moment, as, notwithstanding the narrowness towards the apex as the earth's shadow moves in a contrary direction to that of the earth, it also moves in the same direction as the shooting stars themselves, at the rate of sixty miles in a second of time, thus allowing, to some extent, a larger field for meteoric bodies to pass, and through this field they pass, evidently, instantaneously, disappearing almost as suddenly as they appear, high up towards the zenith.

Hitherto, these instantaneous vanishing meteors have been assumed to be falling in a direct straight line towards the earth, and in consequence thereof their luminous trains have been supposed to have been hidden from the observer by the falling body itself.

When a single meteor appears it is obvious that it will appear of greater brilliancy, of greater volume, and apparently of greater duration through its isolation, as it were, than when a vast number of brilliant meteors swarm the heavens for successive hours, akin to those which happened during the grand displays of 902, 1799, 1833, and 1866. Now, of these four displays, according to all published accounts of them, the best were those of 902 and 1799. The monks of Tunis were the observers in the earlier instance, Humboldt during his South American trip was the observer in the latter, and the records of both observations describe the number of shooting stars as infinite, "scattering themselves like rain to the right and left." Hence it would seem that a southern position is better than a European one for observations of this description, because a greater field of the earth's shadow would be there obtained during the fall of the year. This is clearly a proof that it is an error to estimate meteoric elevations by an eccentric standard, such as a fluctuating atmosphere.

The brilliant meteor which travelled over East Ham parish church was first observed moving across the sky like a star shot from the eastern firmament. Its conduct was akin to the meteor observed by Mr. Booth at Leeds, and by Mr. Ward at Belfast, on May 29 last. It appeared as a yellowish-white globulous light, and continued for some seconds as such, until it apparently arrived at about two diameters of the moon below the red star Aldebaran; it then, with lightning-like rapidity, changed from white to red, grew dim, changed again from red to a green and purple sort of haze, and then, in an instant vanished, just as though it had entered into or had been swallowed up in the depths of Taurus.

Now, the constellation into which it had apparently disappeared was some considerable number of degrees above the horizon, and the meteor therefore gave one the impression that it had leaped over or cleared the earth, and had passed on its way into interplanetary space, its natural habitat, from whither it had apparently come, and that its disappearance was not due to any kind of atmospheric influence whatever, but to the simple natural process of passing from the initial or terminal shadow of night into the domain of direct solar light.

Its variations of colour also tend as evidences to the continuity of form and conditions, and that the meteor was merely subject to a successive but rapid action of the various divisions of the solar spectrum as it emerged from the fringe of our evening sky. The green and purple haze was either an optical effect produced by instant transmission of a lustrous substance from one condition of light into that of another, or else produced by suspended aqueous matter in the regions of the atmosphere between the vanishing meteor and the observer.

It is with a considerable degree of hesitancy that I forward on these views to the "E.M." because I am well aware that if they escape that proverbial basket which is presumed to be ever-present at the feet of the Editorial chair—well, the little attempts at—may I use the phrase?—at astronomical calculations which I have made will receive, from the readers of "Ours" who are interested in these matters, that attention—I mean censure—which they so richly deserve. Nevertheless, I am confident that I am—yes—right; that the textbooks are, well, open to correction. Hence this letter.

38, Boone-street, Lee, Kent. **Wm. Cowan.**

WHERE DID THE RAMPART OF SCHILLER COME FROM?

[30084.]—All over the lunar surface we see as conspicuous features the circular sunk plains with raised rings, so well known to selenographers as "Craters and ring plains," and which have for so long baffled all attempts at explanation.

As a main feature in the surface modelling they are as important as they are mysterious, and so far we can trace no true analogy to them in terrestrial geology. It is true that among the smaller forms in this vast series we see some resemblance to the "craters" of our volcanoes; they have sunk *floors* with raised rings round them, though they are never found, like ours, on the summits of cones of eruption. But among the larger forms, such as Archimedes, an eruptive or explosive origin is generally considered unlikely, and in such cases as Pythagoras—nearly 100 miles in diameter—as quite impossible. Yet the singular features which characterise this vast series, from, say, Messier, 9 miles in diameter, up to Bailly, 148 miles, are of such a special and peculiar nature that it appears impossible to attribute their formation to two such distinct, or rather opposite, causes as aqueous and igneous agency. Many of them are obviously incomplete and either dilapidated or else incompleted forms; but among the more regular ones we see very clearly the following features:—A, a circular or sub-circular form; B, a floor more or less depressed below the outer surface; C, a very conspicuous and general absence of tilting up or dip; D, the presence invariably of a raised rampart, or ring, which not only closely fits the edge of the excavation, but what is more singular still, follows any abnormal irregularity of figure.

There are other subsidiary features held in common by the entire series, which help to demonstrate that all are due to one cause. Many and various have been the attempts to solve the mysterious origin of these unearthly forms. At first they were considered as due to volcanic action of some kind; but as telescopic power increased and scale was better realised, it became evident that the "walled plains"—and later on the "ring plains"—could hardly be due to volcanic forces. Walled plains are now more generally looked on as related to the maria (or seas), and the difficulties of classification, where the series is so evidently complete, into aqueous and igneous origins, is well seen in Neison's "Moon" (pp. 54 to 64) by all who try to tabulate the series from it.

One of the first things to arrest our attention in seeking for a clue as to their origin, is that all circular-sunk plains have distinctly raised rings around them. There seems to be no case of a plain 20 to 50 miles in diameter, sunk 3,000ft. or 4,000ft. deep, that obviously has no ring. This is a peculiar and most important feature, and it points most unmistakably to a structural relationship. Naturally we are at once led to ask what it means.

(1) What is the sunk plain? How has it been excavated, and where has all the material gone to?

(2) What is this raised ring? How has it been raised, and where has all its material come from?

The importance of these questions is realised as it gradually dawns on us that possibly the ring may in some way have been derived from the central excavation.

To some observers this conclusion may seem more or less obvious; to others not so clear. It may appear more likely that both the sunk plain and raised ring are due to *vertical* movements of the crust alone; a downward in the central area, and an upward in surrounding country. But the difficulties by this view seem enormous as we scan the vast series, especially when we notice that the raised rampart always borders the depression so as to leave no wide irregular berm between, and at last become insuperable when we observe that the raised portion closely follows abnormal irregularities of plan, as in Schiller and Hainzel, &c.

In Schiller we have a vast irregular sunk plain, 112 miles long by 60 wide, "the interior nearly level," and sunk some 4,000ft. "with steep, well-connected walls, of very unequal height," some 12,000ft. above the inclosure, and 8,000 above the outer plain (in places), a form which looks precisely like a huge boot-track in thick mud. In Hainzel again the depression is pear-shaped, and the rampart follows the irregularity of figure quite unmistakably, so that independent and opposite vertical movements of the crust over such vast areas, and with such regularity of figure in most cases, seems out of the question as a solution. We are driven, as it were, to look on the ring as due to lateral displacement of surface material, taken from the excavation. If this is so, we not only see where the excavated material has gone to, and where the ring material has come from, but a good reason for the association of the two forms, and also why the ring so accurately fits the border, whether regular or irregular in plan.

In presence of such a vast and complete series of peculiarly unearthly forms, it seems unwise of us to minimise their salient features simply because we can find no true analogy for them on our earth. Our persistent endeavours to solve all by strictly *terrestrial* phenomena alone must end (like those of a savage in one of our great exhibitions, with nothing but his own standards to guide him, i.e.) in bewilderment. In other words, we need, as Darwin has pointed out, *speculation* combined with our observation.

But to return to our "sunk plains." One of the first features to strike the student about them is their remarkable *horizontality*. Despite minor inequalities, such as craters, cones, and ridges, they are so level in the main—so free from the conspicuous dip seen commonly in our sedimentary rocks—that the point is most noteworthy, especially so on a globe supposed to have been surfaced largely by volcanic agency.

Practically, we may look on these floors as having once been all liquid contours; indeed, Nasmyth and Green have suggested molten lava lakes all over the surface (poles included!), and Neison thinks the walled plains "related rather to maria" (or seas), the "mountain rings" being "closely allied in some ways to the walled plains," and ring plains (or great majority of the circular forms), as "connected by nearly insensible gradations with both" maria and true craters! (p. 57); so that there is already a tendency to look on these floors as due to some form of liquid agency.

Some, it is true, are concave, and others convex, the larger walled plains partaking of the normal curvature of the globe, which latter is indeed a powerful argument in proof of liquid origin. But there are at least two weighty objections to the molten-lava theory. Firstly, we can draw absolutely no distinct line of demarcation between lava floored forms, and the ring and walled plains, allied to the maria (or seas). If one is a molten lava lake, now solidified, the others must be also. And *vice versâ*, if the walled plains have been due to water floors (i.e., allied to maria or seas), there seems no valid reason why ring plains should not have had water floors also.

But the weightiest argument against a general surfacing by molten lava lakes is, that nowadays most astronomers (and some selenographers) have adopted the theory of planetary evolution and development. Istead of a final surfacing by intensely heated and volcanic phenomena, they seek rather for evidences of slow and steady refrigeration. Especially so on a (small) globe that is practically destitute of atmosphere, water, and conspicuous colour. Thus the supposition that the *liquid contours* of all sunk floors may possibly have been due to water, now solidified, seems forced upon us.

The question for us seems to be, what this almost universal levelness in the floors means. Is it accidental? or are we to accept it as fair evidence of liquid origin? We cannot well ignore the fact of their being level *in the main*, though often so uneven in detail. But at times, as in Plato, Archimedes, &c., it is almost inconceivable how the surfaces can have been formed, except by some kind of liquid agency, and if lakes of lava are out of the question, there seems to be nothing left to us but water.

It may be asked, "if these floors are soldified water, or frozen lakes, what are the raised rings which seem to have been derived from them?" The answer which is here offered is that these lakes were left for a time as liquid areas, in a slowly glaciating crust, a glaciation which began at the poles in the absence of a dense atmosphere, and thence extended to the equator, swathing the entire globe in snow forms, and necessarily during a low maximum surface temperature. The water vapour arising from these lakes in the ice-sheet could not travel far, in consequence of the absence of atmosphere and low temperature, and thus piled around the margin as snow, forming the raised ring while also lowering the floor level. In this way, it is urged, the transfer of material took place from the sunk inclosure to the raised ring, and it would also account for the latter so closely bordering the former, no matter what its size or shape, as in Schiller. But there is a peculiarity in the floors which adds weight to this view, i.e., on them we often see other and smaller ring-plains precisely like the larger ones. These secondary *rings* (often of large size and with deep floors) have obviously been formed out of the *floor material* of the primary, and thus demonstrate (a second time) that floor and ring materials are identical. The floor material of No. 1 ring has been taken up and transported laterally all round to form ring No. 2—no easy job to imagine, if both were of solid stratified or igneous rock. This has been effected by means of a heat vent, or quasi-volcanic orifice, opening under the main floor after its refrigeration, which would melt out a circular area as lake No. 2, and enable vapour to be given off to form ring No. 2. If this new orifice opened out under the main ring of No. 1, it would melt out a segment (as we often see) and lay its own smaller ring complete, as Faraday or Stöfler. These secondary rings would become smaller and smaller as secular temperature became less, and if a main orifice persisted (intermittently) over vast periods, the decreasing rings would be laid concentrically one within the other, as in the *undeformed*, *terraced* ring plains like Tycho, at last the floor would become finally refrigerated, and any aqueous vapour thence given off from the orifice would pile as the great central cone of snow, and as a true "cone of eruption."

The above is necessarily the merest outline to indicate how the rings (presumably) are derived from the water floors, ere these latter solidified.

Three main objections have been raised against the above view: 1st, the question of temperature; 2nd, that ice vaporises, and would form an aqueous atmosphere; 3rd, that snow peaks and ridges of 20,000ft., are inconceivable.

With regard to the first, Lord Rosse's results *re* temperature are now shown to be probably erroneous, by the Allegheny researches. Both Prof. S. P. Langley, of Allegheny, and C. A. Young, of Princeton, have published their beliefs that the maximum lunar surface temperature is exceedingly low, possibly as low as freezing mercury. With regard to No. 2, a reference to Ganot's "Physics" will show that at very low temperatures, ice will not vaporise, even in vacuo. Lastly, *re* No. 3, we should recollect that gravitation on the moon is but ⅙th of ours. That terrestrial ice at the moon would weigh less than cork to us, and that probably only the basis of the lunar rings and ranges would be compressed to ice. But lunar snow in falling would pack down or pile up far more lightly than ours, under ⅙th our gravitation (lighter than feathers or fluffy cotton), a cubic inch of ours probably equalling a cubic foot of lunar snow in actual mass. Thus the vast snow ranges and peaks would be of an almost inconceivable levity to us, judging by terrestrial standards. They would rise into an airless void, at a maximum temperature of, say, *minus* 50° or 60°, and could not be stirred by the faintest breath for tens of thousands of years; their feathery summits and surfaces would also necessarily appear to us as hard solid rock like ours, though whiter. But it is not supposed that these vast snow peaks and ridges are eternal; physical change is obviously, if slowly, going on. The greater brilliancy of all rugged and inclined surfaces—cliffs especially—would indicate that at perhaps long intervals, avalanches removed the surface layers at such places, and with them the stain due to meteoric dust, which would accumulate on, and darken, the levels and maria as we see.

The latest views regarding the elevation of terrestrial mountain ranges seem to be that they are mainly due to *lateral thrusts*, caused by subsidence of large areas on either side of a line—of weakness rather than to *direct upheaval alone*. But neither view will apparently help us to explain the mysterious origin of the vast and complete series of lunar circular forms, apply them how we may. The formation of such a ring as Archimedes by either lateral or vertical pressure seems out of the question.

We seem driven to the conclusions that—1st, The ring has been derived from the excavated inclosure;

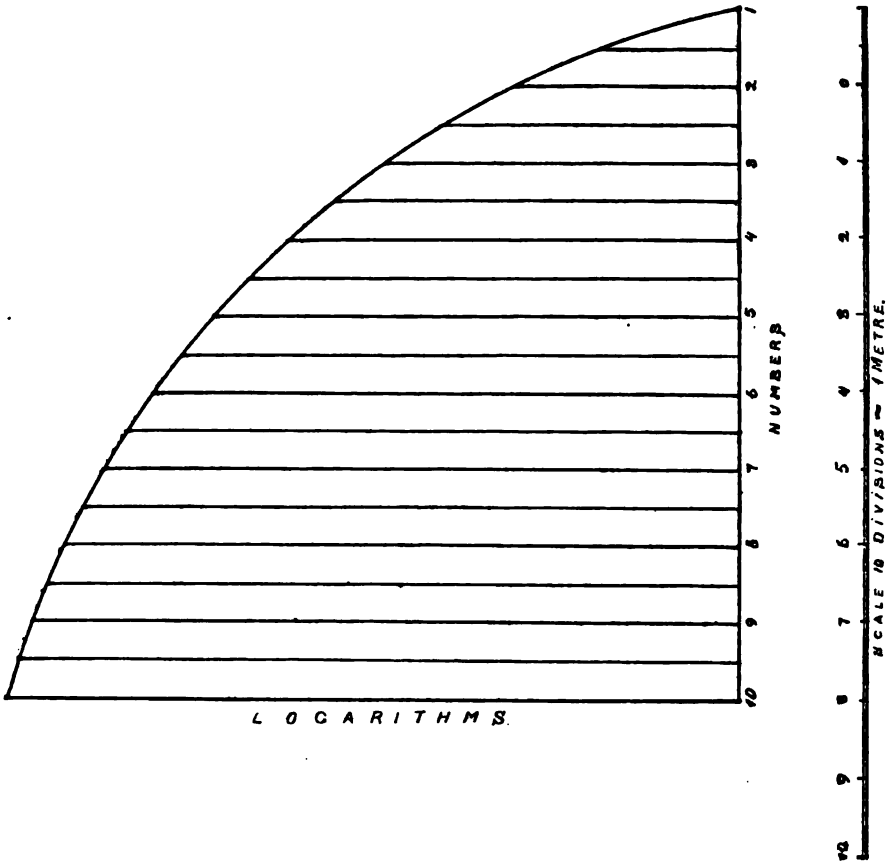
2nd, that these latter sunk and level floors have formerly been liquid areas, probably lakes of *water*; and 3rd, that the rings must in consequence be formed of snow.

Sibsagar, Asam, May 6. **S. E. Peal.**

LOGARITHMS.

[30085.]—It occurs to me that a diagram like the inclosed, only on a larger scale, and with more subdivisions, might be a good way of using logarithms. The horizontal line contains the numbers, and the vertical lines the logs., which would be found by looking out the logs. of the numbers in a table, and applying them to a scale of equal parts corresponding to the horizontal line. Having a diagram completed in this way, the required log. of a given number would be found by measuring the vertical line belonging to the given number. If the scale were made a mètre long, it might carry 1,000 divisions. I should like to know whether any of your readers have seen such a diagram.

A Loggerhead.



THE "ROLL CALL" TOBACCO PIPE.

[30086.]—As tobacco smoking has taken a deep root among the social habits of the people of this and other countries, it must be a matter of some importance to have a pipe which will effectually separate the poisonous and irritating nicotine from the smoke that is inhaled: while the fragrant aroma of the tobacco is retained. Such a pipe, which has been named the "Roll Call," is described below.

In a suitable receptable, B, forming an extension of the mouthpiece, a capillary absorbent roll, C, is introduced, which, when screwed into its place, fits into the cavity A. Through this roll the smoke must pass, which, acting as a steam-trap, absorbs the nicotine-laden steam contained in the smoke. The result is a sweet smoke, and an absence of nausea, a cleaner pipe, and one that needs neither scraping, steaming, nor brushing.

The moisture which all tobaccos contain more or less, is converted into steam by the act of smoking. In ordinary pipes, and most patent pipes, the steam is partly condensed in the stem of the pipe (or in some chambered receptacle in the same), forming a viscid, oily liquid, some of which congeals as it cools, and this clogs up the smoke passages, making the pipe keen and otherwise unpleasant.

The inventor of the pipe under notice claims that the objections named, and many of the objections urged against smoking, are obviated by the use of this pipe, and also that, properly made, it is the coolest and sweetest, the most luxurious, and least troublesome pipe in the market.

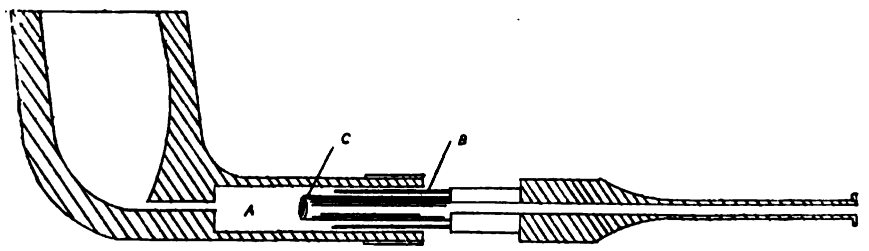
The pipe is made of briar, with vulcanite mouthpiece, and mounted. It can be made of any material of which pipes are made. The following are amongst some of the advantages possessed by this pipe:—

1. It can be smoked in any position.
2. It is economical, as all the tobacco is smoked up, and the last whiff is as pleasant as the first.
3. It is the least offensive to other people, as there are no burnt fumes of nicotine to taint the breath or fill a room.
4. The roll acting as a steam trap, steam is prevented from entering the mouth, consequently a cool, though not over-dry, smoke is obtained.
5. The smoke entering the mouth free from any poisonous irritant, the saliva may be swallowed with impunity, and with beneficial effects rather than otherwise.

From this it follows that the habit of spitting, so disagreeable to other people, is reduced to a minimum.

The price of the rolls is almost *nil*, as 25, or sufficient for more than 100 smokes, may be had for one penny. The pipe and the material employed are both patented, and are sold at a very reasonable rate, as may be seen in the Sale Column.

65, Pike's-lane, Glossop. **Allen Dewsnap.**

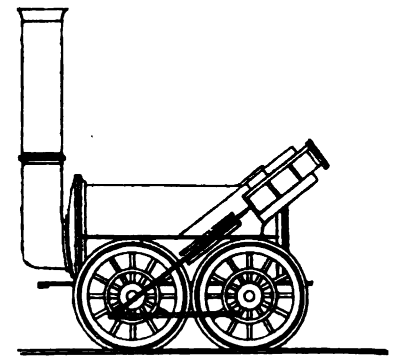


A is a cavity in the bowl-stem. B a tubular receptacle attached to, and forming part of, the mouthpiece. C is the absorbent roll through which the smoke passes.

LOCOMOTIVE HISTORY.

[30087.]—The annexed illustrations form three important links in the chain of ancient locomotive history.

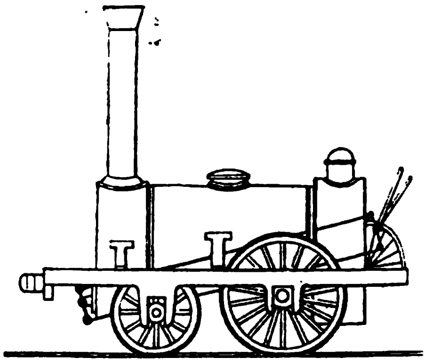
The "Lancashire Witch" was a four-wheeled engine, built by Stephenson for the Bolton and Leigh Railway, 1828.



"Lancashire Witch."

Cylinders, 9in. diameter; length of stroke, 24in.; diameter of wheels, 4ft.; heating surface of flue-tube, 66sq.ft.

The "Mercury," No. 11, built by Stephenson for the Liverpool and Manchester Railway, December, 1830, was a development of the "Planet" type, having the frame placed *above* the driving axle.



"Mercury," No. 11.

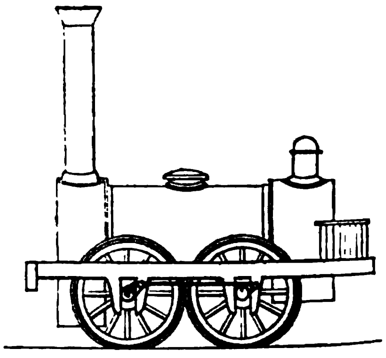
Cylinders, 11in. diameter; stroke, 16in.; driving wheels, 5ft.; wheel base, 5ft. 3in.

The "Mercury" became a standard pattern of four-wheeled engine in this country until the introduction of the "Patentee" type in 1834.

The "Samson," No. 13, and "Goliath," No. 15, were two powerful "goods" engines, specially constructed by Stephenson and Co., for the Liverpool and Manchester line, January, 1831.

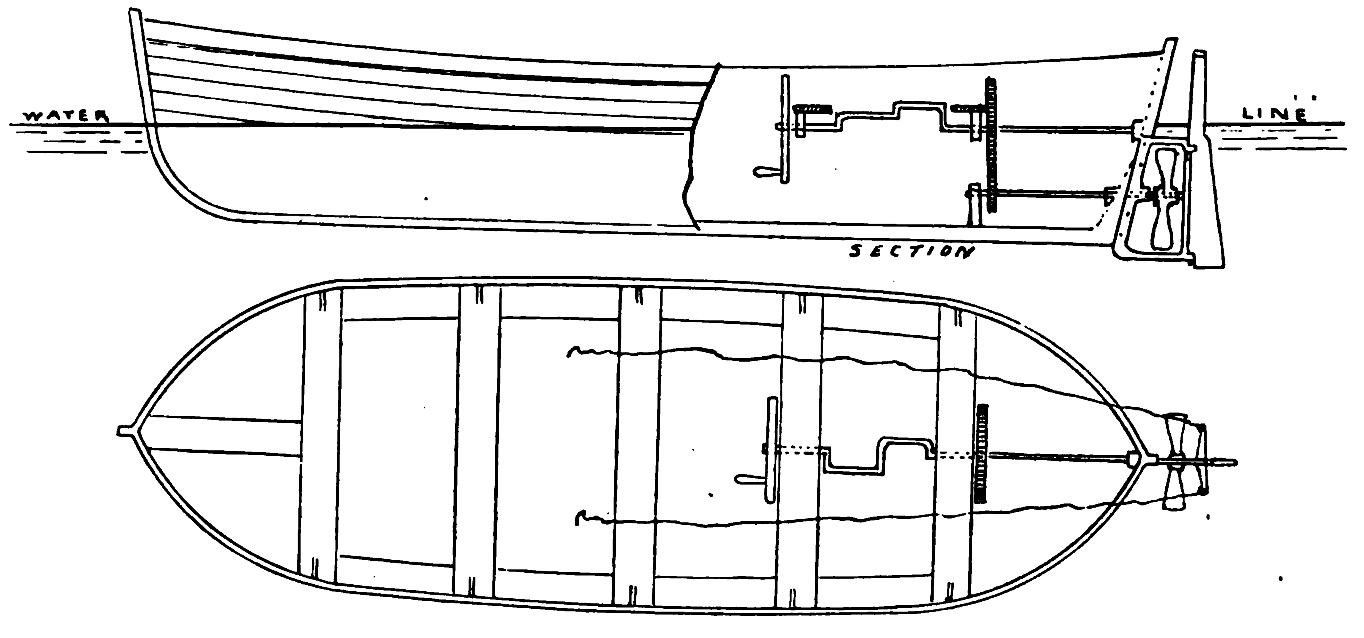
Cylinders, 14in. diameter; stroke, 16in.; wheels, 4ft. 6in. diameter; heating surface, 457·10 sq.ft.; wheel base, 4ft. 9in.; weight of engine and tender, full, 14 tons.

The "Samson," in Feb., 1831, took a train of goods, weighing 164 tons (exclusive of weight of engine and tender), from Liverpool to Manchester in 2¼ hours.



"Samson," No. 13.

The following table, giving the names of engines



which ran at the opening of this railway, 1830, has recently been discovered, and will, no doubt, be of interest to your readers.

OPENING OF LIVERPOOL AND MANCHESTER RAILWAY, 15TH SEPTEMBER, 1830. ORDER OF PROCESSION AND NAMES OF DRIVERS.

Name of Engine.	Driven by
Northumbrian	George Stephenson.
Phœnix	Robert Stephenson.
North Star	R. Stephenson, Senr. (brother of George).
Rocket	Joseph Locke.
Dart	Thomas L. Gooch.
Comet	William Allcard.
Arrow	Frederick Swanwick.
Meteor	Anthony Harding.

Glen Magna, June 17. **Clement E. Stretton.**

THE FADING OF WATER-COLOUR DRAWINGS.

[30088.]—I HAVE recently read with much interest an account of the discussion which took place some time ago with regard to the fading or non-fading of the water-colour drawings in the Museum of the Science and Art Department, South Kensington, and I therefore beg to forward you a little suggestion which has occurred to me. In painting with water-colours artists use common water, and as common water always contains a number of substances—such as iron, silicate, and also varies greatly in composition as to hardness and softness—might not these substances have some effect on the paints used? Therefore, if artists used perfectly pure distilled water—such as is used in chemical and other laboratories—and which does not contain any of the above-named impurities, it seems to me it might give the colours a chance of lasting longer.

I have never tried the experiment myself, but I think it would be well worth trying.

I should like to hear the opinion of some fellow-reader of your valuable paper in regard to this subject. **James Bowie.**

Stapenhill, Burton-on-Trent.

ORNAMENTING IRREGULAR SURFACES, &c.

[30089.]—"NAMWEN'S" request escaped me. The work referred to by "F. A. M." was hollowed out by means of an internal cutter-bar with revolving cutters of varying radii, the use of the slide-rest, dial-plate, and a little manual dexterity. Other shapes can be effectually hollowed out by aid of the eccentric and oval chucks. "F. A. M." asks three questions: the full answers would necessitate a pamphlet, which Mr. Evans is no doubt (?) preparing. Messrs. Birch and Co. have this year brought out a dome chuck of new construction, and very far in advance of any which I have previously used or seen; this doubtless will be described in the "pamphlet," if not I will endeavour, on my return home, to make a few remarks thereon if you care to have them. **C. C. E.**

MANUAL PROPELLING SHIPS' LIFE-BOATS.

[30090.]—THIS sketch shows a scheme for working a screw in a lifeboat 22ft. long, by hand instead of oars; it consists of a 24in. diam. propeller, fitted to run in a wrought-iron stern frame which is bolted on to the keel and stern post of the boat; this is driven by a spur wheel working in a pinion upon the counter or propeller shaft, at a speed of 120 revs. a minute.

Some of the advantages to be obtained are facility and despatch in starting the boat when close alongside of a ship, also the clear space left for stowing passengers, provisions, &c., and developing the full manual power expended.

The simplicity of turning the two-throw crank shaft and handle in flywheel—employing three men—can be performed by any able-bodied person in the boat, where rowing in a choppy sea requires an experienced hand. All the appliances are simple, sure of action, and inexpensive, and may be attached to any existing lifeboat.

Having fitted a similar arrangement to sketch in a 16ft. sea boat, by individual exertion I obtained a speed of 2½ miles an hour from a 20in. fine-pitch propeller, going 108 revs. a minute. Three men working the screw shown in sketch could easily maintain a speed of five miles an hour. The steering can be done by hand lines from cross-head upon rudder.

Considering the short time available to get boats clear of vessels sinking through collision now so frequent, any improvement in means for saving life becomes of importance. **H. Casebourne.**

Carr House, West Hartlepool.

BEST SHOES FOR HARNESS HORSES.

[30091.]—I SHOULD much like a description of the improved "Charlier" shoe Mr. H. Wilkins recommends, and also, if possible, result of a fair trial of the "Selwyn" shoe. The idea is certainly novel, and worth investigating. What strength would you suggest the steel band to be, and what width? and would you prefer it to taper off at heels, or only go as far back as a ¾ plate? Where are they to be had? Have you known of their being tried? I have been experimenting this spring, and will give you result. Light-built mare, running out all winter without shoes, brought up for about three weeks at Christmas, and on recommendation of farrier, because her hoofs were almost worn to the toe-vein; had her lightly shod; ran her out again until end of March, keeping light shoes on her. I find her hoofs have grown a little, but decide to go on shoeing her, her hoofs keeping in first-rate order, carefully avoiding paring sole or frog.

Another heavier-built brougham or van horse, had out all winter without shoes, brought up in spring and put to gentle exercise, still unshod in hope of hardening him to roads, granite and sandstone setts in the town and macadamised outside. His hoof had grown well, and presented a solid wall-like surface to the ground, the frog being long and supple, of indiarubber-like character; but we found they did not grow as quickly as they wore, and we ran him lame in about three weeks, and had to have him shod with the "Charlier" shoe, and so far think that style of shoe is a success.

I have seen a short description of a nailless shoe, but do not know anything about it. I also note that Mr. Jeffery recommends one, but he does not describe it; but from his description I take it it is worth examining. **Dimraid.**

THE Geologists' Association propose to organise an excursion to the volcanic regions of Italy during October next, in which ladies may take part, and to which F.G.S.'s will be specially invited.

REPLIES TO QUERIES.

◆◆◆

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[68493.]—**Gaiffe's Medical Chloride Silver Battery (U.Q.)**—Unscrew the cover and remove indiarubber band. Unhook the zinc and silver plates, and with a brush clean out the holes at the top. Hook on new plate of zinc or the old one well amalgamated. Hook on new plate chloride of silver, putting between new plates eight new pieces of blotting-paper. Replace indiarubber band. Dip plates only into solution of chloride of zinc, 20gr. to ounce of distilled water. On no account wet cover or interior of vulcanite cell. Cell begins to work ten minutes after it is made, but must be short-circuited for a few minutes. They are a constant source of worry, and are gone out of fashion for medical purposes. J. D. H.

[68531.]—**Brighton Railway Engines.**—In No. 68531 the particulars of Epsom should be 464, Epsom, rebuilt 1882. C. F. DENDY MARSHALL.

[68531.]—**Brighton Railway Engines.**—Mr. Marshall has put a query mark beside 484 Solent, and I presume he is uncertain as to its name. I believe it is the *Glynde*, not *Solent*. Also 404 is a six-coupled goods tender. I do not know if there is another engine with the same number.

W. E. C. B.

[68554.]—**Railway Accidents.**—Down Irish mail at Abergele, engine No. 291, name Prince of Wales; up Irish mail ran into the river at Tamworth, engine 279, name Stephenson, L. and N.W.

LOCO.

[68570.]—**Clock Dial.**—The dial is made of brass, and has been formerly silvered. The silver is all worn off, and I want to resilver it again. What I want to know is, What chemicals have I to use to silver it again?

COUNTRY CLOCK DRESSER.

[68612.]—**Flattening Wood for Fretwork.**—Thanks to "Nun. Dor." The question was asked on behalf of a lady who can have the help of no machinery, and had reference only to such thin boards—say, ¼in. thick—of American walnut, and sometimes other woods, as are purchasable from those who supply amateurs. These are scarcely ever level, and sometimes badly warped. To be helped to any simple effective method of flattening them would be a favour. L. C.

[68630.]—**Punching Brass, &c.**—As the only answer I have seen to this query will help "South Australian" very little if, as I suppose, he is a novice at press work, I beg to offer him the following:—A screw press is the right thing for cutting out and punching the holes; screw should be 1¾in. to 2in. in diameter, and have a quadruple thread. This will give the requisite quick blow for a moderate stroke of the arm. The lever on the top should have an iron ball about 5in. in diameter. The press will stand on a bench, and can be worked sitting. Numbers of these presses can be had cheap of brokers in Birmingham. To make the die, proceed thus: Get a forging made of iron, faced on one side with good shear steel; it should be about 2¼in. square (or size suited to the press bolster) and ¼in. to ⅜in. thick. After filing up, mark out on the steel side the size of the blank you wish to cr then carefully drill a row of holes all round within the lines, and with a small chisel cut out the centre. When drilling, let your die rest on a bit of wood slightly thicker on one side than the other, so that when the hole is made, it will be a little larger at bottom than top. This will save you labour in filing. Having got out the centre, carefully file the hole to your marks at the top, and about $\frac{1}{16}$in. wider at the bottom—that is, if your hole is 1⅛in. at top, it should be 1¼in. at bottom. Finish the cutting-edges both inside of hole and on face nicely with a dead smooth file or emery cloth, and then harden and temper to a deep straw or light brown. After hardening, if you want your blanks cutting very clean, your die will be all the better if its edges are rubbed up with a small oilstone slip. To make the punch, fit a suitable blank, faced with steel, to the press, and file up the end true and flat, and fit it carefully until it will nearly go into your die, but not quite. Now, with a small, sharp chisel take a thin shaving off the face of the punch up to about ⅛in. of the edges. Now put the punch into the press, and see that the bolt works tight and true. Fix your die into its bolster, and carefully adjust it to the punch, and make it fast. Put a little oil round the edge, and then, if your work is properly done, a light pull of the press handle will force the punch into the die, and you will have a pair of tools which will cut tissue paper, and which will be ready for your sheet brass. Bear in mind that for this class of work the punch should *not* be hardened. If made as above directed it will cut many thousands of clean, sharp blanks, and the die will be uninjured. To punch the small holes, proceed in the some way, reversing the blank against the gauge. If time is an object, both holes may be done at once with a "peg punch." If you want directions for making this, write again. You would do the inscriptions best probably with a small drop-hammer or stamp. This you might easily make. Turn a wooden pattern about the size of an ordinary sledge-hammer, and make it with a flange about ¾in. square at each end. In each of these flanges, at opposite sides, cut V-shaped notches, so that the hammer can slide up and down between guide-bars. In one end of the hammer get a wrought-iron eye cast, and in the other a hole about an inch square and 2in. deep, in which to fix the tool. It will be all the better for a slot hole cast across the top of it, to insert a drift to get the tools out with. You can make guide-bars of a couple of pieces of flat or angle iron screwed to pieces of wood. How long these will need to be will depend on your work. Should say 3ft. will be ample. Fix the guides over a block or strong bench, with a pulley on top for a cord to lift the hammer. This can be done either by the hand or with a stirrup for the foot, and when you get your dies in position, a little practice will soon tell you what height your hammer needs lifting to give the impression you want. WM. TAYLOR.

[68643.]—**Faulty Steam Gauge.**—How can anyone do more than guess what is the matter with the steam-gauge unless he has the opportunity of examining it? If it has acted well, why loosen the two screws? The chances are that the water is lost, or possibly the gauge may be worn out, for such things do not last for ever. M.

[68651.]—**Sand Blast.**—The sand-blast patent has, I believe, expired, and "Glass Decorator" can therefore use it. Fully described in back volumes, and necessarily in the specification at the Patent Office. M. B.

[68656.]—**Boiler.**—Here is a funny query. Someone wants to make a boiler to stand a pressure of "about 120 or 130lb.," and does not know how to calculate the power of the engine it is to supply. Surely "Launch" had better get someone to make a boiler and guarantee it, and he can easily calculate the "power" when he has the dimensions of the cylinder, the number of revolutions, and the pressure of steam. Several sketches of boilers have been given in back numbers. B. C.

[68657.]—**Sympathetic Snail Compass.**—All humbug; what do you think? Similar things can be found in the daily and weekly press, especially in those organs which sneer at science. But why did not the querist write and inquire of the editor of the publication referred to? But that is immaterial: he would have been as wise as he is now. KAUSTOS.

[68659.]—**Midland Engine No. 3.**—Possibly this engine has been illustrated (save the mark) in previous Nos., but if there is anything special about it a "picture" would no doubt be sent by someone. C. M. P.

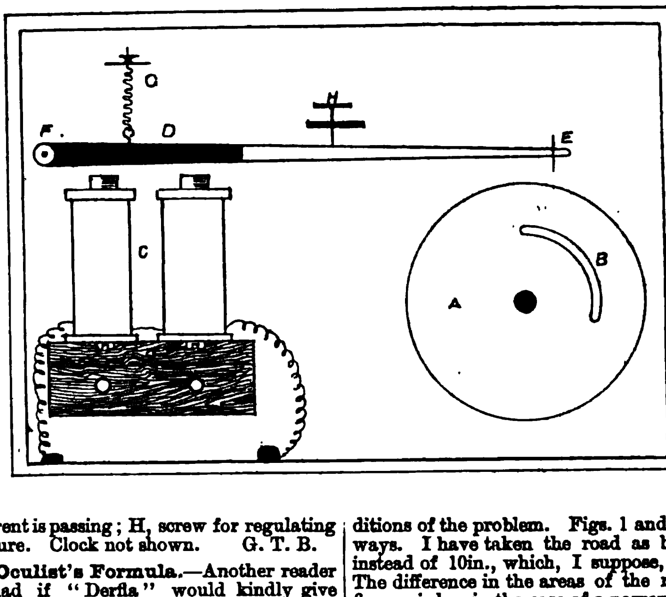
[68669.]—**Stereo-Metal Dross.**—"R. B." can find a method of clearing his metal in back volumes—notably in the articles by Mr. Davies, who seems to have dropped out of these columns lately. See p. 247, No. 947. J. C. T.

[68676.]—**Chameleon Weather Glass.**—Most likely some preparation of chloride of cobalt; but really as this is one of those things that can't interest many, I think the querist might experiment for himself, or procure the specification of the patent, and then he will have all about it. S. P.

[68681.]—**Preservation of Copper Boilers.**—All that need be done is to keep them dry. They may be smeared over with a "wipe" of clean fat mixed with a little whiting. S. P.

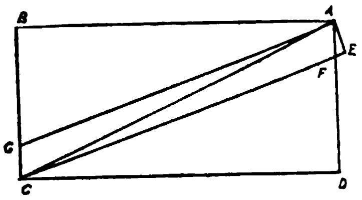
[68686.] — **Overhead Motion.** — Is not "H. E. W." aware that "overheads" of various patterns have been frequently illustrated in this paper; or does he imply that those are incapable of doing "real work" in iron and wood; or what is it he does mean? Surely he does not think that the Editor would find space for such an article every time someone who does not read the paper asks for dimensions of the shafting and all other parts, and so on. "H. E. W." should see Vol. XXII., in which he will find a lot about overheads; but they have been frequently illustrated. A. M.

[68689.] — **Electrically-Recording Anemometer.**—I have spent a considerable amount of time (and I am glad to say with some little success) in designing and making apparatus for transmitting the readings of meteorological instruments to a distance, the vane and barometer included, for the anemometer named. I should fix a stud with a platinum tip in, say, the ten-mile index wheel, so that this would make a good rubbing contact over each revolution of the wheel, with a spring also tipped with platinum and insulated from the case of instrument by a wood or ebony block: connect one binding-screw with the metallic part of the anemometer, and fix the other on the base of the spring named; if the insulation is good a current will pass only when the stud is touching the spring. The recording instrument may be cheaply made by taking the movements out of one of the cheap timepieces; the dial and hands are not required. Fit on the hour-hand spindle a narrow drum, say 9in. in diameter, which may be of wood. I made mine out of a tin-lid and soldered it to spindle; make a long slot in the drum where it comes opposite the winding square, to pass the key through for winding up. Take off the pendulum rod, and fix on or lengthen same, so that the clock will revolve the drum once in 24 hours instead of 12. A paper band divided into 24 equal parts is placed on the drum to receive the record. Over an electro-magnet fix an armature carrying a point or pencil, so that when contact is made the pencil will tap the paper on the drum and make a dot, and each dot will represent a ten-miles reading of the anemometer. By replacing the paper every day a good record may be kept. The sketch will explain. A, drum; B, slot in same; C, electro-magnet; D, armature; E, pencil; F, pivot for carrying armature; G, spiral spring to keep armature from magnet when no current is passing; H, screw for regulating fall of armature. Clock not shown. G. T. B.



[68759.]—**Oculist's Formula.**—Another reader would be glad if "Derfla" would kindly give the information mentioned — i.e., describe the "Dioptre" system, show how to convert into inches, and to find focus of glasses. L. C.

[68796.]—**Mensuration Problem.**—"J. C. Q.," in his solution to this problem on p. 333, made a fatal error in the following way:—Let A B C D represent the field having its diagonal A C corresponding to the diagonal of the road A G C F, which is a parallelogram. Produce C F to E, and draw E A perpendicular to C E, which represents the width of the road. Then, according to "J. C. Q.'s" reasoning, the length of the road $= \sqrt{CA^2 - EA^2}$. But in the right-angled triangle C E A; the side $CE = \sqrt{CA^2 - EA^2}$. Therefore, the length of the road = C E, which is manifestly absurd, because, A G C F being a parallelogram, its length must be either C F or G A. I see no way of solving this problem without the aid of trigonometry, when it becomes comparatively easy; but



as I have no tables of the trig. ratios, I shall not attempt it here. W. E. H.

[68796.]—**Mensuration Problem.**—There are two answers to this problem, as the road may cross the field in two ways, and yet answer all the conditions of the problem. Figs. 1 and 2 show the two ways. I have taken the road as being 10ft. wide instead of 10in., which, I suppose, was a mistake. The difference in the areas of the roads in the two figures is less in the case of a narrow road.

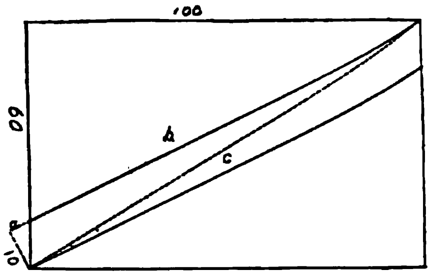


FIG. 1

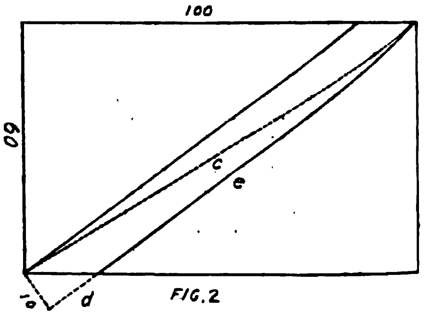


FIG. 2

FIG. 1.

$$a = \frac{6}{10} \times 10 = 6\text{ft.}$$

$$c = \sqrt{60^2 + 100^2} = \sqrt{13,600}$$

$$\text{Also } c = \sqrt{(a + b)^2 + 10^2}$$

$$c^2 = (c + b)^2 + 10^2 = 36 + 6b + b^2 + 100$$

$$\therefore 13,600 = b^2 + 6b + 136$$

$$b^2 + 6b + \left(\tfrac{6}{2}\right)^2 = 13,464 + 9$$

$$b + 3 = \sqrt{13,473}$$

$$b = \text{say } 116{\cdot}07 + 3 = 119{\cdot}07$$

Area of road = 119·07 × 10 = 1,190·7sq.ft.

Area of rest of field = 6,000 − 1,190·7 = 4,809·3sq.ft.

FIG. 2.

$$d = \tfrac{10}{3} \times 10 = 10\tfrac{1}{3}\text{ft.}$$

$$c = \sqrt{13{,}600} \text{ as for Fig. 1.}$$

$$\text{Also } c' = \sqrt{(d + e)^2 + 10^2}$$

$$c^2 = (10\tfrac{1}{3} + e)^2 + 10^2 = 106 + 10\tfrac{1}{3}e + e^2 + 100$$

$$13{,}600 = e^2 + 10\tfrac{1}{3}e + 206$$

$$e^2 + 10\tfrac{1}{3}e + (\tfrac{31}{6})^2 = 13{,}394 + 26{\cdot}7$$

$$e + 26{\cdot}7 = \sqrt{13{,}394 + 26{\cdot}7} = \sqrt{13{,}420{\cdot}7} = \text{say } 115{\cdot}8$$

$$e = 115{\cdot}8 - 26{\cdot}7 = 89$$

Area of road = 89 × 10 = 890sq.ft.
Area of rest of field = 6,000 − 890 = 5,110sq.ft.

ELAG.

[68797.]—**Shunt Machines.**—The following is the proof "Dumbarton Youth" requires of the expression $\frac{r}{r_s^2} - \frac{r_a}{R^2} = 0$, which is given in S. P. Thompson's book on "Dynamo-Electric Machinery" (3rd edition, 1888), on pages 387 and 388.

R = external resistance.
r_a = armature resistance.
r_s = shunt resistance.
r = internal resistance of machine = $r_s + r_a$.

The economic coefficient n is the ratio of the useful electric energy available in the external circuit to the total electric energy developed. By Joule's law there is developed, in t seconds in the external circuit, useful work = $i^2 R t$, and in the same time there is wasted on heating, energy spent in shunt $= i_s^2 r_s t$, and energy wasted in armature $= i_a^2 r_a t$, whence—

$$\eta = \frac{\text{useful work}}{\text{total work}} = \frac{i^2 R}{i^2 R + i_s^2 r_s + i^2_a r_a}$$

$$= \frac{1}{1 + \frac{R}{r_s} + \frac{i^2 r_a + 2 i i_s r_a + i^2_s r_a}{i^2 R}}$$

$$= \frac{1}{1 + \frac{R}{r_s} + \frac{r_a}{R} + 2\frac{i_s r_a}{i R} + \frac{r_a}{R}\left(\frac{i_s}{i}\right)^2}$$

$$\text{or } \eta = \frac{1}{1 + \frac{R}{r_s} + \frac{r_a}{R} + 2\frac{R}{r_s} \cdot \frac{r_a}{R} + \frac{r_a}{R}\left(\frac{R}{r_s}\right)^2}$$

$$= \frac{1}{1 + \frac{R}{r_s} + \frac{r_a}{R} + \frac{2r_a}{r_s} + R\frac{r_a}{r_s^2}}$$

$$= \frac{1}{1 + \frac{R}{r_s}\left(1 + \frac{r_a}{r_s}\right) + \frac{r_a}{R} + 2\frac{r_a}{r_s}}$$

Now $r = r_a + r_s$

$$\therefore \eta = \frac{1}{1 + \frac{R}{r_s} \cdot \frac{r}{r_s} + \frac{r_a}{R} \times 2\frac{r_a}{r_s}}$$

For this ratio to be a maximum, it is clear that

$$\frac{d\left(1 + \frac{R}{r_s} \cdot \frac{r}{r_s} + \frac{r_a}{R} + 2\frac{r_a}{r_s}\right)}{dR} = 0$$

$$\text{Or} \qquad \frac{r}{r_s^2} - \frac{r_a}{R^2} = 0.$$

—BERMUDA.

[68813.]—**Dog-Cart Brake.**—I am much obliged to "The Lydney Dispenser" for his reply on above, but am still in the dark as to virtues of either of the brakes he recommends. I had hoped I might hear result from some of your numerous readers of their experience with them. I find inventors' glowing descriptions as a rule are much more sanguine than experience justifies. I have heard of one, but am unable to drop upon it, that, according to the description, answers the requirement very well, so trespass once more upon your space and readers' indulgence in hope of finding the right thing. What is wanted is an economical and effective brake as easy for driver to handle as ordinary hand-brake in a waggonette, and that does not throw weight on horse's back in two-wheel trap.

DIARMID.

[68825.]—**Dynamo.**—To calculate the best mount of iron and the best form to be used in the construction of the cores for the field-magnets of ynamos, the following facts must be borne in mind: 1. The best working state for a dynamo is when the F.M.'s are only half-saturated with magnetism. Taking 5,000 ampère turns per cubic nch as the saturating point of the very best soft ron, we may take 2,500 as the maximum number f permissible for the very best soft iron. Cast iron alls considerably below this—some brands nearly 0 per cent. 2. Since a body of circular section has he greatest area for the least periphery (Thompson), it follows that the solid cylinder is the best orm to give to field-magnet cores. 3. Since consecutive poles tend to produce an antagonistic or eutral point at the junction, it is well to avoid hese as far as possible. For this reason the modern Edison machine is better and less wasteful of power n this respect) than the Gramme or the Manchester. 4. Since the field is stronger with short electromagnets than with long ones, it is well that their length should not greatly exceed 3·5 to 4 times their diameter. 5. A number of cores bedding into the same pole-piece, each being separately wound, is greatly to be avoided, since the close proximity of the opposing coils of wire acts most injuriously and wastefully. 6. Where good wrought iron or very soft "malleable" castings are used for the construction of the F.M. cores, a very fair proportion between the weight of the iron in the armature and that in the field-magnet cores may be taken as 7 to 1—at least, such is my experience, extending now over nearly ten years. To sum up: Never use consecutive poles. Having constructed, according to the rules previously given, an armature of the size and weight to take the necessary amount of wire, let the F.M. cores have a weight of from seven to eight times that of the iron in the armature. Let the F.M. cores be circular in section, or, at least, as nearly so as possible. Let not the length of the cores exceed four times their diameter. Never use a number of parallel magnet cores of the same polarity, but substitute a single core of equal mass.

S. BOTTONE.

[68830.]—**Cutting Sheet Iron.**—Pay a visit to the Lydney Tin Works and see their method, or take a run to Birmingham and inquire at one of the factories where sheet brass is rolled, or write to Messrs. Rhodes, of Wakefield, for a description of their machines suitable for your purpose.

THE LYDNEY DISPENSER.

[68840.]—**Flat Mirror for Newtonian.**—A 14ft. focus is a very long one for 12¼in. mirror, and it has the disadvantage of having a large focal image when observing the sun or moon. It has, however, also the advantage of having a very small-diameter stellar cone at 12in. from the focus. Taking the diameter of the sun and moon at 32ft., the focal imago is 1·5638, and the diameter of the frustum of the cone whose base is 12¼in., small end 1·5638in., and length 168in., is 2·3271in. at 12in. from the focus; 2¼in. for the size of the flat is no doubt large enough, though there is not much margin. I should certainly not have a larger. This is just an instance in which it would be well to have two flats, as 2¼in. needlessly obstructs the light when looking at stars. The diameter of the cone of rays whose base is 12¼in., and length 168in. at 12in. from the focus, is only 0.875in., so that a 1¼in. flat is amply large enough for all but large objects, such as the sun and moon, and utilises the most valuable part of the mirror. In the ENGLISH MECHANIC for March 23, 1883, p. 61, I gave rules founded on data of "F.R.A.S.," for calculation of focal images by simple figures, and also for the calculation of cones, which "Solar Focus" may like to refer to.

Fordingbridge. T. WESTLAKE.

[68840.]—**Flat Mirror for Newtonian.**—With all due deference to our friends, "F.R.A.S." and Mr. Linscott, I think they give the size of flat unnecessarily large. The light reflected from a mirror is simply a cone of rays having the mirror as its base and the apex its focus. To divert this cone, we intercept it by a diagonal, thereby carrying it to the eyepiece. If a flat is used whose minor axis is larger than the cone of rays, where the flat cuts it, then a portion of light is stopped out from the mirror; but if too small, then a portion of the cone is not diverted. My opinion is this: the diagonal ought to be the exact size of the cone of rays, where it cuts it, and neither more nor less. Any rays falling outside the true cone must be false, and therefore better shut off. A mirror 12¼in. diameter, 14ft. focus, and with the flat placed 12in. within the focal plane of the mirror, will have a diameter of ·875in. at the point, so that a flat 1in. minor axis ought to be ample. With my 12¼in. mirror, 103in. focus and diagonal 14in. from the apex, the diameter of the cone, where the diagonal cuts it, is 1·7in. I find on using a flat 1¾in. in minor axis, taking out the eyepiece and putting the naked eye in its position, I can see the entire mirror reflected in the flat, and when I put a stop on large mirror, shutting off all except ½in. of margin, I get the reflection of this portion in the eyepiece. These seem to support my theory. I give it for what it is worth, and if I am wrong I will be pleased to be corrected.

ECNAL.

[68842.]—**Spring Bed.**—Before going to the expense of any attempt to make this, either see Howe's patent spring bed, or get a drawing of it from Messrs. Heal and Son, upholsterers, Tottenham-court-road, London. I do not know the price they are retailed at; but when I saw the specimens recently I estimated that this admirable little fold-up bedstead could be made, if in large quantities, at 3s. 6d. each. It is very superior to the one figured by "Phos. Bron." THE LYDNEY DISPENSER.

[68851.]—**Cool Shop.**—While lodging at a provision store some years ago in the Quaker City, I remarked to the proprietor how cool the inside of his store seemed. He showed me then the cause. Under the doorsteps of back and front doors there were gratings in which he kept blocks of ice. These gratings he kept charged with ice during the hottest days and nights, which seemed to keep everything within beautiful and cool.

NITRAM.

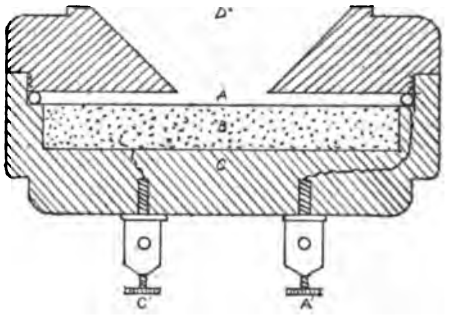
[68851.]—**Cool Shop.**—"Provisions" will have to resort to some more substantial method of driving a fan or air-propeller to cool his shop than wound-up weights or the energy derived from a column of hot air arising from a gas-jet. A ¼H.P. gas, steam, or hot-air engine or turbine would, under any circumstances, be a necessity. I presume he proposes to force the cold air in his cellar into his warm shop. In this case, he must see that there is an ample and direct supply. I should prefer an exhauster such as is made by the Blackman Air-Propeller Co., of Fore-street, London, to a fan, and I have no doubt that that company would send "Provisions" one of their detailed catalogues on application. There would, I think, be no difficulty in branching off the cold air to several points in the shop. So much depends upon local circumstances that only general information can be given. If "Provisions" will communicate with me (see my address in "Wanted"), and give me, say, sketch of shop and cellar, showing walls, doorways, windows, open space from which it is contemplated getting supply of cold air into shop viâ cellar, perhaps I could give him some detailed information, which may not, however, be of special interest to your readers.

Birmingham. HALL.

[68853.]—**Neat's-foot Oil.**—The simplest plan is to buy the clear oil. That is the plan I pursue.

SM.

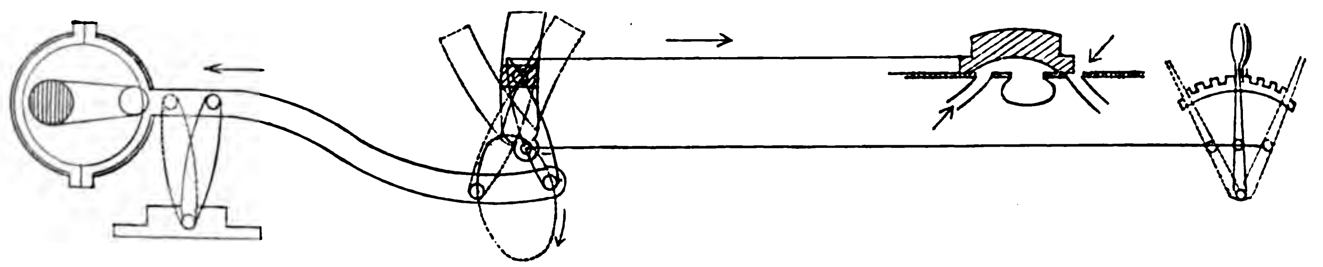
[68856.]—**Transmitters.**—To MR. BOTTONE.—The Hunning's transmitter, as described in the British specification No. 3647, Sept. 16, 1878, consists essentially, as shown in cut, of a circular wooden case, D, in two halves, having the bell-shaped mouth in the upper half. At A is a thin sheet of platinum, clenched at its edges by a ring, but perfectly free to vibrate centrally. To protect this diaphragm from injury, it is usual to place a fine wire gauze or "grid" across the mouthpiece.



At C is a plate of graphite, or platinum, and the space B is filled up with ordinary engine coke, roughly powdered, and freed from dust by sifting. The terminal A' is connected by a wire to the platinum sheet A; while another wire connects the lower plate C with the terminal C'. To these two terminals are also connected the battery and induction coil.

S. BOTTONE.

[68859.]—**Cutting Blocks of Wet Glue.**—I have some knowledge of the making of glue on a considerable scale, but am not aware that any of the large makers have any machine—properly so called—for the purpose of cutting the glue into sheets or cakes. Contrivances for facilitating the process there are, however, some of which I will try to describe. The ancient method was to cut the contents of the coolers into cross sections, or blocks, cold water being run upon the top of the congealed mass, and the thus separated blocks were then lifted out and placed upon a table. A steel wire stretched in a frame after the manner of a bow-saw, the wire hammered flat and filed, so as to have one sharp edge, was then drawn horizontally through the block of glue, the workman's aproned breast forming a stop to the wire. The required thickness of cake was regulated merely by this man's finger and thumb. It was surprising how rapidly a practised hand could cut glue in this way; but as each cake had to be lifted off by a boy immediately it was cut, there was considerable loss of time. A simple improvement upon this "holds the field" in some important factories to-day. It consists in providing a number of light wooden frames, the inside dimensions of which are a little larger than the blocks of glue to be cut. The thickness of the frames regulates that of the cakes of glue. Those frames—six or eight, more or less—being placed one above another, are deftly lifted and placed over the block of glue upon the table, when the cutting wire, as before, is quickly drawn between each frame, and through the inclosed block of glue which is thus sliced into as many cakes. The frames are then as deftly lifted off in a piece, and placed over another block laid down in readiness and similarly treated to the first, which is meantime being snatched away cake by cake by boys, and laid upon nets to dry. This plan, properly organised as to division of labour, is a rapid one.



Another method adopted by a large manufacturer is as follows:—The contents of a cooler previously loosened, but not cross-cut, is turned out entire upon the middle of a long table. The coolers, and consequently the blocks, are 6¼ft. long by 9in. by 6in., or thereby. The table has upon its surface two longitudinal grooves 11in. apart; the block of glue is placed between those grooves. A box consisting of three sides only—viz., a bottom and two sides, without ends, and about 2ft. in length, is made of such sectional dimensions that the edges of the sides, when the box is turned bottom up, fit loosely into the grooves in the table, and it can be slid freely along without touching the glue block. Notches are made in the ends of the sides of box, at such distances apart as the cakes are required to be in thickness. The operation is performed by sliding the box to one end of table, placing the cutting wire or knife in the uppermost notches of the front end, then pushing the apparatus along over the block of glue, the wire entering the soft substance and cutting it as it is pushed along. Upon reaching the further end, the wire is shifted into notches one degree lower down in the opposite end of sliding box, and the latter pushed back to the starting end, so making another cut, and so on, until the block has been cut into the number of sheets fixed upon of the requisite thickness, when the whole are cross-cut into shorter lengths to form cakes, by means of a knife pressed downwards through all the sheets. A squad of boys then lift off the cakes, and place upon nets, while another block of glue laid upon another part of the table is being cut up. I hope the above, without diagrams, will be clear to "Glue," and of sufficient interest to general readers.

One Informed.

[68870.]—**Slide-Rest for Gap Lathe.**—I expect the querist is not provided with a bridge to his gap. Is that so?

Sm.

[68870.]—**Slide-Rest on Gap-Bed Lathe.**—If you cannot get the saddle fastened down except at 3in. from the mandrel, perhaps you could shift the fast headstock 3in. in the direction of the gap.

J. M. Wellwood.

[68874.]—**Bichromate Bottle Battery.**—Copper the ends, then solder.

W. Perren Maycock.

[68875.]—**Motive Power.**—"No Sig." has omitted to give the "time" in which it is required to raise 112lb. to a height of 30ft. Without this data it is impossible to get at an answer. The standard H.P. being 33,000ft.lb. per minute, it follows that the above duty could be done in a minute by ·911H.P. I cannot quite see the drift of the latter part of the query. It seems to me like asking what H.P. duty a "pawl" or "detent" is doing, when a weight has been raised (say, 112lb. to 30ft.) and is supported there by the "pawl" or "detent"; or, supposing this weight has been raised the 30ft. by hydraulic ram, and the pumping having stopped, the weight is held 20 seconds, 20 minutes, hours, or days (losing sight of leakage), what H.P. is being exhausted in the act of holding the weight for the respective periods.

Birmingham. Hall.

[68877.]—**Plaster of Paris.**—There is no practical difference between the various forms of calcium sulphate. Why not try the effect of heating the set plaster?

Sm.

[68878.]—**Lightning Conductors.**—It is now an open question whether it is necessary to be so particular as formerly regarding the resistance to E. of a conductor. A conductor having 1w. R. to E. was considered in good order: now, I very much doubt whether it is of much consequence if its E. resist. be 10w. or even 20w. It seems certain that in future iron will be used in place of copper, paradoxical as it may appear. While Dr. Lodge's views are still "sub-judice," I must forbear to express any definite opinion.

W. Perren Maycock, A.I.E.E.

[68879.]—**Accumulator.**—E.M.F. = 2 volts. Roll up your spiral with white felt interleaved, or any thick fabric not containing cotton.

W. Perren Maycock.

[68881.]—**Link Motion.**—The great fault of both Stephenson's and Gooch's link motions is the inequality of the lead at the various points of cut-off; and though Allan has corrected this fault, he has only done so at the sacrifice of simplicity. Another weak point, shared by all three inventors in their gears, is the numerous levers and joints driven by two eccentrics, requiring constant lubrication, and soon wearing slack nevertheless. In spite of these drawbacks the oscillating links have held their ground hitherto; but signs are not wanting that engineers are at last about to abandon them for simpler and more effective gears. Joy, in recent years, made a great step in advance with his improvement of Hackworth's sling-link, and it is surprising that his gear is not more extensively used, at all events in vertical and inverted engines, to which it is better adapted than to the majority of horizontal engines having the valve chests at the sides of the cylinders. Probably there is some prejudice against employing the connecting-rod instead of an eccentric to work the gear. Acting on this supposition, I have designed a single-eccentric reversing and expansion gear, sketch of which I append. Besides a constant lead, this gear has the advantage over the ordinary link motion of fewer moving parts, and the saving of price and space of an eccentric. The sketch shows the slotted link (a modification of the Hackworth-Joy sling-link), held vertically by a rod from the reversing lever, and pivoted on its centre to a standard or to the slide. In this position the valves move to the amount of lap and lead only. The direction of the engine and the cut-off are determined by the inclination given to the link by the reversing lever.

C. L. R.

[68888.]—**Bicycle Spokes.**—To Shakespear, Dresden.—I don't know the shop method, but I should proceed as follows: (1) Strike out, full size, a circle representing the inner surface or inside of the rim of the wheel; (2) a circle outside the first one, and at a distance from it equal to thickness of metal at the bottom of the rim; (3) circle same size as the hub—all three circles, of course, from a common centre; (4) measure the distance from circle No. 2 to circle No. 3—that will be the length of spoke from the under side of the head to the beginning of the screwed part. If you have a screwing tool to fit in the square chuck of your lathe, you may fix a stop, or stop the bottom of the tool up so that it will not screw beyond a certain point; or you may hold it in the vice in a position equal to the length of thread required, and take your screw-plate down till it just touches the vice, or you may count the revolutions your screw-plate makes in screwing a standard spoke.

Birmingham. Hall.

[68891.]—**Magneto Machine.**—To Mr. Bottone.—The bobbins for a magneto machine having a 6in. magnet should have cores ⅝in. in diameter, 1¼in. long, with thin iron flanges top and bottom 1½in. in diameter. The space between the flanges should be filled in with No. 28 silk-covered wire. This will require nearly ¾lb. (12oz.) of wire. For details of mounting, &c., see my "Electrical Instruments for Amateurs," section 63.

S. Bottone.

[68893.]—**Wet-Plate Photography.**—From the fact of your pictures not being fogged you may infer that the light in your dark room is of the right colour, so the fault lies elsewhere. If you will carefully follow the instructions I give, I think you will succeed. 1. See that you are using good, fresh collodion, of a pale straw colour. 2. Let your silver bath be made up as follows:—

Nitrate of silver	30 grains.
Distilled water	1oz.

This is at the rate of 600 grains to the pint. Collodionise a perfectly clean plate, and stand it in the bath for 12 hours in the dark room. This will saturate the bath with iodide of silver, and prevent pinholes. Add one drop of nitric acid to each pint of bath. The developing solution for positives should consist of:—

Ferrous sulphate	120 grains.
Water	8oz.
Glacial acetic acid	2 drachms.
Alcohol	2 drachms.

Do not use cyanide of potassium for fixing, but make up a solution of:—

Sodium hyposulphite	4oz.
Water	10oz.

Now as to the actual taking of the picture. In order to practise so as to be quite sure of what results you ought to get with a given light, you must proceed in a methodical manner. Which are you using—a portrait lens, or a view lens? If the former, let your sitter be placed out of doors against a dark background (a dark grey workhouse blanket does very well) facing the north. Let him or her have on a dark jacket and white collar. Focus very carefully, until you can distinguish clearly the eyelashes and the pupils of the eyes. Replace the cap. Remove the ground-glass screen, place in the dark slide. Now take a quiet observation. Is it sunshine, with a clear blue sky overhead?—then give six seconds exposure. (Not six as fast as you can count, but about eight beats of your pulse). Is it a fine day, no haze, but no sun?—then give 10 seconds exposure. Is it a dull day with a covered sky, but still no haze?—give 30 seconds. These exposures are for a good collodion, and between the hours of 10a.m. and 3p.m. in the summer months. Supposing, however, you are using a view lens with a stop $\frac{1}{16}$th the focal length, or *f*/16. Then, in full sunshine, you may give five seconds in the shade, or shaded subjects 10 seconds, and on dull days 15 to 20 seconds. Now as to development. Go into your dark room and see that you have all at hand. Pour out the measured quantity of developer (into a clean measure, mind), have your water close at hand, close your room carefully, open your dark frame, and, taking up the plate by the same corner that you collodionised it in the left hand, flood it evenly with developer. Now watch it carefully, holding it all the time quite level. If properly exposed, the picture will appear almost immediately. If a portrait, fix your attention on the face and specially on the eyes. As soon as you can see the face distinctly, flood the plate with water, and rinse off the developer. The dark jacket should show very little greyness by reflected light, looking almost as if it were the unchanged film, while by transmitted light the folds that catch the light should be marked by a slight deposit. The eyes should show quite clearly. It is better to over-expose a little in these positive pictures than to under-expose, provided the water be dashed on immediately the picture is out. If the picture is under-exposed, it develops slowly, the high lights, such as the collar, the forehead, come out first and attain very great density, so that looking at the plate by transmitted light—i.e., looking through the plate—they appear very black indeed; but the shadows are very heavy and there is no detail in the black jacket or the hair. Any attempt at pushing the development only results in dulling the shadows with a spangly deposit of silver. On the other hand, if the picture is very much over-exposed it starts out altogether like a flash, is all very poor and thin, the face looks very flat and shadowless, while the black jacket is greyed all over. If the experimenter tries successively six plates, given respectively 5, 10, 15, 20, 25, and 30 seconds exposure, he will get a better idea of what correct exposure means than pages of written description can give him. The picture, after being developed, should be well washed in a gentle stream of water, and then fixed with the solution recommended above until all trace of blue iodide has disappeared, and the deep shadows (the black jacket, &c.) show nearly as clear glass. This operation may be performed in daylight, as soon as the plate has once been flooded with the fixing solution. After fixing, another and very thorough washing must take place, and must be continued until a drip from the plate, allowed to fall on the tongue, tastes like pure water, without any sweetness. The plate should then be quickly dried before a bright red fire, and when quite dry, and nearly cold, varnished with amber in chloroform, or amber in benzole, on the collodion side. The picture looks brighter and whiter if now blacked on the plain side; but if it is necessary to show the objects in their natural position, the Brunswick black must be poured on the collodion side.

S. Bottone.

[68895.]—**Accumulators to Drive ½H.P. Motor for One Hour.**—The following calculation may assist you in coming to a conclusion. 1H.P. is equal to 746 watts; therefore, ½H.P. 373 watts. One of the best ½H.P. motors with which I am acquainted requires 10 cells of the T type of accumulator to drive it well. Since each cell can give 20 ampères, at 2 volts, this is equal to 400 watts or a loss of 7½ per cent. in conversion of electricity into motion. Now, the most that a man can do in the way of driving a dynamo is about $\frac{1}{10}$H.P., or, 75 watts. An ordinary hand dynamo for lighting would only give 3 or 4 ampères at 20 volts pressure; but this would hardly do for charging the above cells, as they require a charging current of 18 ampères. Supposing, however, that the dynamo were wound specially to give this current, with only 3 or 4 volts pressure, the time of charging, so as to get 1 hour's discharge, would be nearly 5 hours. As to charging by chromic-acid cells, we must remember that each cell of accumulator requires an E.M.F. of 2·5 volts to charge it, so that 10 cells = 25 volts. 13 chromic-acid cells would give this if coupled in series; but, for safety's sake, 14 or 15 should be used. The current given by these cells on the short circuit is over 24 ampères (if the plates are about 4in. by 4in.); therefore, 15 chromic-acid cells, running for little over an hour, would fully charge the 10 accumulator cells. Cost of 15 cells, home-made, say, 3s. each = £2 5s.; cost of charge for 15 cells, say, 3lb. chromic acid at 7½d. = 1s. 10½d.; 3lb. sulphuric acid at 3d. = 9d.; total, 2s. 7½d. This charge would run the battery for 3 hours. Zincs, 4d. per pound.

S. Bottone.

[68897.]—**Constant Current Batteries for Medical Purposes.**—No really constant-current battery is available for medical purposes, because they are generally required to be carried about, and portability and constancy are almost incompatible. The most convenient for carrying about is certainly the "Victoria" Leclanché. But this runs down in about 20 minutes, but soon recovers itself. The most constant for home use is certainly the Daniell; the most generally useful the chromic-acid cell with lifting elements. One of these is as powerful as four ordinary Leclanchés.

S. Bottone.

[68898.]—**Engine Query.**—The whole of the question is one on which leading marine engineers hold conflicting opinions. For my part, I cannot see what difference it can make after the engine has made a revolution.

Bristol. T. C.

[68899.]—**Engine Driving.**—How can the condenser bother you in finding the H.P. of an engine? The gauge shows the vacuum in the condenser, and by doing away with that amount of resistance to the exhaust virtually adds that amount to the pressure in cylinder, as compared with a high-pressure engine. Find the H.P., then, as for high-pressure engine—viz., by taking the mean pressure and area multiplied by piston speed, and divide by 33,000.

Bristol. T. C.

[68902.]—**Tire Bending.**—Three rollers forming a triangle is the machine used for this purpose. When the querist has made several patterns, several machines, &c., then "He that Don't now Know" how to do it will have found out that he could have purchased a machine ready to hand at many times less than his failure has already cost him. Try Rhodes, machine maker, Wakefield.

The Lydney Dispenser.

[68906.]—**Tricycle Rattling.**—Look at the left side of the front wheel axle. If there is a milling round the edge of cone, slacken the nut outside the fork, and turn the milled cone till it is tight, then turn it a quarter-turn back; tighten the nut outside the fork up, and I think your wheel will be right.

W. W. W.

[68909.]—**Piston.**—The junk ring has nothing at all to do with the water collecting in the cylinder. The fault is likely in the boiler; perhaps you have not enough of steam space, and the steam in issuing from the boiler carries a quantity of the water along with it. Then, again, if the boiler is at a distance from the engine, and the steam-pipe not properly lagged, water may enter the cylinder owing to condensation in the steam-pipe.

J. M. Wellwood.

[68912.]—**Lathe.**—If leading screw is three threads, put a thirty-wheel on mandrel; if four threads, use a forty-wheel. (Write Lloyds, of Birmingham, for their list of change-wheels.) Use ten pitch, which will be about 4½in. diameter by 1⅝in. wide; so put the pillars 5in. apart, and have a loose centre to put in end of mandrel to bear against the bar. Wheel about 3in. from head. Use a bolt for gap piece.

Bristol. T. C.

[68916.]—**Model Dynamo.**—To Mr. Bottone.—Not knowing to which type or size of dynamo you refer, I am somewhat puzzled to answer, more especially as you do not state whether it is series-wound or shunt-wound. However, since it runs as a motor, it should act as a dynamo. If series-wound, it must be driven so as to rotate its armature in the opposite direction to which it rotates when acting as a motor. If shunt-wound, it must be driven the same way as it runs as a motor. It may be that the field-magnets have not retained sufficient residual magnetism. To effect this, remove the armature, test the present magnetic position of the poles, and then send a strong current, of pretty high E.M.F., around the field-magnet wires, in such a direction as to confirm and strengthen the existing magnetic polarity. If you cannot succeed, and care to send it to me, carriage paid, I shall be most happy to look at it and tell you what is wrong, gratis.

Carshalton. S. Bottone.

[68918.]—**Copper Wire Gauges.**—To Mr. Bottone.—The following table gives the diameters in decimals of an inch. In conformity with the glorious state of muddle which pervades all the English system of weights and measures, all three are used, and it appears to be quite a matter of option as to which is supplied:—

Number of wire gauge.	Standard.	Birmingham.	Browne and Sharpe (American).
000000	·464	none.	none.
00000	·432	none.	none.
0000	·400	·454	·46
000	·372	·425	·40964
00	·348	·380	·3648
0	·324	·340	·32495
1	·300	·300	·2893
2	·276	·284	·25763
3	·252	·259	·22942
4	·232	·238	·20431
5	·212	·220	·18194
6	·192	·203	·16202
7	·176	·180	·14428
8	·160	·165	·12849
9	·144	·148	·11443
10	·128	·134	·10189
11	·116	·120	·09074
12	·104	·109	·08081
13	·092	·095	·07196
14	·080	.083	·06408
15	·072	·072	·05706
16	·064	·065	·05082
17	·056	·058	·04525
18	·048	·049	·0403
19	·040	·042	·03589
20	·036	·035	·02196
21	·032	·032	·02846
22	·028	·028	·02534
23	·024	·025	·02257
24	·022	·022	·0201
25	·020	·020	·0179
26	·018	·018	·01594
27	·0164	·016	·01419
28	·0148	·014	·01264
29	·0136	·013	·01125
30	·0124	·012	·01002
31	·0116	·010	·00893
32	·0108	·009	·00795
33	·01	·008	·00708
34	.0092	·007	·0063
35	·0084	·005	·00561
36	·0076	·004	·005

S. Bottone.

[68926.]—**Dynamics.**—The fallacy here seems to me to lie in the assumption that if the engines are of unequal power, the more powerful one necessarily does work on the less. This is only true when the speed of the less powerful engine is greater than it would be if it were unattached to the train, and were consuming the same amount of steam on the same road. In this case work is being done on the engine in raising its speed, and it is actually a hindrance. If this speed is the same as it would be if the engine were free, it does not affect the train at all, since it neither expends energy on the rest of the train, nor has work done upon it. If, however, its speed is diminished in consequence of its connection with the train, it must be doing work on the train, which work may be represented by its diminution in speed, or loss of kinetic energy, and in doing this work it lessens that which the stronger engine has to do, and is thus of service in increasing the speed.

H. C. Haycraft.

[68927.]—**Pump Valves.**—Make them 1½in. diam., and use the same size pipes.

Bristol. T. C.

[68934.]—**Electrical Tricycle.**—1. Not reckoning the cost of the tricycle itself, which may be of any pattern, provided sufficiently strong to carry motor and accumulator, we may say—½H.P. motor, £10; ten accumulator cells, T type, £14. 2. Cost of recharging by battery, 3s. 3. Accumulators. 4. Yes, I believe the Act is strictly enforced.

S. Bottone.

[68936.]—**Nickel Crucibles, &c.**—If you will refer to Sutton, you will find that you are directed to use powdered bichromate dried in an air-bath, and not the fused salt. I do not understand your next question about "native state." If what I am led to suppose, it is impossible. In presence of much HCl, H_2S throws down Pb as a red ppt.

Sm.

[68937.]—**Test Solution, &c.**—To "Sm."—The soap test is not of much value, except for soft waters containing little or no magnesia. Get a pamphlet entitled "The Analysis of the Public Water Supplies of England," reprinted from the *Analyst*. You will there learn all about it. Published by J. Davis, 201, Old Kent-road. If you require a solution of $AmHMoO_4$ for pptn. of PO_4, you must avoid the use of HCl. Dissolve 10gr. of the salt in 150cc. AmHo and 150 water, add 150cc. HNO_3 + 150 water, stand till cool, and decant from any deposit. Na_2FeCy_5NO—can't say. Perhaps too much alkali.

Sm.

[68940.]—**The Fratton.**—I saw this engine last summer working the Hayling Island branch. It is a four-coupled tank. I have forgotten the number.

W. E. C. B.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "J. D. H." has replied to 68493.

68365. Prices of Ironwork, p. 161.
68377. L. and S.W. Bogie Engines, 162.
68381. Fire Extinguishing, 162.
68388. Best Quality Crucible Making, 162.
68395. Electro-Magnet, 162.
68402. Incandescent Lamp Stands, 162.
68406. Battery—Bunsens, 162.
68417. Detective Camera, 163.

68632. To Mr. Stretton, p. 248.
68641. Brick Arches, 248.
68648. Setting up Watch and Clock Springs, 248.
68650. Pivots and Pivot Turning, 248.
68665. Weighing Water, 249.
68666. Chloride of Lime, 249.
68668. Surface Condenser, 249.
68678. Foot Lathe, 249.
68679. Harp Lute, by Light, 249.
68683. Boiler Flanges, 249.

USEFUL AND SCIENTIFIC NOTES.

Carbon and Carbon Plate.—Our old advertiser, Mr. George G. Blackwell, of 25, 26, and 27, Irwell-chambers, W., Liverpool, has lately very considerably improved his carbon plant, and is now producing what we believe is the finest carbon plate that can be made, of any shape and size. Agglomerate blocks are a speciality with Mr. Blackwell, as he imports his own manganese, and has fixed special grinding machinery, which, coupled with his carbon plant, enables him to produce in any quantity at the lowest prices.

Royal Cornwall Polytechnic Society.—The 57th annual exhibition of this useful county society is announced to open at Falmouth on September 10th. It will be remembered that during the past three years the society brought together at its annual exhibitions, for the information and instruction of the public, series of exhibits illustrative of the productive wealth of Cornwall and Devon, including, in the first year, rocks, building materials, stones for ornamental and general purposes; minerals, metallic and earthy;—in the second year, clays, including architectural and sanitary ware, fire and ordinary building bricks, and pottery, domestic and ornamental; and in the third year chemical, textile, and general manufactures. There is reason to believe that these several series of exhibitions of local products and industries have not only interested visitors to the Polytechnic; but have also conveyed a knowledge of the productive wealth of the two counties, far and wide, and have led to business being transacted with the continents of Europe and America. The committee, feeling encouraged by the success attending these special exhibitions, have resolved to continue them, and have selected for the next annual exhibition the subject of domestic lighting, to be represented under the following heads:—Electricity, gas, oil, and candles. Medals are offered in the various sections, and it is hoped that a very comprehensive collection will be brought together. The subject to be treated cannot fail to interest all classes, embracing, as it does, every kind of illuminant in ordinary use. In addition to this special feature, the Polytechnic Exhibition will embrace mechanics in its bearing on mining, sanitary, domestic, and general industry; also fine arts, photography, natural history, and all those departments of science, industry, and education, which has marked its long and useful career. Prize-lists, entry forms, and all information may be obtained on application to the secretary, Mr. E. Kitto, The Observatory, Falmouth.

Near Coldbath Fields Prison the outlet of the famous spring has been found that once flowed into the Fleet. Still more interesting is the fact that in carrying out certain building operations near at hand, a portion of one of the wharves along the Fleet banks has been laid bare. The timbers, though blackened by age, were in excellent preservation; and from their size and solidity, it is evident that in bygone days vessels of no inconsiderable size must have been wont to discharge their cargoes at the spot, which is a mile due north of the Thames.

QUERIES.

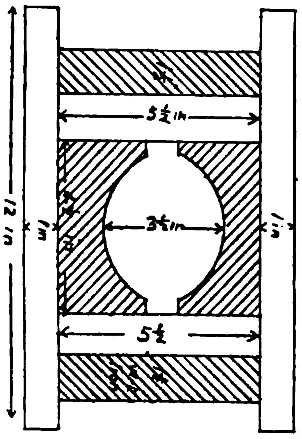
[68943.]—**Staining Terracotta.**—Would any of your readers tell me how to stain terracotta, or similar clay, a dark or black colour? I have some thousands of small articles to enamel, and the clay being a red, it is difficult to stove them quite black without putting on three to four coats. Some dark stain that would penetrate the clay previous would help me much. Any hint will be esteemed.—Dum Spiro.

[68944.]—**Calculating the Moon's Position.**—I thank "F.R.A.S." for his information in his last. It appears, then, that I am in the right way. Now, one more question, and I have finished. Will "F.R.A.S." be so good as to say how am I to find the sidereal time, or R.A. of the meridian of Greenwich? One example will suffice if it be devoid of mathematical intricacies.—Rubic.

[68945.]—**Dynamo.**—To Mr. Bottone.—I have finished the dynamo after your instructions in the "E.M.," and find that the armature heats very much while at work. Is there any remedy for this with this kind of armature? Would building the armature up of punchings, instead of solid casting, answer for long running?—J. B. S.

[68946.]—**Acids, &c.**—Will any of your chemical readers kindly say how a substance may be freed from sulphuric, nitric, carbonic, fluoric, boracic acid, &c.; or give me name of chemical work, detailing such processes—i.e., for rendering a substance to a state of purity.—Student.

[68947.]—**Manchester Dynamo.**—To Mr. Bottone.—Will you kindly give quantity, and gauge of wire for dynamo, as per sketch; also directions for winding, and probable out-put? Can make the F.M. cores larger, if necessary, for incandescent lamps.—H.



[68948.]—**Gaiffe's Chloride of Silver Cell.**—Will Mr. F. W. Mason, or Mr. W. Perren Maycock, kindly give instructions how to fuse the chloride of silver to the silver wire of the above battery? The liquid I use is a solution of zinc chloride, $Zn\,Cl_2$—1 part in 8 of water. Will this be right? I may also add that I use the above solution as a soldering fluid.—Wire Jack.

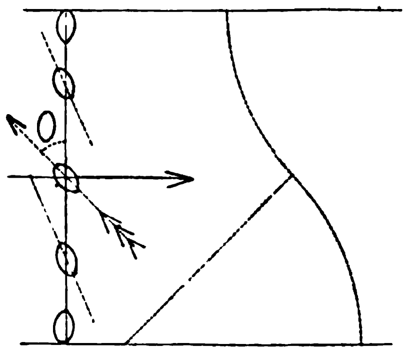
[68949.]—**Wood Pulp.**—In the course of our business we make a large quantity of shavings, borings, and cuttings from moulding and tenoning machines. Would it be possible to reduce these to wood pulp, in which form we could easily utilise them; but at present they are a nuisance. The timber is all pitch pine.—Eureka.

[68950.]—**Brush Dynamo.**—To Mr. Bottone.—Would you kindly give me some suggestions as to the manufacture of Brush dynamo out of a cast-iron ring ¾in. thick, 1in. rim., and 8in. diam., divided into six equal parts. I have had two sheet-iron rings cut out, so that they project ¼ on inner side, and 1¼in. on the outer side. The extra inch is to allow of six grooves, 1in. deep, being cut to wind wire in. One is placed on each side of the ring, and held on by screws, being a substitute for a grooved wheel. I intended to use No. 14 wire, about 1-16in. thick, intending to put two or three layers. Field magnets made of 8 sheet-iron, ¾in. thick, clamped together to form like Jamin's magnets; they are separately excited by three cells, three pint size, driven by hand-power multiplying wheels 1ft. in diam. Tell me best number layers of wire on armature and field magnets, size of wire, and weight on both; whether field magnets will do what your new depolariser is; how the wire is to be wound on—it will be very difficult on armature—what number of lamps I may expect to light; approximate E.M.F. and resistance?—R. J. Brigs.

[68951.]—**Freezing Machines.**—I am in search of a freezing machine for domestic use in a semi-tropical country. Perhaps some of your correspondents could answer me the following queries on the point. 1. Is the ammonia system the best? 2. If so, are small machines to be had worked by ammonia? 3. The names and addresses of makers of such? A machine named the "Arctos" has been mentioned; but I have so far been unable to obtain any particulars as to its construction.—C. W. H.

[68952.]—**Tinning Case-Hardened Articles.**—I have a quantity of case-hardened malleable castings that I want well tinning. My turner in Birmingham tells me that his method of tinning will soften the castings again; and this would make them useless for the purpose required. I should feel greatly obliged if any of your numerous correspondents could advise me where, and by what method I could get this work done? I may say I have fitted up a small apparatus on the Roseleur and Boucher process, as described in Spon's "Dictionary of Engineering," page 1,377. I have used cream of tartar, and proto-chloride of tin; but I do not get satisfactory results. I shall be glad to receive any practical information on the subject.—Caux.

[68953.]—**Differential Equations.**—Some of my little calculus problems seem to attract attention, so I will venture to trespass with one more original one, and will be glad if one or more of the mathematical correspondents will check my result, and give a sketch of their method. At one time I had to cross the Ganges frequently in a small steamer, the distance being several miles in the rainy season. Wishing to find the rate at which the current was moving at various distances from the shore, the boat was made to go in a straight line at right angles to the stream. This can easily be done by watching objects on the shore with a binocular. Now, in order that the boat may move in a straight line, her head must be made to point at various angles (see diagram). If the speed of the boat is b miles an hour, that of the current will be b sin. θ miles an hour. In this way I found that the speed of the current varied very nearly directly as the distance from the shore, and in the middle of the river θ was 45°, or $\sin\theta = \frac{1}{\sqrt{2}}$ The problem then is this:—Given the rate of the boat or b, the value of sin. θ in the middle or $\frac{1}{\sqrt{2}}$. Also given that sin. θ is $= 0$ at the start and $\frac{1}{\sqrt{2}}$ in the middle, and varies directly as the distance from the shore between these points (that is to say, that at any point x, sin. θ will be $= \frac{\sqrt{2}\,x}{D}$ where D is the whole distance from side to side). Then we require to find what is the distance, D, having observed the time, T, that it takes to cross the river, or given D to find T. I find



$$T = \frac{\sqrt{2}\,D}{b} \cdot \frac{\pi}{4}$$

Also show that if the water were not moving, but the boat was going at the same rate and making the same angles with a fixed line as before, the course of the boat would be two half-quadrants of a circle, the radius of which is $\frac{D}{\sqrt{2}}$ (see figure).—M.I.C.E., Bath.

[68954.]—**Eight-Day Clock Brass Dial.**—Will some of your readers inform me how to clean and lacquer the brass dial of my eight-day clock? What is the best acid to use, and what colour to make the lacquer? Also how I am to use it? The figures and name plate also want to be whitened. What is the best way?—W. J. T.

[68955.]—**Barlow Lens.**—Can "F.R.A.S." or any reader give me the following information? 1. How much does a Barlow lens add to the magnifying power of an eyepiece? 2. Does it absorb much light?—what proportion? 3. What effect has it upon definition? 4. Is there any advantage in using it with a low-power eyepiece rather than an eyepiece of a power equal to both? 5. How is it adjusted? Is there a certain distance from the field lens—varying with each particular power—at which it should be placed, or is it put into the draw-tube at random, and allowed to remain in the same position whatever powers are used? 6. What particular kind of work is it most suitable for, and under what conditions and with what powers is it most effective? 7. What is the principle of optics involved in its use? 8. Can it be advantageously used in photographic work, so as to secure a larger field, and if not, why not? In speaking to several amateur observers, I find such uncertainty and diversity of views that I gladly avail myself of the larger constituency your columns appeal to. Of course, careful and judicious experiment is the only correct test; but I presume many of your readers must have tested the Barlow lens in this way.—J. M.

[68956.]—**Electro-Plating.**—I have been electroplating by "Bijli's" instructions, given in "E. M." a short time since, and have now a teapot to plate, but find the inside was not plated originally. What am I to protect inside with, and how is protection to be removed when teapot is finished?—Ball.

[68957.]—**American Organ.**—Will "Organon" or Mr. Fryer help me with my American Organ, now ready for the stopwork? It has four rows of reeds and coupler, placed horizontally, and I intend at some future time to build a second (or swell) organ vertically, therefore I have used a balance key for coupling the two manuals. What I want to know is how to arrange the stop-action over the keyboard, raising the mutes at the end, and the Grand knee movement, not forgetting the action for lifting the octave coupler.—Welshleek.

[68958.]—**Pumps.**—Will some one kindly give me a rule in plain figures to find the diameter of a pump to lift a certain number of gallons?—Water.

[68959.]—**Early Engines.**—Who invented the locomotive seems one of those questions which so far remain unsettled. As to the blast-pipe, for instance, it has been recently stated that the locomotive in 1826 had such a pipe. If that is so, how can it be claimed that it was invented by Hackworth in 1827. Can Mr. West or any reader give an illustration of the Royal George of 1827? It would show if there was, or was not, such a pipe?—Inquirer.

[68960.]—**Arsenic in Sulphuric Acid.**—Will some reader kindly inform me of a ready and trustworthy method of telling the presence of arsenic in sulphuric acid?—Apprentice.

[68961.]—**Soap-Making.**—I have some brown bone fat, and should like to know how to make it into a cheap soap if possible. Can any reader give me a few practical hints as to the manufacture? Would not be against paying a trifle for the information, if reliable.—Fat.

[68962.]—**Bichromate Battery.**—I have been greatly perplexed for the past nine months with a bichromate bottle battery, which I have been making. I got the contact breaker to work freely, but could not connect the secondary coil to produce shock. Would any reader give me connections of same?—M. Louden.

[68963.]—**Filter for Waste Oil.**—Can any reader give particulars of a good filter for waste oil gathered from gas-engine? We have one of Crossley's Otto, and it has more work to do than it is calculated for; consequently we have to flood it with oil—Price's sperm—gathering waste in troughs. It has a fair body, and not a lot of grit or dirt, but we desire to clean it, so it would answer for shafting. What is the best medium to run it through?—R. H. B.

[68964.]—**No Water.**—I live in a town which has a body of men called a local board, and the water-works are under the management of the local board. There are new filtering beds being made at the reservoir, and for that purpose the water is kept very low, so much so that my house is without water sometimes two and three days at a time. The fountain in my kitchen range is supplied by the town water. What I want to know is, if the fountain in the kitchen range should burst or crack from the want of water, would the L.B. be responsible for the cost of a new one?—A Ratepayer.

[68965.]—**Phonograph.**—Will some reader be kind enough to sketch and explain the spring and indenting needle in the latest phonograph?—J. C.

[68966.]—**Edinburgh University.**—Is residence necessary at this university before a degree can be obtained? How many examinations are there to pass?—Inquirer.

[68967.]—**Batteries.**—To Mr. Mason.—Can you give me instructions (in plain language—I do not understand the electrical figures and signs) for making electric light batteries, various sizes, and shapes? I want them for stage use, and consequently portable. Some to light from one to six small jewel lamps, others to light larger ones up to 1c.p. Can I make accumulator batteries successfully and cheaply? Also could I charge them from ordinary batteries? If so, how? The lamps would not be alight more than ten seconds each time, the battery to have a supply for 15 minutes or more. I want them to be as small and simple as possible.—Back-Parlour Showman.

[68968.]—**Optics.**—What is the rule (and the proof of it), for finding the virtual focus of a concave lens, which shall render parallel convergent rays falling upon it? For instance, solar rays are converged by a 3in. diam. lens of 22in. focus; it is desired to convert them into a parallel cylindrical beam of one inch diam. What should be the focus of the concave lens which is interposed in the cone of rays, where they are reduced to an inch in diameter.—Sol.

[68969.]—**Westinghouse.**—Is it necessary, after repairing a Westinghouse brake pump, to adjust the piston valves in any particular position with relation to the main pistons? Any hints on examining and repairing above brake will be gladly accepted.—Norfolk Dumpling.

[68970.]—**Springs.**—Can any reader tell me what kind of sheet metal I could use for a thin spring that is exposed to the weather? I have tried hard-rolled brass and German silver; but these soon perish, while steel rusts away. Has any of our electrical friends tried the electro deposited (burnished) copper we have heard so much about lately?—and would this be hard enough to act as a spring?—Electron.

[68971.]—**Zincs in Gassner's Battery.**—Are the insides of the zincs of these cells made by the patentee amalgamated or not?—M.M.I.Sc.S.

[68972.]—**Locating the Site of Slide-Rest Nut.**—Will one of our readers kindly advise. I am fitting up a self-acting lathe with castings and parts supplied by Milnes, as advertised in "ours." The slide-rest screws and nuts are cut already. I do not know how the nut is attached to top slide, nor how to ascertain exactly its position. There is a stem to the nut that evidently goes into a hole in the plate; but I cannot tell how to locate the position for the hole with that degree of nicety that is necessary. It is palpable that the slightest deviation from the true alignment of inside of nut with screw, must cause the nut to bind on the screw, as the vees would prohibit the slide and nut adjusting to any slight variation.—Work Bench.

[68973.]—**Indiarubber.**—Will some reader kindly tell me how to make such a thing as a glove of indiarubber similar, but a trifle stouter, than the common (children's) air balls before being blown out. It is necessary that it bears stretching without breaking or tearing.—Perplexed.

[68974.]—**Harmonium Reeds.**—I have a harmonium of five octaves compass. The upper three are of sweet tone enough; but the strength of tone of the lower two is out of all proportion to the higher octaves. I have tried lessening the wind pressure, and stuffing the bass notes with cotton-wool; but the result is not satisfactory. Could I substitute two octaves of pipes for the lower notes—or what else could I do? I would not mind some expense to accomplish my object.—T. J.

[68975.]—**Tinning Brass Wire.**—Will some fellow subscriber who has succeeded in tinning brass wire tell me what is wrong in my attempt? I looked in my back numbers, and found a recipe, Vol. XXXVII, page 346, recipe 50,733, and followed it, except that I reduced the quantity as follows. I got half-pound of cream of tartar, half-pound of grain tin, boiled it half-hour in an enamel pan, then I put my pieces of brass wire in, previously well-cleaned. I stirred it up until nearly cold; but no tin came on my brass wire.—J. Hall.

[68976.]—**Defective Finger-Nails and Toe-Nails.**—In a boy about 14 years of age, well in every ther respect, though not robust, the nails appear dented, erivelled, and without polish, and occasionally become lark, difficult to keep, and unsightly. Will some kind eader whose judgment and opinion may be relied on, indly say what is the cause, and how to be restored to ealthy condition.—Beta.

[68977.]—**To Electricians.**—I would like to know he best method of quickly verifying the reading of a voltneter by an ammeter, and to ask opinions on the followng method, which neglects the resistance of both dynamo nd ammeter. Connect voltmeter in series with a delicate mmeter, and note the amount of current taken, multiply his by the resistance of voltmeter; also note the reading n the voltmeter, e.g. resistance of voltmeter was 65·7 hms, ampères taken were ·28, 65·7 × ·28 = 18·39 volts, which should be shown on the voltmeter if it is correct; ut the voltmeter showed 17 volts only. Ammeter esistance was 8·2 ohms, and the shunt dynamo was about 3 ohms, 30 ampères travelling through the lamp circuit at he same time.—Vulcanite.

[68978.]—**Vaccination.**—I have a son, and dread aving him vaccinated. Would some brother-reader enighten me on the following? Shall I have to take him nore than once to be vaccinated? Can I suck the venom ut, or is there some other way of keeping it out of his ystem, or can I get pure lymph to have him vaccinated vith, or if I am summoned and fined, will that overcome he difficulty?—W. W. W.

[68979.]—**Cement, &c.**—Wanted to know how to nake a cement or compound that may be used in a body s thick as a man's arm, that will set in a few hours with ery little shrinkage, that will bear, when dry, a 2in. nail eing driven in without splitting or flawing, that will not e affected by a moderate heat, and that is not too exensive. The colour is of no object. Any information vill be highly appreciated by—One in the Dark.

[68980.]—**Speed of Bicycles.**—Would some reader indly inform me what difference, if any, there would be n the speed of two bicycles, one 48in., the other 58in., if oth were equally started from the brow of a hill, equally eighted, and equal as regards bearings, and whether the 8in., by covering more ground at each revolution, would e first, or the attraction for both being equal, and the iction on the centre of 58in. being greater because of its istance from the ground, the 48in., by making more reolutions, would have the advantage?—Curious.

[68981.]—**Watering Bowling Greens.**—Will any f your readers who are competent to give an opinion lease say if it is desirable to water a bowling green in ry weather? I find many people who say it is not, and he reason they give is, that, if watered, the ground beomes harder, and the grass more readily burnt up. Is his so?—Pica.

[68982.]—**Watch Trains.**—Will "Ex-watchmaker" ive me a few hints on the calculations of watch trains, s I don't understand it? I have seen "Londonderry's" nd "G. W.'s" calculations on watch trains in 1196, but I on't quite understand it, so I should like a few hints n the calculation of trains. Also will you please to nform me what sort of wax is used for wax ferrules? —Young Watchmaker.

[68983.]—**Dynamo.**—I have the carcase of a dynamo, nd I wish to make a Gramme armature for it, 3in. diam., in. long. I should be glad if some expert electrician vould tell me whether it would be better to put two ayers of wire on it, or only one. I should like to light six r eight 10c.p. lamps with it. Please say best size of wire nd weight on armature. Also size and weight which hould be on the fields.—Amateur.

[68984.]—**Parallel Motion.**—I should be glad if ome one would please give me a sketch to scale for model eam engine.—Amateur.

[68985.]—**Stars.**—To "F.R.A.S."—I believe it was in ne of Proctor's works I saw it stated that there are less han 6,000 stars visible to the naked eye in each hemiphere, while in a popular weekly Dr. Dallinger is reported o have said that there are 100,000,000 visible. Did the atter include those visible with a telescope? Concerning he old story of seeing stars in the daytime down a well, was only yesterday told by a man who had recently been own one 110ft. deep, that he dintictly saw them in the iddle of the day with bright sunshine.—Vooght.

[68986.]—**Coupling Dynamos.**—To "Engineer, ovan."—I omitted to state in my query that of the two ries machines I wish to couple, one is a D.P. of 300 volts d 10 ampères, and the other 720 volts and 10 ampères, x and fourteen light machines. As their E.M.F. differs understood that they could not be coupled at all to run lamps each, taking 50 volts and 10 ampères.—Vooght.

[68987.]—**Mongoose and Snakes.**—According to roude, it is now a misfortune of Jamaica that it contains thing to hunt, even the snakes having all been eaten by e mongoose. A generation ago at least two snakes, one ack of about 1yd., and one yellow of about 7ft. long either, I believe, venomous) were very abundant. If the ongoose has even made them rare, might not this animal of great value if introduced into Australia and other ake countries, even India, South Africa, and North merica? There is nothing in the venomous kinds, I ve heard, hurtful to stomachs eating them, and none of em is longer than 7ft., or half so active as the Jamaica e of that length.—E. L. G.

[68988.]—**Brighton Railway Goods Engines.** Will C. F. Dendy Marshall or any other kind reader vour me with a sketch and dimensions of one of the ods engines on this line?—W. E. C. B.

In a village in Somerset the following superitious belief is prevalent. During service in the urch, if the church clock strikes whilst a hymn is eing sung, the belief is that some parishioner will e within the week. So strong is this belief that e striking mechanism of the clock is always opped during services in which hymns are sung.—*otes and Queries.*

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 26, and unacknowledged elsewhere:—

Bricklayer.—Lyons.—Anxious.—Portgordon.—Major.—H. S. H.—O.—Doils Kalphfjda.—A. M. M. A.—R. S. Bruce.—W. Hosken.—S. Bottone.—F. C. Allsop.—Thomas Cumming.—W. F.—A. E. B.—M.—Army Hospital Compounder.—Baker.—M. L. Z.—Cycle Fitter.

W. H. C. (Full details for refilling barometers have been given; but a little experience, at least, is required to do it well. The mercury must be emptied out and the tube cleaned, say with nitric acid; then the bent leg is filled with mercury, and that is by a quick motion jerked over into the long leg. The operation is repeated until the long leg is full, and if necessary (if there is any air in it) the long leg is heated in the flame of a spirit lamp. By all means try and do it yourself, if you have time; but it is better to leave such work to experts.)—G. B. Bennett. (At Portsmouth you ought to have no difficulty in getting lists of books on navigation, as any of the booksellers of that town know what has been published on the subject, and most likely keep the books in stock.)—Phonograph. (We have given all the available details of the phonograph recently, as we gave them some years ago when first brought out.)—C. K. C. (Luminous paint has been fully described—see the indices. Unless you want large quantities it will scarcely pay you to make it, instead of buying; but you can get a sample from Mr. W. C. Horne, 6, Dowgate Hill, E.C.)—Caerleon. (Whatever do you mean? The "dimensions" may be anything you please; but they should be symmetrical. However, dimensions for some patterns of fountains have been given in back volumes.)—Aqua. (Several electromotors have been described even in recent numbers; but as to using it to work a fountain for an aquarium, surely you have not counted the cost?)—Apprentice. (The methods of tempering tools have been frequently given, and are to be found in many of the textbooks. Briefly, the steel is made red-hot as examined in the dark, and is quenched in plain water, which is as good as anything. A bright spot is then filed on it, and the steel is reheated on an iron plate or in some other way, until the desired temper colour is seen, when it is immediately cooled. Looking at the wide-sweeping nature of your query, we must refer you to sundry articles and replies in back volumes.)—St. Augustine. (No doubt the professor would let you have a copy of his paper: he would certainly tell you whether the copies are ready, as would the assistant secretary of the Royal Society. The price necessarily varies with the quantity of matter contained in a paper.)—Dyfi. (See indices. The information required has been given many times. Read Tunmer's "Electricity in the Treatment of Disease," Allen, Ave Maria-lane, E.C.)—Crackjaw. (Would you really try what others might guess? Go to some surgeon and let him examine you; or send the query to Dr. Allinson, *Weekly Times and Echo*, 332, Strand, W.C.)—Thomas Williams and H. Billingsley. (We do not know any other way than by applying to the agents; we do not even know whether phonographs are let out on hire or are sold outright. See Hints, No. 4.)—W. B., Salford. (You want a coil and a battery: otherwise you will want a large number of cells. See answer to "Dyfi" above.)—Walter J. Parker. (You can apply to the Registrar of Births, at Somerset House, giving full particulars; but if you can do that, you can obtain a copy of the baptismal entry from the clerk of the church. The certificate at Somerset House costs 2s. 7d. and 1s. for searching fee; but name and date must be given.)—Amateur. (*All* oil-stoves smell, and especially those of the make you name—at least, that is our experience. You had better consult the maker—at any rate, we cannot engrave a sketch of the stove to accompany your question.)—Dubliniensis. (In type.)

Rupture Sufferers should call at the MEDICAL BATTERY COMPANY'S INSTITUTE, 52, OXFORD-STREET, LONDON, W. (corner of Rathbone-place), and personally inspect Mr. C. B. Harness' valuable Hernia Appliances, which have been so strongly recommended by the medical profession. An experienced and skilful surgeon attends daily, and examines patients free of charge. Pamphlets gratis and post free.

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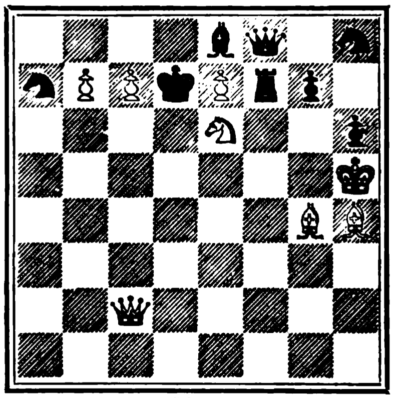
CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLV.—By J. Keeble.

Black.



White. [8 + 8

White compels Black to mate in three moves.

Solution to 1,153.

White.	*Black.*
1. Kt-K 3.	1. K-Q 3 (*a*).
2. R takes P.	2. Any.
3. R-K 6 mates.	
	(*a*) 1. K-Q 5, &c. (*b*).
2. Q-B 6, &c.	
	(*b*) 1. K-B 3.
2. Q-K 8, &c.	

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,153 by J. Bryden (rather pretty, but not difficult), E. Retchford, Fr. Fernando, J. E. Price (only key move), Muzio, W. L. Martin, F. C. Cook (very good, but key move too obvious), and T. A. Pringle; to 1,152 by F. C. Cook, H. G. Walsh, J. E. J. Smith, R. T. Hood, A. Bolus, Muzio, Litho, Othello, and Bernard Green; to 1,151 by Litho, A. Bolus, and Othello.

H. Warren.—Thanks for inclosure.

Othello.—We find solution to 1,151 was duly credited to you.

Mr. Morgan has just added a third volume to his valuable "Shilling Chess Library" in a selection of games from the New York International Tournament just concluded. There are 42 games, and copious diagrams, giving the most important and interesting positions. These games are well worth preserving, especially Blackburne's and Tschigorin's.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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Write for **King, Mendham and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

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Complete **Sets**, consisting of bell, battery, wire, press, &c., packed in box, 7s. Larger size, 8s.

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Gold, Silver, Copper, and Nickel-plating **Solutions**. Practical Hints, 1 stamp.—Henric, 234, Great Colmore-street, Birmingham.

S. Bottone, Carshalton, supplies the following Electrical Books and Apparatus. Invaluable to Electrical Amateurs and Engineers.

"**Electric Bells and All About Them.**" Bottone's new book, post free, 3s. Indispensable to bell fitters.

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"**Electrical Instrument Making** for Amateurs," with 60 illustrations, post free, 3s. Third edition now ready.

Dynamos of the Highest Efficiency, from 15s. to £20; for lighting, plating, cauterising, and experimental [illegible]

A beautiful little **Dynamo** that lights easily two six-volt lamps, post free in box, 15s. 9d.

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Dynamos, from 30s. upwards, made for any desired output. Reduced lists now ready.—H. Jones.

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The most Perfect Musical Instrument [illegible] imagined—Cremona Violins (Hipkins'). See facsimile.—W. [illegible] Blindley Heath.

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Change Wheels.—Complete set Castings, 5-16, pitch, all perfect, 15s., worth double.—9, Wellington-place, Bowdon.

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Dynamo, Victoria Brush compound, 130 volts, 100 ampères, very cheap.—J. W. King, as above.

Steel Name Stamps, 3d. per letter; Figures set, 2s. 4d., post free.—E. Baldwin, Robinswood-hill, Gloucester.

Finest **Iron and Quinine Tonic**, does not cause constipation. Warranted genuine. 32 doses carriage free for 1s. [illegible] J. Eagle, Chemist, 156, Pentonville-road, London.

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Hydraulic Testing Pump, on iron tripod, with pressure gauge, good condition, 70s. Vacuum Gauge, [illegible] cock, 11s. 6d.—Williams, 23, De Beauvoir-road, London.

15ft. 2½in. **Bright Shafting**, three plummer blocks and three pulleys to fit, 75s. Four 1½in. Plummer Blocks, [illegible] 49, Columbia-road, London, E.

Cyclists!—The most elegant and finest constructed Safety Bicycle in the world is the genuine "Advance

Bown's Ball Bearings all over, guaranteed [illegible] able Machines. Prices from £9.—Chas. Inwood "Advance [illegible] Gravesend.

500 Memorandums, Billheads, Cards, Envelopes or Gummed Labels, 3s. 3d.; 100, 1s. 2d., free.—Victoria [illegible] Works, Scarborough.

Gas Engine, 1H.P. Robinson's patent, almost new, but larger wanted.—Moore, Fountain-street, Belfast.

Popular **Microscope Slides.** Thousands for exhibiting, gorgeous polarising, brilliant opaque, &c. [illegible] List.—Henry Ebbage.

Microscopes, Objectives, Polariscopes, all Accessories, Object Cases, and Mounting Requisites.—[illegible] Caledonian-road, London.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JULY 5, 1889.

EFFICIENCY OF METHODS OF ARTIFICIAL LIGHTING.

IT does not require many straws to show which way the wind is blowing with regard to electric lighting, at all events in London, for it is certain that before long considerable areas will be supplied with leads of a somewhat more permanent character than any yet put down in this country, or, perhaps, in the United States; while the great station at Deptford will completely dwarf those which are erected or being erected near Lincoln's Inn-fields, in Kensington, and at West Brompton. The influential deputation which recently waited on the President of the Board of Trade about standardising the electrical units represent the views of both the scientific and commercial world, that at last an era of electric lighting is about to commence. The unwise haste displayed a few years ago has given place to a calm and dispassionate examination of the question, and it being now fully recognised that if the electric light is wanted it must be paid for, many have elected to pay the extra price, just as they pay for choice wines and other luxuries. To the student of science it is at once obvious that so long as coal is the prime mover, it is impossible for the electric light to be cheaper than gas; but there cannot be any question of its superiority from several points of view. As not only shopkeepers, but the authorities at club-houses, offices, theatres, and other large buildings, are apparently willing to pay for quality, it becomes of the first importance to determine the efficiency of the various methods of illumination, and, strange as it may seem, that is not such an easy matter. The standard which is legalised for testing the illuminating power of gas is well known to be far from satisfactory, and many efforts have been made to devise an absolutely reliable standard in photometry. With coal-gas, with oil, even with candles, there is always a rough-and-ready test which satisfies most people; but when other illuminants enter the field and compete with the old fashioned, it becomes more than ever necessary to ascertain whether we are really getting the light for which we pay, and it is now a question whether we get as good a quality as we might. In electric lighting the energy expended is readily determined in absolute measure—that excellent practical unit the watt; but, unfortunately, that does not express what we term candle-power, which, as at present used, is a most unscientific unit, being based upon a source of illumination which is peculiarly subject to fluctuations of intensity and colour. The Bunsen photometer betrays the defects of the standard candle; and those who have examined this subject by methods which make it possible to detect changes of colour as well as brightness know how delusive is the legalised standard. In fact, at nearly every recent meeting of the British Association there has been a "report" on the matter, besides one or more papers; but although the system adopted in this country is superior to the methods not exactly adopted, but practised, in America, it is not possessed of that accuracy which we are accustomed to in connection with the measurement of mechanical energy. More than a quarter of a century ago Julius Thomsen must have seen the importance of this subject, for he presented a paper to one of the Swedish scientific societies which gave the results of his investigation of the energy consumed in the sperm candle, and in various oil and gas flames. His memoir bore the appropriate title of the "Mechanical Equivalent of Light," and the instruments he used were the thermopile and the galvanometer, the indications of which were reduced to absolute measure by determination of the deflection produced by the radiation from a glass globe filled with hot water, calculating the total loss of heat by radiation from the rate of cooling of the globe, using Dulong and Pettit's law. Thomsen found that the energy of the light-giving rays per candle-power of light produced is nearly the same for the flame of either the candle, oil-lamp, or gas-burner—a conclusion which has been confirmed by spectro-photometric observations of the quality of the light emitted. But there are other points to be considered, the most important being the heat produced (and, we may add, practically wasted) in order that we may obtain light. According to the values given by Mr. Preece, the gross efficiency of the various illuminants, assuming the heat equivalent of the luminous radiation of a candle to be 2·6 gramme-calories per minute, is for tallow ·00203, for mineral oil ·00315, and for cannel gas ·00521; or, measured in watts per candle, tallow gives 124, mineral oil 80, and cannel gas 48. That is to say, that tallow candles would heat the atmosphere of a room far more than mineral oil for an equivalent quantity of light. One of the best papers yet published on this subject is that by Prof. E. L. Nichols, of Cornell University, which was read a short time ago before the American Institute of Electrical Engineers, entitled "The Efficiency of Methods of Artificial Illumination," in which he points out that in considering the values deduced by Mr. Preece, it should be borne in mind that coal-gas is a fuel which has been obtained by the previous expenditure of considerable energy, and that if we take as a basis the consumption of coal necessary to the production of a candle-power of light, instead of the heat of combustion within the gas-flame itself, the values for the efficiency of coal-gas as an illuminant would be very considerably reduced. According to Prof. Nichols, the gross efficiency of the incandescent lamp is about ·005, while that of the arc light is about ·01, under the assumption of the waste of 90 per cent. of the total energy of the fuel in the various processes leading to the production of the current, and those figures, small as they are, are considerably in excess of the gross efficiency of candles, oil, or gas. The flames of ordinary gas and of mineral oil give something like 1,000 gramme-calories of heat per minute for each candle-power of 3·6 gramme-calories, while an incandescent lamp of 5 per cent. net efficiency gives only 72 gramme-calories per candle-power. According to Prof. Nichols, in increasing the degree of incandescence, the ratio of luminous energy to total energy of radiation is slowly increased, and at the same time the relative brightness of the various rays which constitute the visible spectrum changes—the "quality" of the light changes, and, in a word, the variations cannot be expressed in candle-power. The investigation of these changes in composition involves, he says, the study of the visible spectrum of the source of light and the comparison of its intensity, wave-length for wave-length, with the spectrum of some properly chosen standard. The instrument for this purpose is the spectro-photometer, by means of which the spectra of two lights to be compared are brought together in the field of view, one above the other, the like wave-lengths being everywhere in the same vertical line. Prof. Nichols gives a description of the apparatus and its arrangements adopted by Mr. W. S. Franklin and himself, and goes on to say that, in arc-light photometry, "candle-power" is a well-nigh meaningless term, and asks whether it would not be advisable to abandon it altogether in favour of some standard affording us an expression for the luminosity of radiation. So far as the incandescent lamp is concerned, light-giving power is a perfectly definite function of the temperature and of the area of the radiating surface; but we are not at present able to measure the temperature of an incandescent carbon filament. It may be possible to devise some optical method of measuring the temperature of incandescence which shall be as easy to determine as the present method of estimating candle-power, while admitting of a higher degree of precision. The comparison of lamps having the same temperatures will then reduce itself to one of radiating surface. As Dr. Otto A. Moses said in the discussion which followed the reading of the paper, this is a subject on which we want "more light"; but unfortunately, the ultimate measuring instrument is an imperfect one, for it is the human eye, and that, as every student knows, is not so accurate on all occasions as is required in matters so delicate as the estimation of light value. The question is, Can calorimetry, or perhaps, photography, help in establishing an absolute photometric standard?

"DELTA" METAL.

DELTA metal is really a metallic alloy. It is an exceedingly interesting substance, and one likely to become widely used. Its strange name is derived from the first letter, D (delta being the name of the Greek letter Δ), of the name of its inventor, Mr. G. Alexander Dick.

Mr. Dick is a Danish engineer established in London. In 1883 a provisional patent was taken out in his name under "Improvements in Metallic Alloys."

By the old processes alloys made from copper, zinc, iron, phosphorus, or manganese required very high temperatures, and very often during the heating these substances became partly oxidised. By Dick's improved process molten zinc is saturated with phosphuret of iron, spiegel-eisen, or ferro-manganese, the temperature being about 1,200° Fahr., or rather less than that at which zinc volatilises. The compound thus produced is used in the manufacture of copper alloys. Either iron or metals of the same family may be used—e.g., aluminium, manganese, &c. The result is a kind of modified brass.

In addition to the comparative ease of its production, this alloy possesses many other advantages. Its resistance is very superior to that of most of the kinds of brass. It can be worked in the forge or stamping press with the greatest facility, at temperature bordering on 500°, a quality which ordinary brass does not possess, and bronzes only very slightly. The new alloy is also much less alterable under atmospheric influences than brass that is richer in zinc.

The influence of a small quantity of iron upon the properties of a brass alloy has been noticed for a considerable time, and have given rise to numerous patents (Kein in 1779, Stirling in 1850, Aich in 1860, Rosthone, &c.) But the use of such alloys has not become very general, and hitherto it has been very difficult to obtain them of a sufficiently homogeneous character; moreover, it is not easy to avoid oxidation during their fusion.

Dick's perfected invention consists essentially in the employment of phosphoric compounds of zinc, iron, copper, manganese. According to the most recent patent the iron, manganese, and the phosphorus are introduced simultaneously into the alloy under the form of phosphoric ferro-manganese.

It should be noticed that the French Society for the Encouragement of National Industry voted some time ago a pecuniary grant to Madame Zacharie (*née* Tavernier) to assist in the development of a somewhat analogous in-

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vention. The idea of this invention consists in the preparation of a brass containing 40 to 50 per cent. of zinc, by melting together equal weights of copper and zinc, and then introducing successively two substances, the composition of which is kept secret.

In Mr. Dick's alloys the hardness can be varied by increasing or diminishing the proportions of iron and of manganese, or by adding small quantities of aluminium and tin; thus the composition can be modified to suit the purpose for which the alloy is intended.

Three varieties of these alloys have been analysed at L'Ecole des Mines, and in the following table the analyses are exhibited and compared with those of two other alloys that have already been mentioned in this paper:—

	Cu.	Zn.	Fe.	Mn.	Al.	Sn.	Pb.	Ni.
Metal △ No. 1 ..	55·2	41·4	1·19	1·12	Traces		0·64	
Metal △ No. 2 ..	55·6	41·6	0·77	0·34	Traces	0·21	0·86	
Metal △ No. 8 ..	61·5	35·6	1·22				0·55	
Metal Stirling.	51·4	35·4	4·90			2·70	4·30	0·66
	53·1	36·0	2·70				4·00	3·60
Metal Tavernier.	52·2	42·5	1·63				0·53	
	51·2	47·5	0·46				0·67	

The points of fusion have been determined as follows:—

Metal △ No. 1	900
Metal △ No. 2	940
Metal △ No. 8	860
Bronze containing 20 per cent. of tin	765
Bronze containing 10 per cent. of aluminium..	960

Before fusion a molecular transformation, manifested by an absorption of heat, was produced in the different varieties of Delta metal, the temperature at which the phenomenon was observed being about 840°.

Of the three varieties experimented upon, No. 1 offered the greatest resistance to rupture when drawn into wire. No. 8 was found to be the most easy to melt and mould.

Delta metal appears to have attracted much attention in France, and further experiments have been made upon this interesting alloy by M. Sauvage, one of the chief engineers of the "Compagnie des Chemins de Fer du Nord."

He finds that Delta metal No. 1 and No. 4 can be easily forged. At a dull red heat they can be worked as easily as lead, but it is necessary to prevent it from being too much heated, for then it scales off under the hammering, while, if the heat be not great enough, it will become brittle and full of flaws.

The variety No. 8 does not appear to be so suitable for forging.

Experiments on drawing out the metal yielded the following results:—

	Resistance per sq. millimètre.	Elongation p. 100.
Delta metal No. 1	47·2kils.	37·5
" " No. 4 1st ingot	53·1	23·0
" " " "	53·4	26·0
" " " 2nd ingot	53·1	28·5
" " " "	53·1	27·5

Remarks.—Fracture silky grain, very close, pale yellow. Fracture fibrous, reddish.

Experiments on the effect of torsion, bending, &c., give equally satisfactory results, especially so in the cases of the alloys No. 1 and No. 4.

Altogether these varieties of this new alloy seem likely to be of very great value, for it has behaved in a highly satisfactory manner under very severe and exhaustive tests.

It especially claims attention on account of—

1. The facility with which it can be worked at the forge and stamped at a dull red heat.

2. Its considerable resistance to fracture and its ductility, in these respects approaching some varieties of steel.

3. Its resistance to the influence of atmospheric agencies.

4. The low cost of production: it contains less copper than the generality of brasses or alloys of that metal.

There appears to be only one inconvenience attached to the use of this alloy—namely, that it is very difficult to remelt without alteration. It easily loses zinc; its melting point differs but little from the boiling point of this metal.

A MODEL LOCOMOTIVE.—XI.

Lining-out and Boring, &c.

The lining-out, boring, and facing of the cylinder is the next stage of our work. We must properly line-out the bore and the faces before attempting to machine any single section, because if we were to reverse the process, the probability is, that some portions might afterwards not hold up to dimensions. Castings are seldom just like their patterns, and castings made from the same pattern will be found to vary, such variation being due to the fracture and mending-up of the mould, to rapping, and to the inaccurate setting of cores.

We must have a level surface to commence operations upon. This may, for our purpose, be a lathe-bed, or table of a planing-machine, or of a shaper. In the absence of these, a piece of board, well battened, and surfaced as true as possible with trying-plane, winding strips, and straightedge will answer the purpose sufficiently well. We shall also want a scribing block, and steel square, some thin wedges of iron or wood, and some blocking-up pieces.

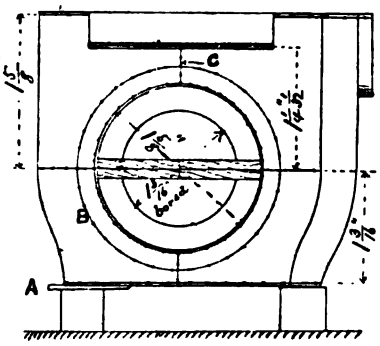


Fig. 51.

First bridge the ends of the cylinder castings with strips of hard wood, as shown in Fig. 51. Block up as shown in Fig. 51, and the description of the operations to be performed on one cylinder will, of course, apply to each of the castings. The aim first of all is, whatever the inaccuracies present in the castings, to average them between the bore, the faces which are bolted together, the valve faces, and the flange faces which bolt against the framing. If any one of these is not finished correctly to dimensions, some of our previous work, or some of the work yet to come, will not fit in therewith accurately. We must endeavour as near as possible to take off the allowances originally intended, because if we exceed these much, then the finished thicknesses of the different parts will be rendered disproportionate—that is, thinner and thicker than is desirable. If we take much off any one flange, we make it so thin it may fracture when the bolts are being tightened, and so spoil the casting after expending hours of labour upon it. If we take too off the valve face, we allow little for wear, encroach on the curved portions of the passages. If we bore eccentrically we lessen the metal one side of the cylinder, and cause the end flanges to be of unequal width. But, on the whole, is a lesser evil than unduly thinning down those flanges which bolt to the frame plates, which unite the cylinders to each other. I am little precise on these points, because error marking out cannot be retrieved. To mark correctly is half the battle; to mark out will probably spoil the work at a later

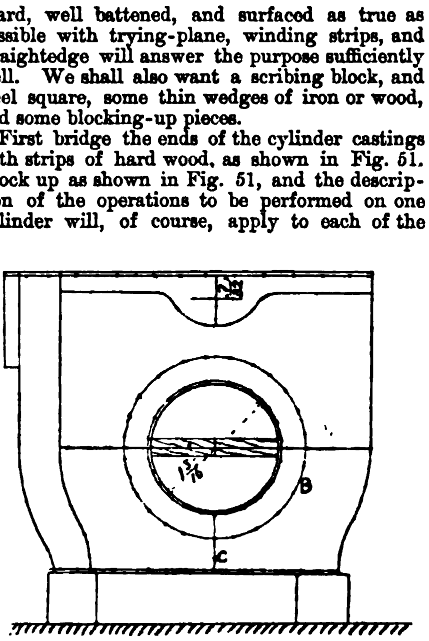


Fig. 52.

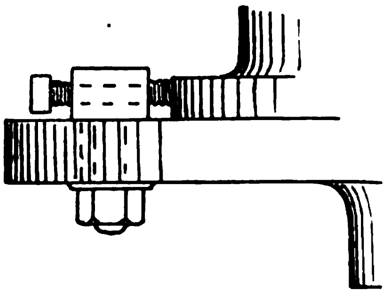


Fig. 53.

A method of marking alternative with shown in the figure would be to turn the cylinder a quarter round, and scribe the lines there vertically with a square set up from the Though this would also answer, yet it is sidered more accurate to mark the lines with scriber parallel with the table-face, as being certain to insure the lines on each end being perfectly alike. The similar lines at each end marked with the scriber set similarly, the cylinder not being moved.

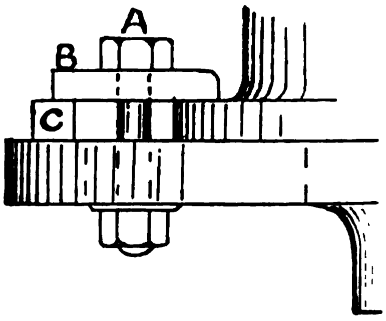


Fig. 54.

At A is illustrated the use of a wedge in packing up castings whose surfaces are more or uneven. Uneven castings will rock, and wedges are introduced where required to steady They also serve to pack up the work into position required for the purpose of average dimensions. Sometimes a rough cut is taken one surface in order to afford a bedding on table, and so do away with the necessity of justment by wedging. But then it is necessary to make sure that the material removed does damage the truth of the subsequent lining Generally it is best to line out the rough before machining any portion whatever.

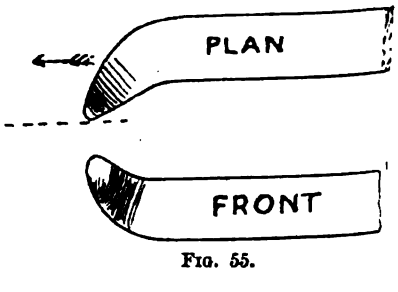


Fig. 55.

The surfaces are whitened with chalk before the lines are scribed, in order to make them

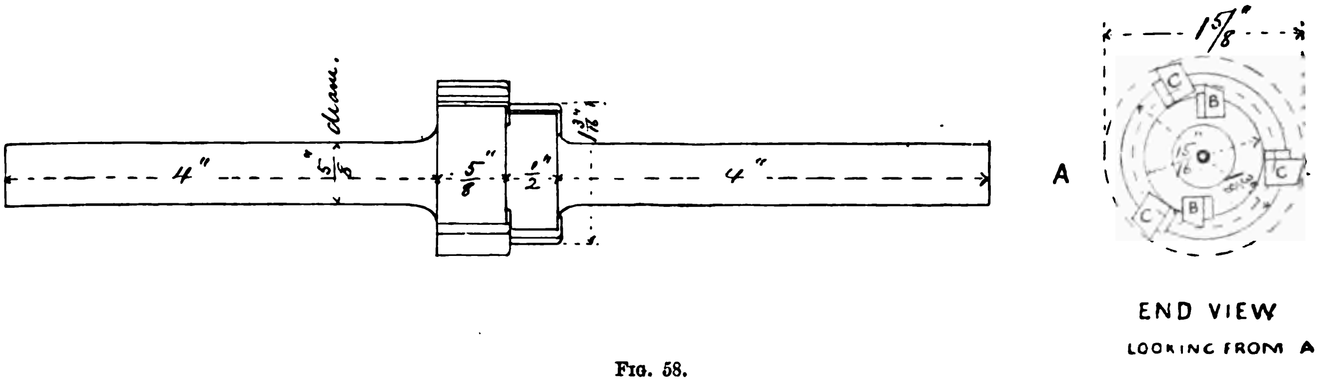


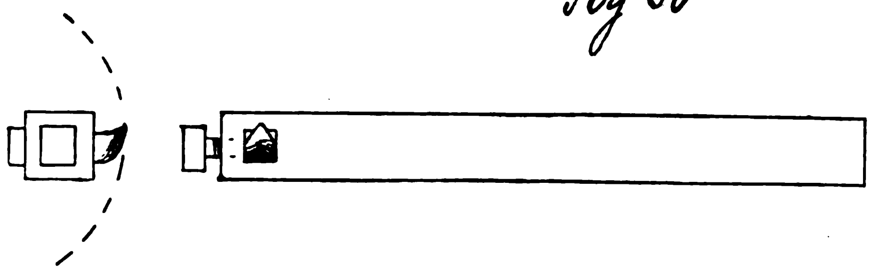
FIG. 58.

up the better. The centre lines, and lines for flange faces are not only marked on the ends, but are also carried round both sides. After being scribed they are centre-popped at short intervals, to render them more distinct, and to prevent all risk of partial obliteration while handling the castings about subsequently. We mark not only the circles representing the cylinder bore, but also another circle B, larger in diameter, and concentric therewith. This is a "witness" line, and is a check upon the working line, so that when the bore is completed to the working line, and that obliterated, or nearly so, the outer circle acts as a check if required, and as a witness that the bore has not been done eccentrically. One end of the valve face can be scribed at this stage. At the same time scribe, with a square set up from the table, a vertical centre line C on each end of the cylinder, whose purpose will be apparent presently. Also scribe vertical lines on the sides of the casting corresponding with the finished length of the cylinder measured over the flanges. Mark also the centres of the valve-rod stuffing-box (Fig. 52). Now we may remove the cylinder for boring. Boring should take precedence of planing the flanges. This is a matter of practical wisdom, because it is easier to plane to a line than to bore to a centre. If, therefore, we happen to bore a trifle out of truth, there is still a chance to accommodate the planed faces thereto. If we plane first and bore afterwards, and the boring is then not quite correct, we cannot alter the planed faces.

The best way to bore the cylinders is to bolt them on the saddle of the slide-rest, and use a boring-head and cutters specially made. The easier way is to bolt the castings on a dog-chuck, and bore with a tool clamped in, and fed by the slide-rest. The latter plan may be adopted if the lathe is in good order, and the workman careful. I will describe both.

A four-jawed chuck with independent jaws will be the most suitable for holding the cylinder, the jaws clipping the edges of the flanges, and adjusted tentatively until the centre-popped circles on the front face run round true. Supposing a dog-chuck does not form a portion of the lathe equipment, then a plain slotted chuck will serve the purpose nearly as well, if the slots are fitted with plain dogs like Fig. 53. Clamping the dogs through the slots in approximate positions, the pinching screws are then tightened against the flange edges. Or even without such aids the cylinder can be held perfectly securely in the manner shown in Fig. 54, where A is a bolt passing through a slot and clamping down a short bit of bar iron, B, upon the inner face of the flange, a packing-bit being inserted at C to keep the bit of bar fair on the inside of the flange. Three or four of these will be distributed around the flange.

Fig 56



Having only a rough-cast hole as yet, it is quite likely that though we chuck the cylinder with the centre-popped circles at the front end running true, yet those at the back end may be out of truth, perhaps not much, but enough to produce an inaccurate bore. For this reason we chuck first with the thin internal flange for the back cover outwards, and bore that only at this setting to 1$\frac{3}{16}$, and then at once reverse the cylinder to bore the body. Having the flange bored true, we can now set that to a circle on the plate, and also observe it in running round, and see at once whether it is in any slight degree eccentric. So that at this second chucking we shall get the hinder end true by the bore, and the front end by the centre popped lines, and, having it so set, can bore and finish the body.

The bore can be completed in one cut; but two are better. A side roughing tool, like Fig. 55, can be used, or a tool-holder, like Fig. 56. The latter is a stiff bar of iron, pierced near the end for a tool-point, which is pinched with a set-screw. A bar $\frac{7}{8}$in. square, a tool-point of from $\frac{3}{8}$in. to $\frac{1}{2}$in. steel, and a $\frac{3}{8}$in. set-screw will do for the cylinder. The advantage lies in its superior rigidity, which renders it better adapted for boring a long hole true, the stiff bar being less liable than the solid tool to chatter, or to yield before the stress of cutting. It is because of the elasticity of the cutting tool, or of the tool-bar, that it is better to take two cuts than one. The stress of heavy work will cause the tool or bar to spring, and bore an oval or otherwise untrue hole, or a hole larger at the hinder end than at the front. By removing most of the material in a first roughing cut, and finishing with a second very light cut, this tendency to untrue boring is much reduced. But in boring a hole like this, with a tool set in the slide-rest, there is a risk from which the use of the boring-bar is free—that, namely, of want of parallelism, due to lack of truth in the slide-rest itself. This affords another reason why two cuts should be taken. At the end of the first cut try the bore with calipers, and note whether it is larger at one end than the other; and if so, adjust the slides of the rest to prevent a repetition of such error. If the inaccuracy is but slight, it is probably owing to the spring of the tool.

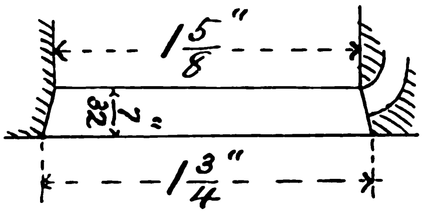


FIG. 57.

The second or finishing cut should properly be taken with a broad-faced tool. This may have top rake, or be flat, acting as a scrape simply. There should be a slight rounding of the leading corner of the tool.

Note that the cylinder is made bell-mouthed (Fig. 57)—that is, there is a slight enlargement of the diameter at the front end, and to a little distance inwards, just sufficient to prevent the formation of a shoulder by the wear of the piston.

In the absence of a planer or shaper, it will be best to face the end flanges while the cylinder is chucked on the face-plate. This will be much less laborious than filing. But if the faces can be planed or shaped, I think it will be better to bolt the cylinders together first, and then plane the two off at the same time. This is simply a matter of convenience. Facing the ends in the lathe first, of course much care will be necessary to bolt the castings together so that the faces shall be perfectly in line afterwards. Planing them off together insures coincidence at once.

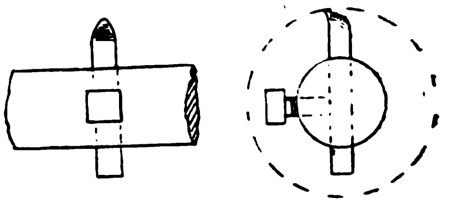


FIG. 59.

The alternative method of boring by means of a bar and cutter is as follows: The cylinder is blocked up on the saddle of the slide-rest, the upper slides being removed for the purpose. The blocking is so arranged that the headstock and poppet-centres shall coincide with the centres marked on the strips of wood bridging the mouth of the cylinder. Thus set, the casting is clamped down upon the saddle by means of T-headed bolts entering into the similar slots in the saddle; the bolts being pinched down upon bits of bar iron similar to that shown in Fig. 54, only that in this case it is the longitudinal flanges that are clamped instead of the end flanges.

A boring bar suitable for this job is shown in Fig. 58. The head can be made distinct from the bar or mandrel, and either be screwed on with set screws or keyed in a longitudinal groove in the bar. Being so small, however, and having two cylinders to bore, it is better to make a solid head, as shown, and to combine the cutters for the bore, and for the internal flange in one. The bar is of wrought iron, the drawing is suitably dimensioned, and scarcely needs explanation. I show two cutters B B for the small hole, and three, C, C, C, for the principal bore, for perfect balancing. The cutters are of tool steel, softened, and wedged in place, turned up in position in the lathe, marked, and removed, backed off, and tempered at a plum colour. When replaced, each is set a trifle in advance of its predecessor, say to about the thickness of a sheet of drawing paper, in order that one shall follow the other, and cut in succession. The front corners are very slightly rounded, to penetrate easily, and without grooving.

The bore would be very accurate if this cutter-head were run through at once. But it will be better to take a rough cut through first, and this may be done with a tool-point set in a slotted bar,

Fig. 59. The bar may be 1in. in diameter, and the tool-point of ¼in. square steel. The cutter-head following after will scrape the bore perfectly true and smooth. If the making of the cutter-head gives too much trouble, the single cutter will answer the purpose; especially if the second cut is made by a broad-faced cutter substituted for the roughing tool.

After boring, the abutting steam-chest flanges, and the flanges that go against the frame-plates, are faced. If these are placed in a machine, then when set for planing the steam-chest flanges, the face for the slide-valve will also be planed, which will insure the parallelism of the latter with the former. If it is filed, then a gauge must be used for depth. One like Fig. 60 will serve the purpose.

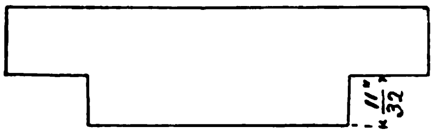


Fig. 60.

This will be a suitable stage at which to suspend operations until the next article. **J. H.**

(*To be continued.*)

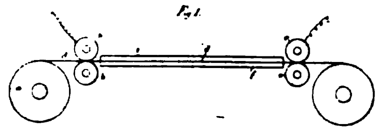
TEMPERING WIRE BY ELECTRICITY.

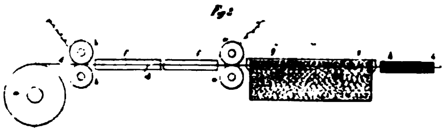
THE method of tempering wire by means of electricity, recently patented in this country by Mr. W. Holland, of Sparkbrook, Birmingham, is another instance of the purposes to which the electric current can be put. The invention is especially applicable to the heating of cylindrical steel and iron wire for the purpose of rolling it flat, or for turning up flat wire into a trough shape for the manufacture of umbrella and parasol ribs and stretchers. The heating of the wire is effected by electricity preferably derived from a dynamo machine. When the wire is to be hardened the patentee causes an electric current to pass through that portion of the wire between the drum on which it is coiled and the hardening plates, between which the heated wire passes. The electric current heats to bright redness the portion of the wire, and the heated wire being suddenly cooled as it passes between the hardening plates, is thereby hardened. The motion of the wire is effected by the rotation of the rollers through which the wire is passed. The hardening plates are kept cool by a current of cold water which circulates around them. Instead of the hardening plates, an oil vat may be employed for effecting the hardening of the wire. Where the wire is to be tempered after hardening, it is caused to pass through a tempering apparatus consisting of a tube surrounded by another, and the space between the two tubes is filled with lead kept melted. The same process of heating the wire is resorted to when the wire is to be annealed. Where cylindrical wire is to be flattened or flattened wire is to be made into a trough shape, the patentee interposes between the drum from off which the wire to be operated upon is drawn and the hardening plates, a pair of rolls of the required figure, the rolls being plain cylinders where cylindrical wire is to be flattened, and where a flat wire is to be made into a trough shape, one roll has a groove having the configuration of the exterior of the trough to be produced and the other a projection or ring of the configuration of the interior of the trough to be produced. After leaving the rolls the heated and rolled wire may pass to the hardening and tempering apparatus.

In order to soften steel wire hardened by the drawing process, the wire is uncoiled from one reel and coiled on another situated a few feet apart. The electric current is passed through the portion of the wire stretched between the two reels, which portion is thereby heated to redness. As the heated wire is coiled on the second reel it is cooled, but with sufficient slowness to cause the wire to be soft.

Fig. 1 is a diagram illustrating the essential parts of the apparatus for carrying the invention into effect when steel wire is to be softened or annealed, or soft or annealed cylindrical wire is to be flattened, or the flattened soft wire bent or turned up into a trough shape for the manufacture of umbrella wire and for other purposes: *a* is the reel on which the wire to be treated is coiled; *b b* is a pair of rollers, and *c c* a second pair of rollers, between which the wire *d* passes, the wire after treatment being coiled on the reel *e*. Between the said pairs of rollers *b b* and *c c* is a tube *f* of glass or other imperfect conductor of heat, so as to prevent radiation from the heated wire passing through it. To the rollers *b b* one of the poles of a dynamo machine or battery is connected, and the current of electricity, after passing through the wire *d*, stretched between the two pairs of rollers *b b* and *c c*, passes through the pair of rollers *c c* to the other pole of the dynamo-machine or battery. By the passing of the electric current through the wire situated between the two pairs of rollers, the wire is heated to a low red heat, and thereby softened or annealed. The wire is drawn through the apparatus and off the reel *a* by giving a slow motion to the rollers *c c*, so that as the heated wire is coiled on the reel *e* it is cooled with sufficient slowness to cause it to remain soft.

When cylindrical wire heated to redness in the manner described is required to be flattened, the rollers *c c* are replaced by flattening rolls for flattening the heated cylindrical wire as it passes between them; and when the flattened wire is to have a trough or other shape given to it, the rollers are replaced by rolls, the acting peripheries of which are fitted to give the proper shape to the wire rolled between them; or the flattened wire, after it has passed the flattening rolls, may be passed through troughing rolls. When the flattened or shaped wire issuing from the flattening or shaping rolls is to be hardened and tempered, the heating appliances already described are combined with the hardening and tempering appliances illustrated in the diagram, Fig. 2. The wire *d*, heated in this case to a bright redness, and flattened or shaped by the rolls at *c c*, Fig. 2, passes through the oil vessel or tank *g*, by which the flattened or shaped wire is hardened. After leaving the oil vessel, or tank *g*, the hardened wire passes through the tempering apparatus shown at *h*, the tempering apparatus consisting of an annular or tubular chamber or vessel containing melted lead, which is kept melted by burning gas jets or otherwise. By the passage of the wire through the axial hole in the apparatus *h* it is tempered. After leaving the tempering apparatus, the wire is cut off into lengths, or coiled on a drum as may be required. In place of the bath or vessel of oil *g* for hardening the wire, hardening plates kept cool by a current of cold water circulating around them may be used.





Instead of heating the wire directly by the current of electricity passed through, it may be heated indirectly by electricity in the following manner: Inclose in a tube lined with asbestos or other imperfect conductor of heat a strong wire coil or helix of German silver, or other suitable material, through which coil or helix pass the current of electricity so as to heat it to redness. The straight wire to be heated is passed through and supported as it passes through the heated coil or helix of German silver, the straight wire being kept as nearly as may be in the axis of the helix, whereby it is heated to the required degree.

VORTEX MOTION.*

EVERYONE has noticed the symmetrical wreaths of smoke and steam occasionally projected high into the air on a still day by a locomotive; similar rings may often be noticed after the firing of a gun. It is not uncommon to see a smoker forming such wreaths with his mouth. These rings are simply whirling masses of air revolving upon axes curved in annular form, the smoke serving to mark the projected and whirling body of air, thus distinguishing it from the surrounding atmosphere. The whorls would exist without the smoke, but they would, of course, be invisible.

All the apparatus needed for producing vortex rings at will is an ordinary pasteboard hat-box, having a circular hole of 4in. or 5in. diameter in the cover. Two pads of blotting-paper are prepared, each consisting of six or eight pieces. Upon one pad is poured a small quantity of muriatic acid, and upon the other a similar quantity of strong aqua ammonia. These pads are placed in the box, and immediately a white cloud is formed, which consists of particles of chloride of ammonium so minute as to float in the air.

By smartly tapping opposite sides of the box, a puff of air is sent through the circular opening of the cover carrying with it some of the chloride of ammonium. The friction of the air against the edges of the cover retards the outer portion of the projected air column, while the inner portion passes freely through, thus imparting a rotary motion to the body of air adjoining the edge of the cover, the axis of revolution being annular. After the ring is detached the central portion of the air column continues to pass through it, thus maintaining the rotary motion.

When two rings are projected in succession in such a manner as to cause one to collide with the other, they behave much like elastic solid bodies. By making the aperture in the box-cover elliptical, the rings will acquire a vibratory motion. By fastening the box cover loosely at the corners, the box may be turned upon its side, and rings may be projected horizontally. It is obvious that smoke may be used in this experiment in lieu of the chloride of ammonium.

PRACTICAL DETAILS OF BLACKSMITHING.*

JUDGING from the length of time during which the common anvil, used for general purposes by blacksmiths, has retained its present form, it may be reasonable to infer that it has attained very nearly to perfection in its shape, if not in its material. It has been hammered upon day in and out for many years by very ingenious men, the very nature of whose occupation demands that they be fertile in resources, and prone to invention; and yet it does not appear that they have been able to discover any way in which they could improve the principal tool they use, and the one upon which their eyes constantly rest.

There have been, it is very true, great improvements suggested by those outside of the trade in making the anvil element enter into combination with others, for the purpose of comprehending a greater or less number of workshop tools in one system. Among these forms, perhaps as great a favourite as any with the daring trespassers upon the smith's province is the vice united with the anvil. Vice, tire-shrinker, and anvil is another. Vice, anvil, and drill-press is the fond fancy of some economist. A tool-dressers' anvil with impressions in the face for shaping side tools, and [illegible] diamond points, with also a hand-shear attachment for clipping the corners of drills is a very [illegible] device for that particular branch of the business, but the demand for such a combination is [illegible] fanciful than real, as all the dies for these purposes, if any are used, can be made to fit in the square hole in the common anvil, and the small shear, which is very convenient for the drill dresser, can be attached to the forge or the tool-bench with rather greater advantage.

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* By Geo. M. Hopkins, in the *Scientific American*.

* By B. F. Spalding, in *American Machinist*.

The combined anvil and dolly is the combination which is most in use, and this use is principally confined to the chainmakers, among many of whom it is considered indispensable. I do not know that they are placed on the market for sale anywhere in this country. The anvil part is made of cast iron, and every chainmaker who has any peculiar ideas of his own which he desires to put into practice can easily have a pattern made to accord with them, modifying in some detail the general style shown in Fig. 1, which represents an anvil 10in. long, and 3½in. broad on the face, 8in. high, and with a strong, blunt horn.

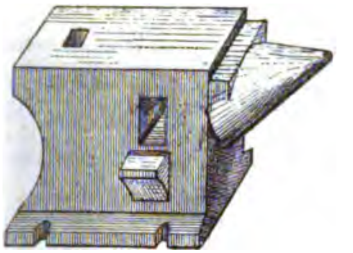
Fig. 1

Fig. 2 shows the bottom die, the face of which, containing the forming groove, is of steel, the rest being of wrought iron. The shank is to be inserted in the hole shown in the side of the anvil, and is fastened by two keys on top, tapering in opposite directions. A wedge of very little taper is driven between it and the ledge shown in the figure below the hole. This makes a solid bearing, which is a very important matter to the man who is using his muscle with the hammer. It is better than the plan of letting the ledge come up flush with the bottom of the hole. The shank can be securely fastened in the hole, and firmly wedged down against the bottom of it, before the ledge wedge is put in. There is no strain liable to break the shank off at the neck, caused by driving the ledge wedge, and whatever wear is suffered from the constant striking upon the dolly and reaction through the die is taken up in driving the wedge without being noticed, while if the die rested directly upon the ledge at first, it would get slight service before it would so wear as to no longer have a solid bearing. It would then be necessary to use packing under it, and this cannot be adjusted as easily as a wedge can be driven.

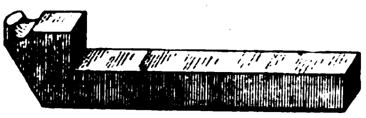
Fig. 2

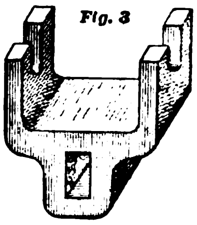
Fig. 3

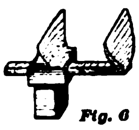
Fig. 6

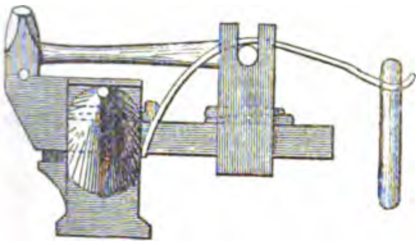
Fig. 5

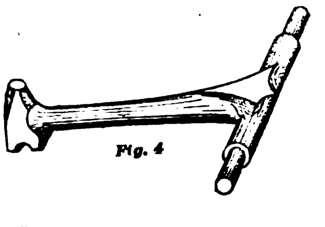
Fig. 4

Fig. 3 shows the boxing for the dolly, and has in the lower part of the frame a hole, so that it can be put on the part of the die shank which extends through the anvil for the purpose of affording it a support. The head of the dolly sometimes has a bit of steel welded on it, and the face is generally made of steel; the rest of it is of wrought iron.

The whole arrangement is shown put together in Fig. 5, with the simple but efficient device of a bent wire and a weight to hold the bearings in the boxing. Sufficient weight is hung on to make it bind hard enough to hold the dolly up when not in use. When the smith has given it the two or three blows necessary to smooth off the weld in the chain link or ring which he is working on, he gives the dolly an oblique upward blow, which raises it up off from the die, and leaves an open space large enough to put the work into the rounding groove without any hesitation when the welding heat is on it.

With this very convenient tool excellent chain is finished up in a neat and workman-like manner of any size up to ½in. diameter.

Fig. 6 represents a "gauge-hardy," which is sometimes used in the hole in the face of the anvil when the work does not come to the forge already cut to the right length. The gauge rod is keyed in a hole in the hardy in preference to being fastened with a set-screw, as set screws easily jar loose, and quite frequently break off.

A very good tuyere iron for a chainmakers' fire is a cast-iron box 8in. by 4in. by 2in. inside measurement. The blast-pipe enters a 2in. hole at one end, and in one of the narrow sides are drilled holes ¼in. in diameter, and about 1¼in. apart. The box should be ½in. or ¾in. thick on the side where the blast holes are drilled. This tuyere forms the front of the fire, and the blast blows the fire away from the workman. The inside of the box is cored out, and the blast holes are drilled of any size and distance apart that is found to be best adapted to the kind of work. The boxes are sometimes made with only five sides, being left open on the lower side, and bedded in mortar or clay when they are set. This saves making a dry sand core, and gives a little better chance to clean out the blast holes if they get stopped. The cored box can be cleaned, however, from the pipe-hole, and is not subject to the objection of leaking air when the setting gets loose.

IMPROVEMENTS IN ARTIFICIAL LIMBS.

THE Committee on Science and Arts, of the Franklin Institute, which considers all claims for an award of the John Scott (of Edinburgh) Legacy Medal and Premium, has recently recommended the granting of nine different awards under the legacy, one of these awards of the medal and premium being to A. A. and Geo. E. Marks, of 701, Broadway, New York City, for their "improvements in artificial limbs." In an abstract of the report of the committee, published in the *Journal* of the Institute, it is said that the first improvement consisted in the substitution of an elastic artificial foot, made of indiarubber, without any joints whatever, for the artificial foot, previously made of wood, with joints to permit motion of the ankle and toes, and also an artificial hand made of indiarubber, simulating the missing member. As a matter of course, such an artificial hand, which is here illustrated (Fig. 1), could do little else than restore appearances. It had, besides this, the merit of not wearing out gloves and other apparel as rapidly as its wooden and metallic articulated predecessors, and it was much less costly and not so unpleasant when it came into personal contact. The rubber foot, which is also illustrated in Fig. 1, consisted of a wooden block rigidly secured or formed with the leg, and extending downwards to within about two-fifths of the distance from the ankle to the sole, and forwards to nearly the first articulation of the metatarsus and toes. This block was covered with indiarubber, and all the rest of the foot, from heel to toes, was formed of elastic vulcanised rubber.

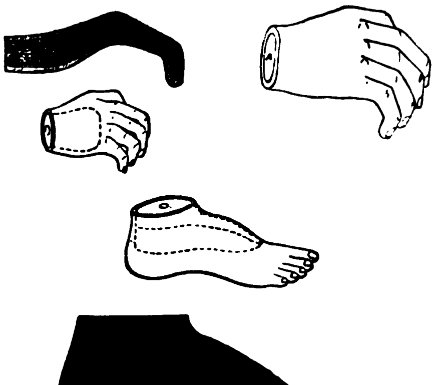
FIG. 1.

The action of such an artificial foot was that of an elastic segment of a wheel. The shock of placing the weight upon the heel at each step was avoided by the elastic cushion of rubber forming the heel, and as the weight was progressively transmitted to the forward part of the foot, by the combined effect of muscular exertion in the remaining part of the natural limb to which it was applied and the momentum previously acquired, an easy flexure of the toes took place, which, reacting elastically as the weight was transferred to the other limb, assisted in the flexure of the knee joint, giving an easy and naturally appearing movement. Such artificial feet were, upon trial by those who were maimed and had used other artificial substitutes, found to be easier to use, lighter, and more comfortable. They were rapidly introduced into use, and have proved from their greater simplicity more durable and far less destructive to clothing.

The next improvement (Fig. 2) is an improved and simplified construction of the knee joint of artificial limbs, made with a view to strength, facility of accurate manufacture, and easy application. This joint consists of a flanged plate, secured by screws to the under surface of the thigh socket, and has formed, integrally with it, of steel, by drop forging, a cylindrical pillar, terminating in two lateral journals having the same axis, resembling an inverted capital letter T. These journals perform the function of the condyles of the femur in the natural limb, and are fitted accurately in bearings formed with oblique caps, secured by screws in the rear of the knee portion of the leg.

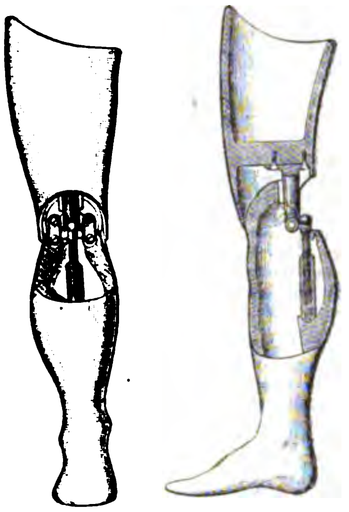
FIG. 2.

On the rear of the pillar, in about the same horizontal plane as the axis of the journal when the limb is extended and erect, is formed a short lever, having a spherical end, against which a cup, formed upon the upper end of a sliding plunger, is pressed upwardly by a spring in a guiding cylindrical case, having a hemispherical lower end resting in a correspondingly shaped cup or cavity in a shoulder in the interior of the calf portion of the leg. When the limb is extended, the spring operates will full effect, in holding the limb extended; as it is flexed the lever gradually assumes a greater angle to the line of reaction of the spring and cup, so that when it is flexed with the thigh at right angles with the leg the spring has no motion or effect, and if flexed still further, the spring then operates to assist in further flexure. The pillar and journals are made hollow, so as to reduce their weight.

It is obvious to every mechanic, from the form of these parts, that they can readily and accurately be finished by drilling and turning, that from their shape they must possess great strength, and that they can easily be fitted accurately into their working positions in the limbs.

Another useful feature of this form of joint is that the upper part of the pillar forms an effective stop, to arrest the forward motion of the thigh upon the leg during extension, by coming in contact with a cushioned cavity in the rear of the knee; this point of support, being at a considerable distance from the axis of the knee-joint, avoids any severe strain and shock from the sudden extension of the limb, which in other constructions, having the stops made in plates at the sides of the joint, are necessarily close to the axis of motion, and consequently are subjected to a greatly increased strain.

This concussion of the stop is found to be a frequent cause of breaking both of the stops and joints of other forms of limbs, and has had a great deal of ingenuity expended upon it to avoid it, by providing check straps or cords reaching from the thigh to the leg, and designed to stretch tight before contact of the stops occurs. These cords required greater care to keep adjusted to the proper tension than could readily be given to them. The simple contrivance here shown obviates the entire difficulty.

The axis of the knee-joint is placed near the back of the limb, so that the weight of the wearer insures a firm support on the limb when extended, and at the same time slight exertion suffices to move the limb in stepping forward.

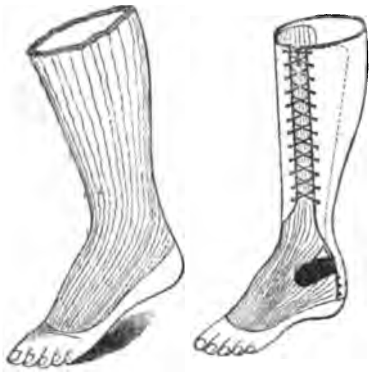

FIG. 3.

The shell or parts, which in form imitate the natural limb, are made of light willow or basswood, as thin as is consistent with strength in the lower part, and in the upper part excavated to fit the remaining portion of the natural limb; these are covered tightly with parchment and painted and varnished to resemble the complexion of the natural skin.

The continued use of the limbs thus constructed demonstrated that the front portion of the foot was too easily flexible, or rather that greater elastic force was desirable, and this requirement was met by the inventor by a device in which a textile fabric was introduced between the lamina of indiarubber forming the ball and toe portion of the foot, as shown in Fig. 3.

The desire to adapt the indiarubber hands to changes of flexure, for purposes of better and more natural appearance, and to grasp light objects, led Mr. Marks to improve them by making a light wooden core in the palm or metacarpal portion of the hand, and inserting ductile or flexible metallic wires in such core, which extended centrally through the fingers. By bending the fingers they retain the form in which they are set. The test of several years' use of these last-named improvements have proved their utility.

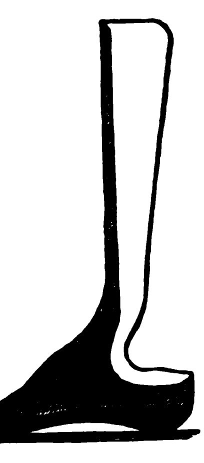

FIG. 4.

The latest improvement in artificial limbs consists in forming the leg and foot part of a single piece of wood (Fig. 4) having the grain curved naturally in its growth, such pieces being procured from the parts of the trunk contiguous to the roots and branches of trees; limbs made in this way are stronger with the same amount of wood remaining in them than when made of parts and glued together, and are made waterproof, which is a specially valuable feature when the occupation of the wearer exposes it to constant dampness, or to water itself, as in fishing, mining, dredging, &c.

By making limbs in this manner from natural curves in the growth of the wood, it has become practicable to make light and substantial artificial feet, adapted to partial amputations of the foot. Such appliances have been used with unprecedented satisfaction where articulated feet were clearly impossibilities. The advantages derived from lightness of such artificial substitutes will readily be apparent when the resistance to motion from inertia is considered. The ankle and foot and lower part of the limb being light and hollow, move easily and promptly with but little exertion from the remaining part of the natural limb, and the comfort and ease of the wearer are thereby greatly promoted.

The Franklin Institute has not made any examination in this department of the arts since January 11, 1849. Since this time about sixty or more patents have been granted for alleged improvements in artificial limbs, nearly all of which, except these, which are the subject of this report, added complications or additional parts to the limbs. In none of these inventions does there appear such desirable simplicity of construction and reduction of cost of production as in those under consideration. The makers are enabled to make most durable and substantial workmanship of all parts, and have demonstrated all of these points by making something over 9,000, which are in constant and satisfactory use. The extreme simplicity of construction has proved the means of bringing their cost within the reach of many persons requiring such appliances, who could not otherwise afford to use and maintain them, and there are now many persons using them and actively competing with others in many lines of industry; among them machinists, blacksmiths, farmers, fishermen, carpenters, moulders, instrument makers, railway conductors, engineers, and, in fact, representatives of nearly every handicraft.

ON THE PREPARATION AND PROPERTIES OF METALLIC MANGANESE.*

THE properties of manganese, like those of iron, appear to differ according to the method used in the reduction of the metal. When obtained from the oxide by heating with carbon, most authorities agree in the statement that the metal oxidises so readily in the air that it can be preserved only under "rock oil," or in well sealed vessels. In water it is said to "oxidise rapidly, with evolution of hydrogen, and crumbles into a dark grey powder."

Cast manganese containing 8 per cent. of iron is said to be unalterable in the air.

In the year 1869 some manganese prepared after the process of Brunner (the reduction of the chloride mixed with fluorspar, by means of sodium) was found to have as little tendency to oxidation as iron.

Repeating recently this process, pure chloride of manganese was fused in a clay crucible and poured on a stone slab; when cold it was pulverised and mixed with an equal weight of powdered fluorspar. This mixture, divided into portions of 1oz., was introduced into a French clay crucible, previously heated to redness. Eighty grains of sodium, cut into small pieces and freed from naphtha, being added to each portion, the crucible was covered, and reaction allowed to take place before adding another charge. After 6oz. of the mixture had been added, the contents of the crucible was covered with fused chloride of sodium in powder, the cover replaced, and the heat carried to quiet fusion. After the flux became entirely fluid, the heat was continued for ten minutes. The crucible was then removed from the fire, and after cooling the metal was found as a button at the bottom.

Three crucibles, of the capacity of eight fluid ounces each, were used at a time in a furnace without artificial blast. Care is necessary not to urge the heat too high; otherwise the crucibles will not resist the action of the fluorspar flux. The French clay crucibles (Beaufay) were used on account of their greater freedom from iron and silica; they also resist the flux better than the Hessian, black lead, or iron crucibles.

The yield of manganese under favourable circumstances was about 20 per cent. of the chloride used.

Reduction was also tried by using fused chloride of sodium without fluorspar, the yield of metal was much less and differing in some of its properties from that obtained with the use of fluorspar. Manganate of soda was formed when sodium chloride alone was used as a flux.

Manganese thus obtained is very brittle, with a steel white fracture, so hard that a file will scarcely touch it, the edges of the fractures scratch, and almost cut, glass.

The metal retains the brightness of a fractured surface after prolonged exposure to the air, and appears not more disposed to oxidation than iron. It is entirely passive to magnetic attraction.

The specific gravity of the metal obtained when fluorspar was used was 7·072, when remelted under fused sodium chloride, the sp.gr. rose to 7·153.

The metal obtained without the use of fluorspar was less brittle, and had a different fracture; its sp.gr. was 7·231.

Authorities differ regarding the sp.gr. of manganese, ranging it from 6·85 to 8·013.

An examination of the metal obtained, using fluorspar as a flux, showed the absence of iron, and the presence of calcium, demonstrating the reduction of some of the latter metal from the spar. This may account in a measure for the increased sp.gr. on remelting under sodium chloride, as also the greater sp.gr. of the metal when the spar was not used. As calcium has the sp.gr. of 1·57, a small amount alloyed with the manganese would sensibly affect its gravity. The sp.gr. of iron, grey, is 7·1; sp.gr. of iron, white, 7·5; sp.gr. of iron, pure, 7·84.

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* By CHAS. BULLOCK, a Paper read at the Meeting of the Chemical Section of the Franklin Institute, May 21, 1889.

DETAILS OF SWEET'S 16in. ENGINE LATHE.*

IN Fig. 9 a half-plan is shown of the surface of the bed on which the head-stock rests, with a longitudinal section through the train of screw-cutting gears, represented in Fig. 10. The curved T-grooves at the head end and corner of this surface receive the bolts by which the head-stock is fastened in place. The shaft S is the continuation of S″, shown in Fig. 1 of previous article, and [illegible] in a square hole in the gear *g*. The gears *g′* and [illegible] each revolve loosely on the shaft S′, a steel cam C being fast to it. The shaft has an end movement sufficient to allow the projections on either side of the cam to engage with the counterparts on either gear, and so imparting motion to S′ in either direction.

Special attention is called to these clutches—as screw-cutting by this lathe can be done by reversing the screw instead of reversing the lathe, it is imperative that the clutch or shaft should make a complete revolution, or, in other words, always assume the same relative position with the upper shaft when thrown in gear, that it has before; or to explain, assume that a threading tool is in a half-finished thread, and the clutch thrown out; then, when thrown in again, it must take the same position, in order that the tool shall be correctly set. This heretofore has been accomplished by using a single-tooth clutch. But a single-tooth clutch is objectionable, as it tends to twist the gear to one side and wear it out of truth. In the clutch here used, there are two teeth on opposite sides in contact, and yet the shaft makes a complete revolution; that is, always takes the same position when thrown in gear, whether running forward or back.

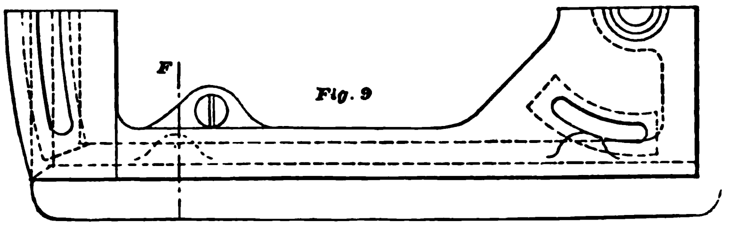

Fig. 9

This movement of the clutch shaft S is caused by the half-ring *r*, which is connected to a handle within reach of the operator. On this shaft are two sleeves s_1 and s_2, the inner one having a key fitted in a spline in the shaft, the spline extending to the outer end. This sleeve is also connected with the outside one so as to drive it positively, a slight end motion of the sleeve s_1 being provided for to allow clamping. The inner end of the slee-

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* By Prof. C. I. KING, in *American Machinist.*

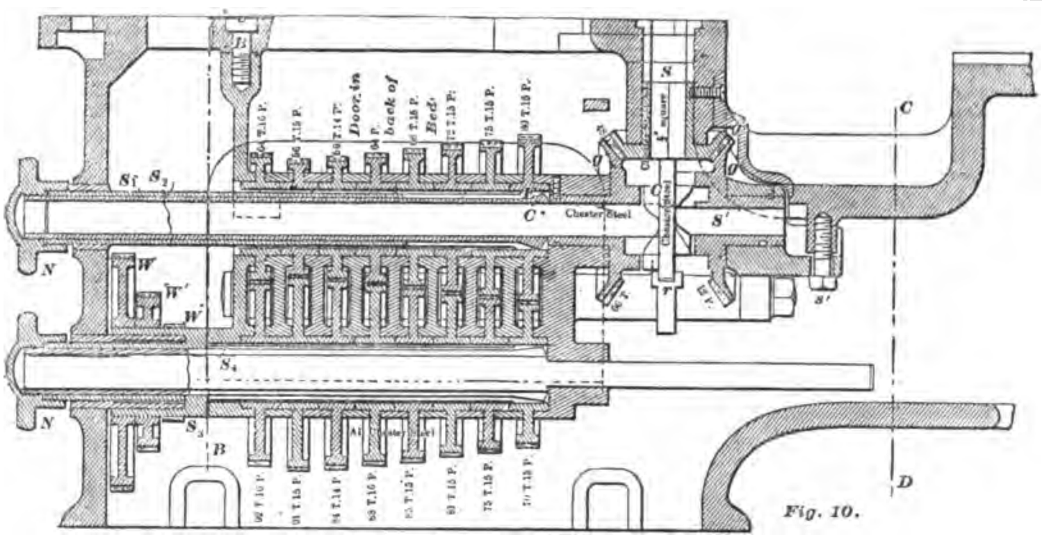


Fig. 10.

erminates in a cone C'', while the inner corner of s_1 is chamfered to fit it.

This sleeve is also cut in four parts for 4in. back from the chamfer, so that when forced against the cone C'' the end E expands into the gear with sufficient force to drive it. The sliding of one sleeve on the other is caused by turning the star nut N, in which two threads are cut, one of 12, and one of 16 pitch. These sleeves can be drawn out to clamp any pair of gears in the set. The lower shaft and sleeve are similar in action to the other one, though one sleeve is dispensed with, and the shaft and sleeve are drawn out together in setting for any pair of wheels. On the lower shaft, just outside of the frame which carries the screw-wheels, are three other gear wheels, W, W', W'', one of which is cut on a steel sleeve S_3, the two others being keyed to it. It also has two keys, which extend into the splines in the sleeve S_4, which, being driven by one of the gears of the train, causes the three wheels to revolve with it. The sleeve S_3 is supported in place by a second sleeve put in from the outside, and which also forms the bearing for S_3. Eight rings are marked on each of the sleeves, one for each wheel, the distance between each ring equalling the length of the wheel hubs. These rings are divided into three parts, and at each intersection is stamped the number of threads to be cut in that position, one set of wheels cutting three different screws by means of the three wheels W, W', W'' in combination with three wheels on the main screw.

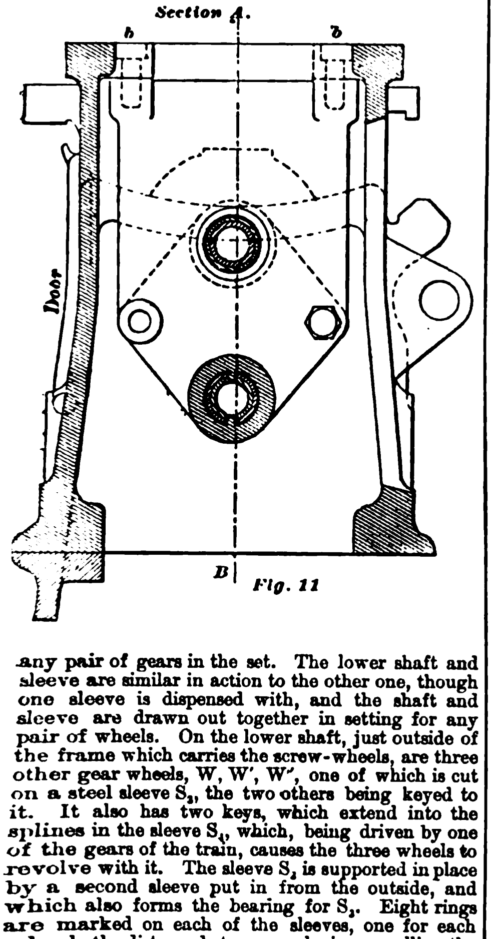


Fig. 11

The method of holding the screw gears in place is shown in part by Fig. 11, which gives an end elevation of the first plate through section A B, with dotted outline of the intermediate plate. This first plate extends up to the bed and is bolted fast, as shown at B, Fig. 2, and *b b*, Fig. 3. A plan and edge view of the intermediate plates is shown at Fig. 12. The terminal plate at the opposite end is seen at Fig. 13. It carries one of the bevel wheels *g''*, Fig. 10, and also has two end hubs, H, against the end of which the cast piece shown in two views at Fig. 14 is placed. This casting also serves as a journal box for gear *g'*, Fig. 10, the two set screws *s s*, setting up against the projection P, on the inside of the bed (section C D) gives slight side adjustment, while screw S', Fig. 10, carries the weight and gives the vertical adjustment. Two bolts, one on each side, pass through the hubs of all of the plates, fastening them firmly together. The pin *p*, projecting from the hub H, Fig. 13, serves as a pivot for the reversing arrangement. The hubs of the screw wheels project far enough on each side to go half-way through the larger hubs of the plates, while the bolt hubs project far enough beyond the larger ones to allow their surfaces to come together, and yet to allow room for the wheel webs, so that the wheels turn freely, while the plates are fastened solidly together.

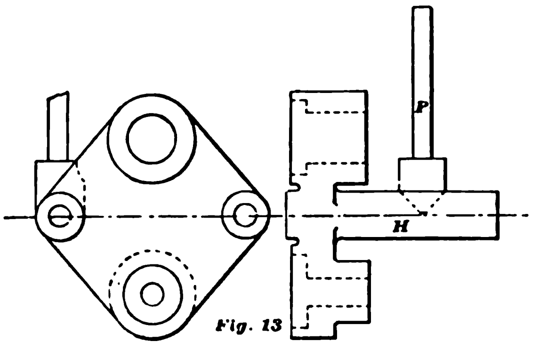


Fig. 13

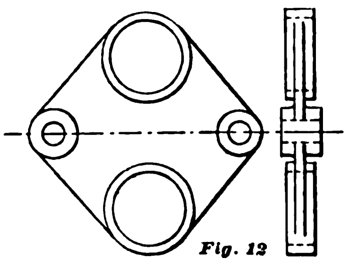


Fig. 12

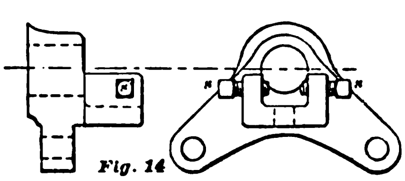


Fig. 14

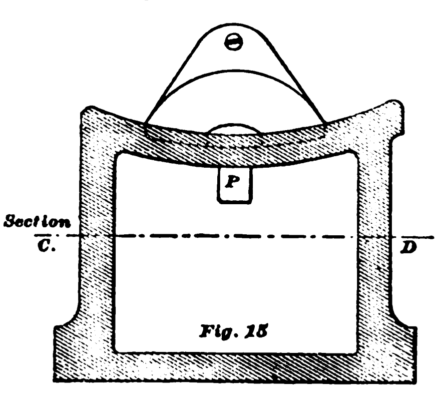


Fig. 15

THE BENNETT ACOUSTIC TELEPHONE.

EVERY business man is now familiar with the electric telephone, as it is seen to-day under the Bell patents, but there are many who are not aware that for private use, such as connecting residences, for communication from residence to office, for speaking-tube use in stores, hotels, &c., there is on the market an instrument—the Bennett acoustic telephone—which fills all these demands for limited distances, and which can be bought outright. The principle of the Bennett telephone depends solely upon the vibrations of a spring brass diaphragm, transmitted through a stranded iron wire tightly strung to a similar diaphragm at the other end of the line. The extreme simplicity of this instrument is seen by the description of the "Champion" telephone. In front there is an ordinary mouthpiece, serving to concentrate the wave of sound on to the brass diaphragm, which lies directly on the wooden board forming the base of the instrument. To modify the vibrations somewhat, a diaphragm of non-resonant material is laid in close proximity to the brass. The iron wire is then attached by means of a brass button, and the instrument is ready for use. The diaphragm of the telephone must be at right angles to the direction of the wire, as it approaches the instrument, and where it is not convenient to bring the wire direct to the back of the telephone another modified form must be used. The Bennett telephone is provided with a curved tube from the mouthpiece to the diaphragm, which in this form may occupy a horizontal, vertical, or oblique position to suit the direction of the outgoing wire, which, as a rule, lies directly under the end of the receiving tube. In this system of telephony one of the most important factors of success is the method of supporting the vibrating wire and of turning corners. The "Gilliland" insulator used by the National Telephone Company is simply a ball of iron with a ring at each end, through which the tie wire passes. This insulator is not inserted between the vibrating wire and the bracket; but the tie wire merely passes around the insulator, being in contact both with the vibrating wire and the bracket, the insulator having the effect of preventing the vibrations from passing to the bracket and being lost. These telephones will work successfully over a distance of from two to three miles on straight lines, but where many angles are encountered about a half-mile may be considered the maximum. The Bennett telephone is well covered by fifteen patents, and has been successfully introduced in many cities in the east and west.—*Electrical Review* (N.Y.)

One of the attractions at the Paris Exhibition is the great Imperial diamond, weighing 180 carats, being 44 more than the Regent diamond, and 74 carats heavier than the Koh-i-noor. The diamond belongs to a group of London capitalists, and is exhibited in the French Jewelry section in the Industrial Courts.

SCIENTIFIC NEWS.

ANOTHER comet has been discovered by Mr. E. E. Barnard, of the Lick Observatory, and, according to Dun Echt Circular, No. 171, Prof. Krueger telegraphed the following position:—June 23, 14h. 41·3m. local mean time; R.A. 1h. 20m. 53·4s.; N. Dec. 38° 50′ 44″. Motion plus 4m. 24s. in R.A., and plus 34′ in Declination. The comet is described as faint.

Prof. C. C. Hutchins, of Bowdoin College, Maine, has been working on the subject of lunar radiation, and his experiments, made with a thermograph having only one thermal junction, show an agreement with those of Lord Rosse and Prof. Langley, of Allegheny—that the heat received or reflected from the moon is cut off at the moment of totality in an eclipse. Prof. Hutchins considers that about half of the incident rays are absorbed, which would, therefore, render the surface of the moon very hot; but the evidence to be obtained from eclipses shows that scarcely any of the surface heat succeeds in passing through the earth's atmosphere.

The death is announced of the Director of the Palermo Observatory, Prof. G. Cacciatore, in his seventy-sixth year.

Dr. Charles Bland Radcliffe, consulting physician to the Westminster Hospital and the National Hospital for the Paralysed and Epileptic, died last week. Dr. Radcliffe had written various works, including "Epileptic and other Convulsive Affections of the Nervous System, their Pathology and Treatment," which went through several editions, "Vital Motion as a Means of Physical Motion," and a course of lectures delivered at the Royal College of Physicians, London, and "Epilepsy, Pain, Paralysis, and certain other Disorders of the Nervous System."

Dr. Pepper, Provost of the University of Pennsylvania, greatly wants to resign his post, but the trustees will not hear of it. He gets 5,000 dols. a year salary, and gives the college 10,000 dols. a year from his own pocket. No wonder they want him to stay. That is what the *New York Tribune* says.

The current number of the *Mineralogical Magazine* opens with a paper by Mr. L. Fletcher, in which he describes a new South American mineral under the name of "Daviesite." This mineral was obtained from the Mina Beatriz in the Sierra Gorda, Atacama, where it occurs in association with percylite, caracolite, and other minerals of less rarity than these species. Daviesite is found in very minute colourless crystals, of prismatic habit, belonging to the ortho-rhombic system; and it appears, from qualitative analysis, to be an oxychloride of lead. It is named after Mr. Thomas Davies, the well-known mineralogist, who for upwards of thirty years has been an officer in the mineralogical department of the British Museum.

The Council of the University College of North Wales have decided to open an Agricultural Department at the College in October, and steps have been taken with a view to the appointment of a Lecturer in Agriculture. The proposal for the formation of dairy schools in connection with the College has met with much support.

The Hopkins prize for the period 1877-1880 has been awarded by the Cambridge Philosophical Society to Prof. George Darwin.

Dr. Arch. Geikie has been elected a corresponding member of the Physical and Mathematical section of the Royal Academy of Sciences, Berlin.

The annual general meeting of the Marine Biological Association was held last week, when the adoption of the annual report — the first since the opening of the laboratory —was moved by Lord Walsingham, F.R.S., who remarked that the amount of work done during the year was more considerable than he could have thought possible. Prof. Flower, C.B., F.R.S., in moving the adoption of the treasurer's report, expressed a hope that the funds at the disposal of the Association would be so considerably increased that their range of work might increase too. His references to the many and very valuable services rendered by the retiring treasurer, Mr. Frank Crisp, were warmly supported by Mr. Gassiot and Prof. Ray Lankester. It is unfortunate that the appeal made last year for subscriptions towards the purchase of a good seaworthy boat has been so poorly responded to. The officers of the laboratory will be hampered and limited in their inquiries into the habits of sea-fish till they have a first-class boat at their command.

Prof. Sir W. Turner is the president-elect of the Anthropological Section of the British Association which meets at Newcastle in September, and as a coincidence it may be mentioned that one of the most valuable papers read at the meeting in Newcastle in 1863 was contributed by the distinguished anatomist who is to preside over the Section this session, and who was then one of the secretaries of the sub-section D of Physiology.

Lord Trayner, in a recent case, made some remarks which are worth the attention of patent agents and patentees. "A specification," the learned judge remarked, "may so insufficiently describe the process or the machine patented as to render the patent invalid. It may, nevertheless, contain sufficient description to disclose or publish the invention so as to prevent its being validly patented by another subsequently."

The dimensions of the Atlantic liners are gradually being increased until they begin to approach those of the *Great Eastern*. The *Majestic*, launched from Harland and Wolff's yard, Belfast, is 582ft. long, and, with her sister vessel the *Teutonic*, belongs to the White Star Line. They are believed to be the longest vessels afloat, but still fall short of the *Great Eastern's* length by more than 100ft. The vessels have a breadth of 57ft. 6in.; depth, 39ft. 4in.; and a gross tonnage of nearly 10,000 tons. They are built of Siemens-Martin steel, and will each be propelled by two independent sets of triple-expansion engines, constructed by Messrs. Harland and Wolff, driving twin propellers with manganese bronze blades. They are constructed with transverse bulkheads, and also with a longitudinal bulkhead running fore and aft. The vessels are intended to carry 300 saloon passengers. There is also accommodation for 150 second cabin passengers and about 750 in the steerage.

The new twin-screw steamer *Columbia*, the largest steamer ever built on the Mersey by Laird Brothers for the Hamburg-American Company's New York line, with engines of over 13,000H.P., made so satisfactory a trial trip (when she accomplished over 40 knots in an hour and 45 minutes), that the representatives of the Hamburg-American Company accepted the vessel in mid-ocean from the builders, the Union Jack being hauled down and the German flag hoisted in the Irish Sea. On Saturday the vessel left the Mersey for Hamburg, and was seen passing Dover at an average speed of 18 knots under easy steam.

Mr. H. A. Stoltenberg, C.E., of Chicago, proposes a system of elevated railroads for that city, in which the lines are to be carried at a much greater elevation, about 120ft. above the level of the streets. In this way not only will the noise caused by the trains be less audible below, but the light will be less obstructed, and as at this elevation the line will clear the roofs of the highest houses, much easier curves can be adopted. Lifts will be used for raising the passengers to the stations. Mr. Stoltenberg, whilst acknowledging that an equally good line could be obtained by going 60ft. below the level of the road, points to the awful state of the atmosphere on some portions of the London Metropolitan; but that objection should not apply to the City and Southwark Subway, now nearly finished, in which the trains are to be run by electricity, and which is situated at about the depth below the surface recommended by Mr. Stoltenberg.

At a recent meeting of the Physical Society Mr. A. W. Clayden read a "Note on Some Photographs of Lightning and of 'Black' Electric Sparks." The lightning photographs were obtained during a storm on June 6. Two flashes seen on one plate show a complicated and beautiful structure; one of them is a multiple flash, and flame-like appendages point upwards from every angle. The other is a broad ribbon, and although the plate shows signs of movement, the displacement is not in a direction such as would produce a ribbon-like effect from a simple flash. The second plate shows four flashes, none of which are ribbon-like, though the camera had moved considerably. The third plate was exposed to six flashes, one of which was believed to pass down the middle of the plate; but on development only a triple flash in one corner of the plate was seen. Careful search, however, revealed the central flash as a dark one with a white core, and other dark flashes were subsequently found. The plate was very much over-exposed, and this suggested that black flashes might be due to a sort of cumulative action caused by the superposition of the glare from a white cloud upon the normal image of the flash. To test this, sparks from a Wimshurst machine were photographed, and before development the plates were exposed to diffused gaslight for a short time. The bright sparks yielded normal images with reversed margins, and the faint ones were completely reversed. Other experiments showed the reversal to spread inwards as the time of exposure to gaslight increased. Finally, reversal was effected by placing a white screen behind the spark to represent a white cloud, the only illumination being that of the spark itself.

The trustees of the Elizabeth Thompson Science Fund, established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense," have issued a circular, stating that, as accumulated income is again available, they desire to receive applications for "appropriations" in aid of scientific work. This endowment is not for the benefit of any one department of science; but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from the fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points: (1) precise amount required; (2) exact nature of the investigation proposed; (3) conditions under which the research is to be prosecuted; (4) manner in which the appropriation asked for is to be expended. All applications should be forwarded to the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical Schools, Boston, Mass, U.S.A. It is intended to make new grants at the end of 1889. The trustees are disinclined, for the present, to make any grant exceeding 500dols.; preference will be given to applications for smaller amounts.

The electric street railway at Atlantic City, N.J., which is run on the Sprague system, has been visited by a large number of street railway men from all parts of the country, and electricians and others interested in electric traction. A record (June) of the operation of this road since the first cars were started shows that a grand total of 6,464 separate trips have been taken by the cars in operation upon this road. During this time, and in spite of the fact that the motors used were of the new Sprague type, which had hitherto not been tried upon any road, not a single trip was lost by the electric cars.

At the meeting of the San Francisco Microscopical Society, June 12, Mr. A. H. Breckenfeld exhibited some fine specimens of Melicerta ringens, a tube-building rotifer, belonging to the family of wheel animalcules. This variety is considered the most beautiful of the species, and builds for its protection an ingenious tube, which it forms of round pellets that are elaborated in the interior of the animalcule, and securely gummed together with a secretion derived from the same source. This rotifer, when feeding, extends itself partly from its tube and by means of several rows of cilia produces a rapid rotary motion, one set of cilia drawing a current of water containing food to its mouth, while another row ejects the débris by a current produced in an opposite direction. The tube and occupant are highly transparent, and viewed by dark ground illumination excite astonishment and wonder at the sagacity displayed by nature in protecting these minute organisms from their enemies and furnishing them with such elaborate means for obtaining their subsistence. Mr. Breckenfeld also exhibited a slide of Æcidium or "cluster-cup fungus," found infesting the scanty vegetation on Signal Peak, Yosemite Valley, some 7,000ft. above sea level. Dr. E. G. Clark exhibited some interesting slides of cinnabar ore in chalcedony, showing free mercury, a rare thing in the natural state. This gentleman also showed a beautiful mounting of crystallised gold, displaying the peculiar fern-leafed disposition of the crystals produced by galvanic current. Mr. C. Riedy exhibited his collection of old and rare works by the early writers on microscopy. The different volumes cover the entire field of microscopical research from its very beginning, and contain a complete résumé of the evolution of optical science, together with the progress of mechanics as applied to the microscope. Many of the editions—in fact, a majority of them—contain a high grade of illustrations, considering the date when they were executed, while some are embellished with fine-line copper-plate engravings that would do credit to our own day.

USEFUL AND SCIENTIFIC NOTES.

How to Make Ground Glass.—A writer on this subject says: I desired to have several pieces of ground glass, to use for some purpose. I first bought five cents worth of emery and two plates of glass of the size required. Spoiled negatives will answer, if they are cleaned, which can be done with a strong solution of lye. I placed one of the glasses on a flat board, and sprinkled a small quantity of emery on it, which I wetted with water. Placing the other glass on that, I ground them together, renewing the emery and water whenever necessary. In about one hour I had two of the finest quality of ground glasses, fully as good as those I would have to pay 75 cents for, 8 by 10 size.

Water-Gas.—Even at 1,000° the decomposition of watery vapour by carbon is incomplete. Before water-gas can be commonly used for heating or lighting, like coal-gas, a method must be found of communicating to this gas, which is in itself inodorous, a scent much more penetrating and persistent than that of coal-gas, since, by reason of the large proportion of carbon monoxide which it contains, it is at least five times more poisonous than coal-gas. The deadly character of a gaseous mixture seems to increase much more rapidly than the proportion of carbon monoxide. According to the researches of Dr. Wyss, the dangerous results of the inspiration either of coal-gas or water-gas are due solely to carbon monoxide. During the months of January and February, 1888, seven cases of poisoning from water-gas have occurred in New York. It is proposed that water-gas might be rendered odorous, so that its escape could be at once detected by means of mercaptan.—J. LANGE and J. LUNGE, in *Zeitschrift für Angewandte Chemie*.

The World Full of Death-Traps.—According to the *American Analyst*, the worst enemies of the human race are the doctors, who try to prolong our miserable existence in a world full of death-traps. One medico tells you not to eat or drink what you relish, because you will eat or drink too much. Another says that you must only eat what you fancy, because otherwise you will bolt your food without giving to each morsel the thirty-six mastications which are necessary for digestion. You must wear a respirator over your mouth, a pad on your chest, and a swarth of flannel round your loins. If you live in town, you will die of fog; if you go to the country, you will be poisoned by bad drainage; if you drink water, you are tempting the typhoid fiend; milk spells scarlatina, and tea-cake is sudden death. Do you shun these tempestuous pleasures of the senses and take refuge in the recreations of the mind? Do you borrow a novel from the circulating library? That is to import the germs of disease into a healthy household. The volume in your hands may have been perused by a person recovering from an infectious illness!

The Mint.—In the nineteenth annual report of the Deputy Master of the Mint it is stated that the gold coinage of 1888, although exceeding that of 1887, was below the average. No half-sovereigns were struck. The demand for silver coin was again excessive, and the Colonial coinage was very large. It is remarkable that, although £860,000 worth of silver coins of the new designs have been already issued for England and Wales alone, comparatively few are found in circulation. Fourpences of the nominal value of £570 were withdrawn, and for the first time since 1856 a coinage of fourpences was executed. These were shipped to British Guiana, where they are largely used for payment of task-work. The amount of new coin issued to Ireland during the year was much larger than usual, and the general demand for silver coin in that country is taken as an evidence of the improved state of business. The general account shows a net excess of receipts over expenses of £137,077, which is the largest balance of profit made in any year, except 1877, since the publication of the reports. A calculation with regard to the waste in gold coinage within a definite period has resulted in showing a gross waste of more than £745 per million. The fall in the price of copper is remarked upon. The average price paid by the Mint for this metal, which forms 95 per cent. of the bronze coins, was during 1888 about £84. From March, 1889, it rapidly declined, the price paid early in May being about £43 per ton.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

GASSENDI—DAYLIGHT OBSERVATIONS.

[30092.]—I HAVE not had time as yet to look into the questions opened up by M. Gaudibert in his interesting letter on Gassendi; but one thing I am pretty certain of is that the cause of my not seeing the little crater on the N.W. floor of the formation was on account of its being *covered by the shadow* of the N.W. wall at the time of my making the sketch. I was a little puzzled at first; but one must bear in mind, in comparing sketches, of the great alteration that libration makes in the perspective of the plain. However I hope later on to reply more in detail to M. Gaudibert's remarks, which are very interesting.

Our very valued "F.R.A.S." is generally so correct that it would seem presumption on my part to question any statement of his; but I must confess to not agreeing with him when he says (referring to the difficulty of daylight observations of stars and planets) that if the observation is due to volcanic dust or other matter in the upper air, the difficulty of seeing should be not only *near the sun*, but equally so in every part of the sky! Is he not forgetting that the trouble is due not so much to an *opaque* as to a *luminous* veil? That the sharply-defined circle of reddish light round the sun a few years ago was due to diffraction, I think there is little doubt, and that the matter causing this phenomenon was not only *round* the sun was shown by a very similar light (of course less brilliant, and *only seen when the sky was otherwise very clear*), seen by many observers, including myself, round the full moon at these times. The *origin* of the matter is another question.

The difficulty of daylight observation is greatly caused by bad definition, as when the sky is very clear the sun is also hot. I have at times seen Capella so badly defined as to be almost invisible at times with 10in. aperture, and at other times have easily seen the small companion to ϵ^2 Lyræ during a brilliant, hot August afternoon, the sky appearing equally blue in both cases. If a little disturbance of the air will render a star invisible in a blue sky, the same will apply even more strongly to a small planet on the lighter sky near the sun.

Herbert Ingall.

SUNSPOT.

[30093.]—A LARGE sunspot which I have been watching during the last thirteen days seems to prove that even during the minimum period it is necessary to keep a watch on the sun.

This spot has been of considerable interest. Its first appearance was on the 15th. When nearly central it appeared almost circular, exceeding $1'$ of arc in diameter.

I roughly estimated it in 5° south latitude; longitude 32°. The umbra appeared dense and unbroken and fringed with rapidly changing streamers. The penumbra was of great extent, and showed, when the atmosphere permitted, the usual radiated structure.

It was difficult to say whether there was any difference in the width on either side when foreshortening took place, although at its ingress the following side was the more extended. It had the usual accompaniment of small outlying spots, but towards the close they had mostly disappeared, and a separation of a portion of the umbra, at its northern extremity, had commenced.

On the 28th it passed out of view, being only recognisable at 8 a.m. on that day as a thin line close to the sun's western limb. Observers should be on the look-out for its return on July 11th.

E. Brown.

Further Barton, Cirencester, June 28.

METEORS.

[30094.]—I SHALL look forward to the next few weeks to see the criticisms on Mr. Cowan's letter (30083, p. 370) about meteorites.

The theory there propounded requires an amazing amount of faith; but would Mr. Cowan explain how it is that his meteorites only become visible when they come into the cone of the earth's shadow, which he calls "the shadow of night"? (Poetic, is it not?) As no amount of inspection of the night sky will show where the shadow is projected into space, does he imagine the earth's shadow to act as a hole in a screen to meteorites, and not to the stars beyond.

We are also required to assume that *all* visible meteorites are prodigious bodies, while those which actually reach us are accidentally small ones. Then we are asked to believe that cosmic matter, by basking in sunshine, will behave like luminous paint for varying periods of time, only with this exception, that they only spring into visibility *after* they have left sunlight. Again, I ask, under this theory, why not visible before they reach the shadow, and in a greater degree?

Other points suggest various replies; but the last clause is the index to the letter. It is useless to argue with any man who is "confident he is right" in any scientific speculation or theory, for a theory is always liable to be upset by a single observation not being explained by it.

M. E. Swan.

[30995.]—YOUR correspondent Mr. Wm. Cowan exhibits so much ingenuity that I hope he may yet theorise in astronomy to more purpose; but his present views will not, I think, meet with much acceptance. Mr. Booth will no doubt be able to satisfy him as to how the heights of many meteors have been ascertained, and the established connection of the Leonid meteors with the comet of 1866 is inconsistent with his theory as to this celebrated shower. There is, I think, no evidence of any material fluctuation in the limits of the atmosphere, and the earth's shadow certainly has not the effect which he ascribes to it.

To deal with this latter question, why do we not see stars in the daytime, and why are not the northern slopes of high mountains in this hemisphere enveloped in perpetual night? The answer is, On account of the quantity of sunlight irregularly reflected from the atmosphere. If further evidence of this is needed, it is afforded by the fact that if we cut off any large part of this reflected light, we can see stars in the daytime, as in the case given by another correpondent of going to the bottom of a well 110ft. deep. Why is this state of things altered at night? Simply because the sunlight is no longer reflected in sufficient quantities from the atmosphere. As long as twilight lasts some of the light is still reflected, and only a few of the brighter stars are seen. But when twilight ceases the stars come out brilliantly everywhere (provided that the sky is clear), although in most directions there is sunshine above us at a height which is small compared with the distance of most meteors, according to Mr. Cowan. There is, therefore, in the direction of these stars no atmosphere reflecting any appreciable portion of the sun's light beyond the limits of the earth's shadow, and I think Mr. Cowan will have no difficulty in seeing stars in directions where we would get clear of the earth's shadow at a height of 60 or 70 miles. Moonlight confirms this. The fainter stars disappear in bright moonlight on account of the amount of moonlight reflected from the atmosphere in their directions, but let the moon be eclipsed so that the moonlight is no longer reflected, and the stars appear again. Any considerable fluctuation in the height of this *reflecting* atmosphere would lead to a considerable change in the duration of twilight; and when we once get clear of the reflecting atmosphere the presence or absence of the earth's shadow can make no difference in the light of any self-luminous body. A meteor shining by reflected light would indeed be *eclipsed* in crossing the earth's shadow as the moon is; but this is the direct contrary of what Mr. Cowan supposes.

It is true—and observations on meteors partly prove it—that an atmosphere so rare as to reflect no sensible quantity of light may produce other effects. Meteors may be so heated by rushing through the atmosphere (I agree with Mr. Cowan in thinking that there is no combustion, they are not "burned up") as to become luminous at heights at which no sensible amount of light is reflected. But there is no satisfactory evidence of such an atmosphere at heights much exceeding 100 miles, though the heating process may very probably *commence* at the height of 200 miles, since it must go on for some time before the meteor can be seen. If, however, the atmosphere extended to the moon, the moon would, of course, be heated like the meteors, and its motions would be sensibly retarded. However, assuming that meteors are rendered luminous by rushing through the atmosphere at heights where there is no sensible reflection of light, no change would take place in the light of these meteors when they entered the shadow of the earth. In fact, if their point of nearest approach was situated outside of the shadow, the position of greatest luminosity would also be outside of it.

As to the velocities of meteors, I wish to add that if they moved with anything like the velocities ascribed to them by Mr. Cowan, their orbits would be strongly hyperbolic, and, consequently, when they once passed us they could never return. Bodies moving with such velocities could not, therefore, return periodically. This affords a serious objection to the late Mr. Proctor's explanation of meteors with fixed or stationary radiants. Meteors appear to come from the same radiant point for months in succession, not in a single year, but in many successive years. Can these meteors all be moving in very marked hyperbolic orbits? I think not. **W. H. S. Monck.**

OCULIST'S FORMULA—DIOPTRES.

[30096.]—The modern system of numeration of spectacle lenses, although very simple, seems to be a puzzle to some of your correspondents. May I be permitted to give a short explanation?

Instead of taking as a unit a lens of 1in. focus, and expressing lenses of greater focal length by fractions; the new and more convenient method takes as a unit a lens of 1 mètre focal length (100c.m.), which is called a dioptre, D, and all the series differ by relative intervals. Thus, a lens of twice the strength, or half a mètre focal length (50c.m.), is 2 dioptres (2 D); a lens five times the strength, or one-twentieth of a mètre focus (20c.m.), is 5 D, and so on. Between whole numbers are intermediate ones, differing by ·25, ·5, and ·75 D. The weakest lens of the series begins by 0·25, which has a focal length of 4 mètres, then come 0·5, or 2 mètre, 0·75 or 1·33 m., 1·0 or 1m., or 1·0 D, 1·25 D or 0·88m., and so onwards. Now, as a mètre is very nearly 40 English inches, it becomes very easy to reduce one system to the other, near enough, that is for practical purposes. A lens of 1·D focal length corresponds, then, to one of 40in., or, as expressed in the old system, to $\frac{1}{40}$; 2·D to one with double this refractive power, or $\frac{2}{40} = \frac{1}{20}$. The formula for converting old system into new, therefore, may be expressed by $\frac{d}{40} = \frac{1}{a}$, d representing the number of dioptres, and a the number of inches. Conversely, for converting new into old, $d = \frac{40}{a}$.

D.	Focus in English inches (approximate).
0·25	160
0·5	80
0·75	50
1·0	40
1·25	30
1·5	24
1·75	22
2·0	20
2·25	18
2·5	16
2·75	14
3·0	12

and so forth. The readiest method of finding focus of lens of unknown strength is to hold one end of a scale of inches or centimètres against a wall, and focus the image of a flame or bars of window upon it, carrying the lens along the scale until a sharp image is formed. The distance of the lens from the wall, as read off on the scale, will give the focus in inches or c.m.

For very accurate comparison of focal lengths there is a rather complicated apparatus, devised, I think, by Helmholtz.

I suppose I need hardly add that the sign + or − before any number means convex and concave, or positive and negative focus. **G. C. K.**

WHAT DO WE SEE?

[30097.]—A casual observation of your able correspondent "F.R.A.S.," in your last issue, leads me to make a few remarks on the above subject. The possible theories on it, I think, are only three in number: 1st. We see the real external objects themselves. 2nd. We see the image (or rather picture) on the retina. 3rd. We see something distinct from both the real objects and the picture on the retina.

The first of these is the popular view; the third, I think, is that of the scientific world, as well as of psychologists generally; the second is my own. This second theory is, no doubt, untenable if we can also detect the size, figure, and position of objects by touch; for if so, we could not fail to discover that the visible objects were much smaller than the tangible, and placed in an inverted position. But if a man holds a flower near me in the dark, I could very possibly describe its shape and colour from merely noticing the perfume. It does not follow that a blind man could learn the shape and colour of a flower by smelling it. In like manner, I might be able to tell at once the size and shape of an object by handling it in the dark, although touch gave me no information on this subject originally.

Further, I suppose a man born blind and paralysed (or devoid of the proper organs of touch) would be able, if he had smelled a wallflower more than once and had been told the name of it, to say that an object held near him was a wallflower. In like manner a blind man who had handled a square more than once, and had been told the name of it, would be able to say that the object presented to him (for handling) was a square; but he might as little understand what *I* mean by a square as the other man would understand what *I* mean by a wallflower. Therefore, before we are asked to explain why we see objects erect by means of an inverted image in the retina, I think there is a preliminary question—viz., Do we see them erect? **W. H. S. Monck.**

SPHERICAL SLIDE-REST v. DOME CHUCK.

[30098.]—I perceive "C. C. E." does not think it likely that Mr. Evans will respond to my appeal for information on the above subject. I will give what information I possess in hope of drawing out others who are more at home upon it.

I think, then, that the two pieces of apparatus differ very much in cost, the Sp. S.R. costing about £50, and the D.C. about £15. They differ in their range, though their powers overlap, so that there is much that can be done by either one or the other. I will point out the points of difference:—

Fig. 1.

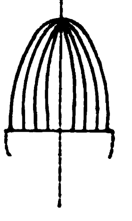
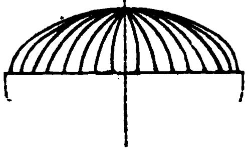


Fig. 2



Sp. S. Rest.	Dome Chuck.
Work does not require to be transferred.	Work, spherical or otherwise, must be first shaped on mandrel, and then transferred to D.C.
Contains its own segment apparatus.	Requires or renders very desirable a tangent screw, and segment stops upon the lathe pulley.
Cannot be used for rectangular work.	Can be used for the production of solids of square, hexagonal, or many sided cross-section, such as square bases to columns, &c.
Can be used in connection with the oval chuck, so as to produce solids of elliptical cross-section, such as the domed cover of an oval box.	Can be mounted upon the oval chuck, so as to produce solids of circular cross-section and elliptical longitudinal section.

The additional worm-wheel adjustment added by Messrs. Evans and Birch to their dome chucks I will leave in hopes that the makers will themselves explain them. I hope, too, that "C. C. E." will soon return home, and that we shall hear from him again. **F. A. M.**

A FRENCH LOCOMOTIVE WORKS.

[30099.]—I do not know whether Mr. Joshua Rose, who is an Englishman, and an occasional correspondent of yours, is likely to send you any notes on French machine shops; but, noticing the interest many of your readers take in lathe work and locomotives, the following extracts from a letter sent by him to the *Scientific American* may possibly be worthy of the space. Mr. Rose is describing a visit paid to the works of the Chemin de Fer du Nord, near Lille, and he says that in the Hellemmes shops there is one machine that finishes all the work on a locomotive cylinder complete. Now, the fact of using milling machines in place of planing machines does not prove that it is economical to do so; and as the question of the relative economy of these two machines has been much discussed of late in the United States, I may say that, judging by the quantity of machinery in comparison to the amount of work being done in the shop, milling machines must be very much more economical than planing machines. Indeed, I was surprised to find the smallness of the machinery part as compared to the size of the works. It may be explained, however, that the wheel department was separate, and there were more machines in the erecting shop and boiler shop than is usual. But the main fact remains—viz., that the milling machine has displaced the planing machine here, and, to my mind, with very great advantage. There is, indeed, I believe, but one planing machine in the whole of the works.

Those who consider that a frame carrying a cone and live spindle for driving the cutters, and a self-acting feed-table with two notch plates for index wheels, constitutes a complete milling machine claim the honour of its invention for England.

Whitworth made years ago a milling machine of the kind known in the United States as the Lincoln pattern, but whether he copied or was copied I have not as yet been able to determine. There is in the S.E.R. works at Ashford, Kent, a milling machine with a box frame carrying a live spindle with convenience for mills or cutters at each end, and a self-acting feed for both. How old this machine is I do not know, but it has been at work since 1849 to my knowledge, but on nuts only, and has none of the spiral feed motions or other fixtures that are the life of the American milling machine. Most of the lathes at Hellemmes are of French make, but made by an Englishman, and, while solid enough, possess some very awkward features. Locomotive fireboxes are here made of copper, and the firebox stays are also made of copper. In cutting the threads on these stays the pitch was found to alter, it was stated to me, on account of their getting warm from the cutting operation; but this I believe to be an error, and that the causes in such cases are due to the longitudinal strain caused by cutting the thread. The machine used for this purpose possesses a peculiar feature, which I only remember to have seen once before applied to a screw-cutting machine, and that many years ago, the principle being as follows:—The work-driving part of the machine corresponds to a lathe head, and the dies are carried in a sliding head taking the place of a lathe tailstock. On the live spindle, in place of a live centre, is a long hob, corresponding to those used on an American Fox lathe, and having a similar guide arm, which is attached to the die head, so that the hob acts as a lead screw, forcing the die head to travel at the right speed for the pitch of thread being cut. There is no doubt that a device of this kind is necessary whenever long screws or square threaded ones are to be cut.

A blunder is committed in this machine that has been very thoroughly exposed in the United States, and that there does not seem much excuse for, considering the attention that has been called to it in the past. I refer to the putting of three chasers in the head instead of four. As this machine is of English make, however, it is not fair to charge French practice with its errors. Curiously enough the tays have four plates, but the company make their own taps, and, indeed, have their own thread, there being no standard in France.

One or two things with reference to the lathe work struck me as remarkable. For example, I saw no universal chucks, the chuck plates having round holes in them, into which fitted movable dogs. One or two lathes had turret heads, with the usual complement of tools; but there were no stop motions to them, and as a result the workman went on measuring for each cut just as he would have to do without the turret, which, I may observe, was placed on the top of the slide-rest. I saw the same thing done in an English shop, and so suppose it is a regular thing here; but do not see why so much of the advantage of the turret should be lost for the mere want of a stop motion.

My curiosity was aroused to find on the smaller lathes, say up to 24in. swing, long-handled hand tools, and I waited some time to see what they were used for. At last I found that, to take the finishing cut, these hand tools were used in connection with the automatic feed of the lathe, being merely held in the hand and resting on the roughing tool while fed automatically, the idea being, no doubt, to save taking out the roughing tool to resharpen it for every finishing cut. I am bound to say that, so far as I could see without examining the work, the men seemed to get along very well this way; but I have no hesitation in saying that it is not a commendable practice, as more parallel and true work will certainly be got by a rigidly held slide-rest tool.

Emery grinding machines are used for the mills and cutters, these machines having been designed at the works. The tools look well sharpened, and were evidently hardened right out, and not lowered in temper at all. They had evidently, however, been quenched in oil, for if quenched in water they would have been whiter. The cutter-grinding machine is not as well designed as similar machines are in the United States, and yet, from the number of large milling machines and the variety of work they were applied to, the works will compare favourably with any other works I have yet seen anywhere.

In the wheel shop I noticed a lathe that, while it drove the axle from the middle, as is done in the axle lathes of the Niles Tool Works and of Wm. Sellers and Co., yet had no tail-stocks or dead centres; but the work was steady, nevertheless, and cuts of ¼in. deep were being taken off. Two men, one on each end of the axle, were working at this lathe. I also noticed that in turning up the journals of axles that had the wheels on, a split pulley was put on the axle to drive it by, so that both lathe centres were dead centres, and the truth of the journals was, therefore, independent of the truth of the live centre of the lathe, and this is an excellent idea.

A machine for grinding up guide-bars was constructed to use what may be called cupped emery wheels (corresponding in shape to those in use in some of the planer knife-grinding machines in the United States). Wooden wheels, covered with coarse emery, were used; but I do not think this machine anything like equal to the American style, where the bars or work rests on the face of a table through a groove in which the perimeter of the emery wheel projects to an amount equal to the depth of the cut, and the bar is merely slid along the table over the wheel, because when, as in the French machine, there is a feeding mechanism to the machine, there is a want of solidity and a chance for lost motion.

The drilling machines call for no especial notice, except one that was used to drill ¼in. holes through copper stays about 6¼in. long. The machine was belted to run about 800 revolutions per minute on what may be called the Sellers system, the belt passing over guide pulleys to a pulley fast on the drill spindle, thus getting the requisite speed without the use of gearing; and this is undoubtedly the best way to drive a drill, when it can be done, or in other words, to drive drills of moderate diameters. The stem of the drill passed through the somewhat flattened end of a pipe conveying the soap water, which passed down the stem of the drill to the cutting end, which was about $\frac{1}{16}$in. larger than the drill stem and shaped like a very keen twist drill, the twist end not being over ¼in. long. The feed was given both by hand and foot at the same time, and it took, on an average, 70 seconds to drill one stay, which I call good work.

Another machine worth calling attention to was one for truing up the sliding faces of axle boxes, which was done by a cupped emery wheel similar to that described with reference to the guide-bar grinding machine. This, however, I think a more desirable form of machine for its purpose. The emery used on these two machines was very coarse —about as large, say, as No. 6 gun shot, or perhaps larger.

Taking these shops as a whole, they compare favourably with either American or English shops, and are well worthy of a visit.—Joshua Rose.

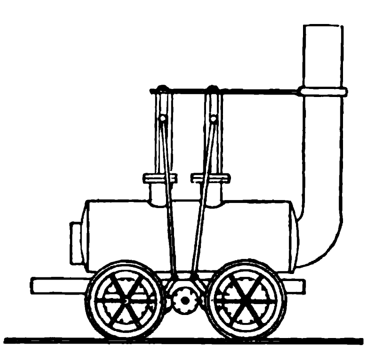
That is the essence of Mr. Rose's letter, and I think it may interest those of your readers who are machinists and lathemen.

Providence, R.I. **T. M. P.**

GEORGE STEPHENSON'S FIRST ENGINE.

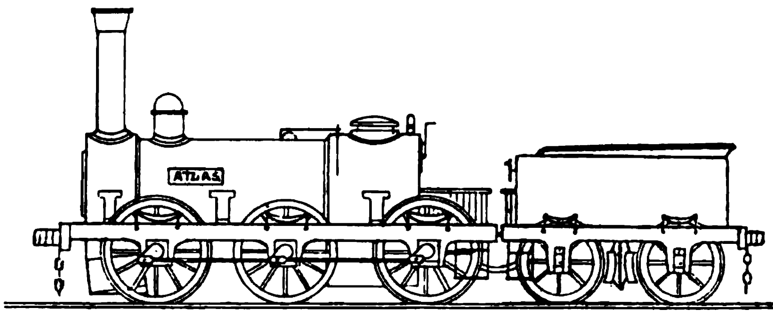
[30100.]—Towards the close of the year 1813 Lord Ravensworth and partners in the Killingworth Colliery intrusted George Stephenson, the enginewright, with money to construct a locomotive engine for their railway. The engine was built at the West Moor workshops of the colliery, and after being about ten months in hand, was placed upon the Killingworth Railway, and tried for the first time on the 25th July, 1814, and was named or generally known as "Blutcher."

The engine ran upon four smooth wheels of 3ft. diameter, placed 5ft. apart between centres. The boiler was 8ft. long, 34in. diameter, having a flue-tube passing through it of 20in. diameter. The cylinders were 8in. diameter, 24in. stroke, and placed vertically half within the boiler. The power of the two cylinders was combined by means of two spur-wheels, as shown in the diagram. On the 25th July, 1814, the "Blutcher" conveyed a train of eight waggons of coal, weighing 30 tons, up a gradient of 1 in 450 at a speed of four miles an hour.



The engine was not provided with springs, and the cogwheels becoming worn, Stephenson was intrusted with money to construct a second engine. This was built in 1815, under a patent granted to Stephenson and Dodd, 28th February, 1815. In this second engine the connecting-rods were attached direct to crank-pins upon the wheels, and the exhaust steam was discharged into the chimney by two blast pipes.

Leicester, June 27. **Clement E. Stretton.**



LOCOMOTIVES.

[30101.]—In my letter p. 304, the gradual development of the four-wheeled engine into the six-wheeled type was traced. The "Hercules," which was illustrated, showed the construction of the goods engine having four coupled wheels and a pair of small trailing wheels.

During the year 1833 the increase of coal traffic upon the Leicester and Swannington Railway necessitated the use of more powerful engines to convey the coal trains between the top of the Swannington and the top of the Bagworth inclines, the gradients rising 1 in 251 and 1 in 203.

To overcome the difficulty, Mr. Stephenson decided, in September, 1833, to construct a further development of the "Hercules" type by substituting another pair of coupled wheels in place of small trailing wheels.

The new engine was completed at Newcastle upon the 8th February, 1834, being No. 58 in the books of the makers, and the fourth engine constructed under the patent of 1833. It was named "Atlas," and No. 7 in the books of the Leicester and Swannington Railway.

Diameter of cylinders, 16in.; stroke, 20in.; length of boiler barrel, 8ft. 6in.; diameter of boiler, 3ft. 11in.; number of tubes, 154; diameter of tubes, 1⅝in.; heating surface of tubes, 589·05sq.ft.; heating surface of firebox, 67·45sq.ft.; total, 656·50sq.ft. Diameter of six coupled wheels, 4ft. 6in.; length of frame, 18ft. 10½in.; wheel base, 11ft. 7½in.; pressure of steam 60lb. per square inch, afterwards increased to 70lb.; weight in working order, 15 tons; weight of tender fully loaded, 5 tons; total, 20 tons.

Our readers will see that the "Atlas" having inside cylinders and six coupled wheels is the type of goods engine very largely employed in this country.

The valve gear consisted of a single eccentric for each cylinder, and the engine was reversed by means of "treddles" on the foot-plate.

The "Atlas" was stationed at Coalville, and worked satisfactorily for fully 25 years.

In 1835, Messrs. Tayleur and Co., of the Vulcan Foundry, Warrington, constructed an engine of similar design, named "Vulcan," for the Leicester and Swannington line, and it was also stationed at Coalville. **Clement E. Stretton,**

Consulting Engineer Assoc. Soc. of Enginemen and Firemen.

40, Saxe Coburg-street, Leicester, June 26.

THE EFFICACY OF LARGE APERTURES IN MICROSCOPY.

[30102.]—A friend has lent me the last bound volume of the *Journal* of the Quekett Club, in which I have read with great interest the paper by the President (read Jan. 25, 1889), concerning the diffraction theory of Prof. Abbe. I am myself inclined to think that scepticism, in regard to the truth of that theory, is growing. The experiments described, and so well known, were apparently so convincing that at first they took us all by storm. I certainly was no exception, and was convinced with the rest, and the unbelievers at that time were in most cases easily convicted of very limited knowledge concerning the subject they discussed. I doubt if this is the case at present, or if the tone adopted in some quarters respecting sceptics can now, or will ultimately, be justified. I believe one authority in particular, who combines the most extensive acquaintance with physical optics, with the most profound knowledge of the mathematics of the subject to be found in this country, finds himself quite unable to believe in the diffraction theory. To myself some of the phenomena of gratings appear irreconcilable with it, and I have an idea that by experiment in this direction the truth will probably be ascertained; but I have had no time as yet to work out any of the experiments which suggest themselves to my mind, and have at present no views of my own to propound. The purport of these remarks is simply to call attention to a new theory put forward by Prof. Lowne, and to suggest an absolutely crucial experiment by which that, at least, may be determined.

The weak point with all those of us who question the diffraction theory is that we have as yet no other tenable view to propound, which seems to account in any way for the undoubted facts which Abbe and Stephenson have worked out, for the results of their "diffraction" experiments, or for the actual effects of high apertures as regards resolution. The interesting point in the paper referred to is that for the first time it does propound a theory which is at least intelligible; whether true is another matter. In brief, the president of the Quekett suggests that the diatom to be resolved is *illuminated* by *reflection* from the posterior surface of the front hemispherical lens. He thinks this view borne out by the fact that certain parts of the image are *brighter* than the blank field; and he affirms that "only the centre of the pencil falling upon the back surface of the front lens is transmitted to the eye." He adds, "I believe that this is the great advantage derived from high angles of aperture." That is, as I understand him, more illumination of the top face of the diatom in the manner of a Lieberkühn. He proposes to test this matter by further experiments.

I have myself very grave doubts if this new theory is correct; but it is a singularly interesting one. I draw attention to it partly as a proof that speculation is not yet at an end, but chiefly to point out that there is one most simple experiment, easily made, which will determine it with absolute certainty. That is, to *silver the back* of the front lens, and then remove the silver from the centre of the back only. The reflection from the margin will be, if anything, rather increased; and whatever becomes of the theory in question, I believe the expedient may prove of some service as an illuminator of certain objects, and may give valuable resolution of structure by the modification in this point. But the silver will really stop off all but the central pencil, which it will allow to pass unaltered; and if Prof. Lowne's theory is correct, the "high" resolution will be unaffected. I hope such an experiment will be made without delay, and it will be well worth while merely as one in illumination, if no one has attempted it before. I am afraid, however, it will demolish the theory, for if the latter be sound, one would say that *all* lenses with hemispherical fronts ought to give equal resolution, irrespective of aperture, which belongs to the *back* portion of the lens. This is not the case, and I fear we have yet to find a theory which shall reconcile the undoubted facts with conclusions that seem forced upon us by the phenomena of physical optics.

June 24. **Lewis Wright.**

MOUNTING INSECTS IN BALSAM.

[30103.]—Your readers are no doubt familiar with the usual methods of preparing and mounting insects in balsam; but at the meeting of the San Francisco Microscopical Society, on April 24, Mr. Lickenby referred to some special points, which may be of interest. It is quite difficult in preparing many of the smaller forms of insects to remove the débris from the surface of the specimen without injuring the delicate portions. This Mr. Lickenby accomplishes by the aid of albumen, flowing the white of an egg over the object and immersing the slide in hot water till the albumen is coagulated, when it will generally crack open and may be removed in two portions, carrying with it all the foreign matter and leaving the surface of the specimen perfectly clean. Another thing strongly advocated is thorough washing of the objects in running water, and a final rinsing in either filtered or distilled water before placing in alcohol. In mounting the insect is placed under the cover glass arranged in proper shape, the clearing solution applied, and when sufficiently transparent the oil of cloves is drained away and Canada balsam introduced at one edge of the cover glass, the slide being held over the flame of a lamp to gently warm the balsam and allow it to flow in and displace the remaining oil of cloves. No annoyance need be felt at the presence of bubbles of air, as they will all gradually disappear. The mount, when filled with balsam, is placed in a warm oven or incubator and kept at a temperature of from 120° to 130° Fahrenheit for 24 hours, when the balsam will be thoroughly hardened and all the air-bubbles driven out. Mr. Lickenby does not advocate the use of volatile solvents with balsam, he being convinced that a certain amount of gas is always retained in the mount in a latent state, requiring only a slight amount of heat to produce bubbles and disfigure the specimen. The outer skeleton of insects is composed of a substance called *chitine*, which is quite unique in its chemical composition. It appears to be, within certain limits, very resistant to acids and alkalis, and it is owing to this fact that caustic potash can be used in such varying proportions in treating them for microscopical study. It is said, however, that *chitine* succumbs to the action of chlorine compounds, which would render that substance unfit for use in bleaching many of the delicate forms. **Cal.**

THE MAN-EATING TIGRESS.

[30104.]—The notorious Jounsar man-eating tigress has at last been killed by a young forest officer. This tigress has been the scourge of the neighbourhood of Chakrata for the last ten years, and her victims have been innumerable. On one occasion she seized one out of a number of foresters who were sleeping together in a hut, carried him off, and deliberately made him over to her cubs to play with, while she protected their innocent gambols from being disturbed. His companions were eventually forced to take refuge in a tree from her savage attacks. Here they witnessed the following ghastly tragedy. The tigress went back and stood over the prostrate form of her victim and purred in a catlike and self-complacent way to her cubs, who were romping about and rolling over the apparently lifeless body. She then lay down a few yards off, and with blinking eyes watched the gambols of her young progeny. In a few moments the man sat up and tried to beat the young brutes off. They were too young to hold him down, so he made a desperate attempt to shake himself free, and started off at a run; but before he had gone twenty yards the tigress bounded out and brought him back to her cubs. Once more the doomed wretch had to defend himself over again from their playful attacks. He made renewed attempts to regain his freedom, but was seized by the old tigress and brought back each time before he had gone many yards. His groans and cries for help were heart-rending; but the men on the tree were paralysed with fear, and quite unable to move. At last the tigress herself joined in the gambols of her cubs, and the wretched man was thrown about and tossed over her head exactly as many of us have seen our domestic cat throw rats and mice about before beginning to feed on them. The man's efforts at escape grew feebler. For the last time they saw him try to get away on his hands and knees towards a large fig-tree, with the cubs clinging to his limbs. This final attempt was as futile as the rest. The tigress brought him back once again, and then held him down under her forepaws, and deliberately began her living meal before their eyes.

It was this formidable beast that the young Cooper's Hill officer and a student attacked on foot. They were working up her trail, fifteen yards apart, when suddenly Mr. Osmaston heard his younger companion groan, and, turning round, saw him borne to the ground by the tigress. Mr. Osmaston fortunately succeeded in shooting her through the spine, and a second ball stopped her in mid spring. Meantime his companion rolled over the hill, and was eventually discovered insensible a few feet away from his terrible assailant. He is terribly mauled, and now lies at the Chakrata Station Hospital, where hopes of his recovery are entertained. **Eos.**

MERCURIAL SPEED REGULATORS.

[30105.]—Will Mr. Higginson (p. 350) accept my thanks for pointing out to me the fact that the invention in question is better than was specified in the specification? It is not every invention that turns out so creditably. Again, he says my knowledge is greater than in 1881. This is also very complimentary. Still, he must be very dull who learns nothing in less than eight years. Mr. Higginson tries to draw your readers away from the real facts of the case by classing the apparatus I sent with others that was invented for a different purpose.

By your permission, Mr. Editor, I will explain the reasons why the one I sent you was invented, so that your readers will not mistake its true meaning. Having put some new machinery in, we wanted to run at the highest maximum speed. The engine driving the machinery is coupled with a water-wheel that turns one-half of the weight. When the engine was only half-loaded, and some heavy machinery was thrown off, the engine increased in speed, and before it could be adjusted some amount of damage was done. To improve this we took out a slow Watt governor, and put one of Busse's patent governors in its place, with somewhat better results, but still not satisfactory. We had a weight on a lever leading to throttle-valve that had to be constantly moved to bring the engine to its required speed. To dispense with the movable weight the mercury vessels were applied in 1881, as shown in my sketch, and we have had no trouble of that kind since, as the apparatus give almost perfect isochronism to the governor. The mercury vessels as shown in my sketch have been at work for more than eight years, like two good sentinels doing their work well.

Mr. Lancaster, a well-known inventor and machinist, of Accrington, has had the one described on June 7th on his engine for six years, and I will give you his own words concerning it. He says:—"I applied mercurial speed regulator to my engine immediately after you sent it, and it has been on ever since and works exceedingly well, and is a capital speed regulator. Every engine should have one of these regulators; it is the best in existence."

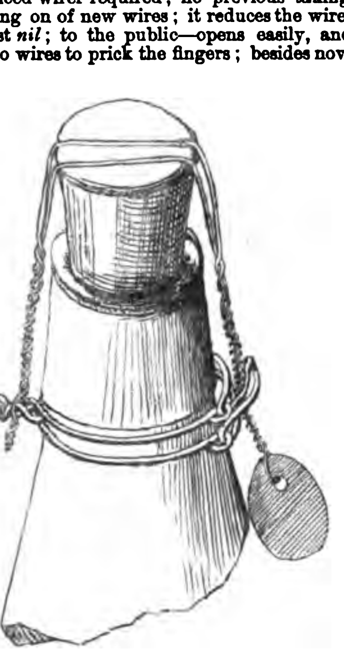
The above are not my words, but those of a gentleman speaking independently upon the matter. I think enough has been said to satisfy your readers they can apply this invention.

With Mr. Higginson's patent I have nothing to do, nor the lines on which he works it. He hints at litigation; that amounts to nothing, as I think neither Mr. Lancaster nor ourselves will take ours off at his request.

Todmorden. **W. H. Sutcliffe.**

IMPROVED MEANS FOR RETAINING CORKS IN BOTTLE-NECKS USED FOR AERATED LIQUIDS. MAIN FEATURE: FIXING THE CORK AT ANY HEIGHT.

[30106.]—In sending you my invention for your inspection, I may mention it has, over a space of two years, been well tested, and during that time has been frequently altered and improved, till it has assumed its present state of simplicity and utility. It fixes the cork at any height with rapidity and security, and offers the following advantages:—No experienced wirer required; no previous taking off and fixing on of new wires; it reduces the wire bill to almost *nil*; to the public—opens easily, and at once; no wires to prick the fingers; besides novelty with the public commands attraction. The tin disc may be used for a label or otherwise. The catch may be made to suit any degree of lightness. In washing the bottles, the wires need not be left dangling, but placed in the catch to hang thus: U. Their cost in manufacturing would be little. A double wire with fancy twist might be used for high-class trade. Soft brass wire looks and lasts well (over cork). As to trial: those accustomed to the ordinary way take kindly to no new method; but after a little practice it will be found to be the quickest method of fixing corks by hand yet introduced.



The glass-stoppered bottles have become deservedly popular; but those in the trade know a large section of the public object to the rubber ring; also any dirt or dust that gathers is pushed in on opening. Again, the thousands of existing factories have already machines for cork bottles, and would, I am convinced, rather than further speculate, go in for a saving on their present system; therefore I conclude it answers a want in that direction. **And. Bowers.**

6, Ramsay-place, Portobello, Edinburgh.

EXPLOSIVES.

[30107.]—Having given you two letters on black gunpowder, I will now call attention to other explosives, such as were partly described at the meeting of the Royal United Service Institution on the 5th April last; for example, cocoa powder, nitrate of ammonium gunpowder, E. X. E. powder, perforated cake powder, S. B. C. powder, smokeless powder, Schultze's powder, poudre B., Johnson, Borland powder, F. Engel's, F. C. Glaser's, E. Turpin's, C. F. Hengst's, and the like.

The last named I took in hand for trial, and in my opinion it well deserves careful attention, for my practical experience of it is certainly suggestive of efficiency.

My target was two deal boards, each ⅝in. thick, planed and lightly screwed together; total thickness 1¼in. The bullets used were all identical; but while with black rifle powder they only stuck in the first board, the Hengst powder of the same bulk, but of only one-third the weight, drove them clean through both boards, and beyond. Now the black powder would have a muzzle velocity of about 1,300ft.

The question now arises, What may be the greater propelling force of the "Hengst," that with one-third of the quantity does more than twice the work of the black?

I have not yet tested for range in the open, but estimate it as very considerable.

John Shakespear.

Colonel late R.A., J.P., &c., A.M.Inst.C.E.

25, Great George-street, S.W., June 28.

A PIANO FOR EVERYBODY.

[30108.]—I congratulate "Vandal" on his appropriate pseudonym in yours of June 14.

The American "organ" is not fit to be named on the same day as the harmonium. People will not take the trouble to learn the latter, and prices are thus kept too low to enable it to be made otherwise than cheaply and coarsely.

Granted that the *timbre* of the former is slightly superior—though this difference disappears at once at the first attempt to get power—the latter has the grand feature, redeeming it a hundredfold, of exquisite expression. *It can sing*, and an instrument that cannot do this is beyond defence. A well-made harmonium is what it pretends to be, and any musician may be proud to understand and handle it.

Contrast this with the former. Its snobbish assumption of a grand name; its vulgar, meaningless, grimcrack case; its dummy "real pipe front," suggesting a "combination of pipes and reeds," its "four rows of reeds," resolving themselves into one and a half; its array of useless, practically dummy, "stops," and other lying pretences to deceive credulous clerics; worse than all, its starveling, mawkish, expressionless, soulless, eunuch voice. Pah!

I suggest "American eunuch snob" as the true title for this abomination. **Thomas Casson.**

THE EIFFEL TOWER.

[30109.]—In the article on the Paris Exhibition in your last issue, M. C. Detaille states that the range of vision from the third platform of the Eiffel Tower—a height of 900ft.—is 56 miles. This appears to me to be a mistake, for taking the depression due to curvature as 8in. per mile, reduced to say 6in. per mile by the effects of refraction, the distance of the view from that height would extend to only slightly over 41 miles. Of course high objects would be visible at a greater distance than that.

Hetton-le-Hole. **Lyons.**

THE HARDENING AND TEMPERING OF STEEL.

[30110.]—The *raison d'être* of this peculiar phenomenon has long been an open question, and, I believe, remains so still, notwithstanding that of late years a largely-increased use of the metal has directed especial attention to the whole subject.

In putting forward the following views, I do not claim any special ability to solve the problem; but I believe that the theory I shall here enunciate will adequately explain its every aspect, and I shall endeavour to show how. If I am wrong in any point, I hope your readers will correct me, and even though I am all wrong, there will be nothing lost if my mistakes bring some of the phenomenally active minds of your correspondents to bear upon a question of so much importance to the mechanical and scientific world. This embryo theory is not born of any experimental discoveries of my own, but is chiefly derived from considerations evolved from the researches of Sir F. Abel and Prof. Hughes, and what new factors I shall introduce are based upon certain well-known properties of the two distinctive constituents of the metal.

To save repetition, I will first briefly summarise these various data, and on this solid foundation proceed to build my, perhaps, airy castle. The references are mostly to articles in this journal.

Prof. Hughes, by electrical and magnetic tests, found that soft iron, subjected to torsional strains, exhibited considerable molecular freedom: annealed steel a little less; and hardened steel scarcely any at all (XXXVII. 2). From these experiments he arrived at the numerical results that quenching increased the molecular rigidity of iron by 35 per cent.; of steel, 400 per cent.; while hammering or mechanical compression gave to each an increase of 50 per cent. (XXXVIII. 463). He also concluded that a hardened specimen of steel contained a larger amount of fixed carbon than when in the annealed state.

Mr. I. S. Parker, in the *Chemical News*, stated that, in estimating carbon by Eggertz' colour test, hardened steel imparts less colouration than is due to the actual percentage; also that the undissolved residue retains a skeleton form of the original mass, while a softened specimen of the same steel yields a much deeper colour and a flocculent precipitate. And Mr. L. Archbutt, in a letter (XXXVII. 386) calling attention to the unreliability of Eggertz' test, shows that the harder the steel, the less the colour.

Sir F. Abel, from special experiments on the subject, found that the carbon exists in annealed steel as a "carbide of iron of uniform composition and uniformly diffused," while a great proportion of that in hardened steel is "fixed." He concluded that the rapidity of cooling fixes it before it can recombine; by which he seems to imply that the previous heating dissociates the carbide into its component elements. He also noted a similar distinction to that observed by Parker; hardened specimens, when treated with chloride of copper, precipitating their carbon in a more coherent form than either cold-rolled or annealed.

It has also been shown that hardened steel has a diminished specific gravity, which significant fact seems to have been entirely overlooked by Prof. Akerman when he formulated his compression theory (XXX. 109, 134). And, indeed, seeing the extreme hardness that may be produced by a sudden abstraction of heat compared with the very minimum degree to be attained by mechanical compression, it is manifest that the iron plays only a secondary part in the phenomenon. The whole balance of evidence points to an altered condition of the carbon, there being nothing to indicate that the iron has undergone any change whatever, except that magnetic tests, and, in fact, the whole nature of the hardened steel, show an enormous increase of molecular rigidity. And the measure of this property is, in a sense, a measure of hardness, so that Hughes's researches in this direction do not help us much—only confirming what might justly be surmised.

It is then to the carbon that we must turn for an explanation, and it appears to me a very promising source. It is shown on all sides that the sudden cooling in some mysterious manner fixesthe carbon, and it is also practically proved by the fore-mentioned variations in the colour test that the amount of carbon thus fixed is proportional to the degree of hardness. But no importance seems to have been attached to these deductions, probably on the assumption that the carbon is fixed as graphite. With this I disagree, believing it has gone a stage further, and crystallised, or more properly, condensed, into the diamond form. On this hypothesis the various properties and peculiarities of the hardened steel may be readily explained. Thus the hardness of the cutting edge is due to the presence of innumerable diamond points, and the increased elasticity, resistance to attrition, and strains and brittleness, to the intricate network of a substance of intense molecular rigidity, but with a small range of elasticity, pervading the mass of iron and binding it together with inflexible but fragile bonds. In annealing the crystalline strains are released, and colour tempering is a graduation of the same process. The anomalous increase of bulk is readily explicable on the dissociation hypothesis of Sir F. Abel; but this is not at all clearly defined, and, as far as I am aware, the only test is the comparative solubility: it is quite possible that the crystal skeleton may be an insoluble form of the original carbide. If this is so, we can only suppose that, in assuming its cellular formation, it has set up molecular strains sufficient to account for the visible expansion, and compensate for the necessary condensation in its own bulk.

So much for the plausibility of our theory, which is perhaps not very original after all. It is certainly not very startling, and one can build his faith upon it quite as confidently as upon any theory of molecular aggregation—that high-sounding term that has to cover such a multitude of mysteries. We have somewhat prematurely called it a *theory*, but as it stands it is only an *opinion*, and before it can be dignified with the former title we must go deeper and inquire into the mode and cause of the change that we have above indicated as probable. And this inquiry has an intimate bearing upon, and virtually is, a question of wider and more mysterious interest—the formation of diamonds. I have not made a close study of mineralogy; but I believe the suggestion I shall here make is somewhat novel, and has an extensive application throughout the whole science of physical chemistry.

Putting it tersely and generally, it is that the temperature variations in the specific heat of a substance have an intimate connection with its form modifications. To avoid multitudinous side issues, I shall only consider the special application: but from this readers will no doubt be able to divine on what grounds the hypothesis is based, and how it may affect other questions besides the one under review.

First noting data, we find that carbon exists in at least three very dissimilar modifications of form—the amorphous, the graphitic, and diamond; and there is another—*carbonado*—a kind of black, uncrystalline diamond, which, if pure and homogeneous, would be an intermediate between the two last. Of these, graphite has a specific gravity variously estimated as from 1·2 to 2·3, and a specific heat of 0·168 at 22° C., and 0·449 at 650°. Diamond has specific gravity 3·5, specific heat of 0·0635 at 50°, of 0·1318 at 33°, of 0·2218 at 140°, of 0·3026 at 250°, 0·441 at 600°, and 0·459 at 980°. The two other members of the group—silicon and boron—exhibit similar peculiarities, but in a less degree. None of the remaining elements exhibit variations approaching these, neither in the marked modifications of form, nor in the rapid increase of the specific heats; therefore, the two properties being co-existent, it may not unreasonably be presumed that the one is dependent on the other.

If a piece of graphite be heated to about 700° C., it will absorb a quantity of heat energy equal to the gross sum of its specific heats between the initial and ultimate temperatures; being then slowly cooled, it will lose ·45 calories during the first unit fall in temperature, and a decreasing quantity for each successive degree, until the added heat is again dissipated. Now, if the loss were to continue constant at the higher rate, through a number of degrees, an extra loss would result, which would necessarily be taken from the latent or internal heat of the body. As it is very probable that, as in the primary changes of state, these secondary changes are attended by a displacement of latent heat, we have here a possible cause of the change. It is only necessary that there should be a tendency to disperse the added heat at a uniform rate, and it is not at all inconceivable that a sudden cooling may incite this tendency, or, in other words, that a rapid outflow of heat may cause an overflow, the rapidity of the action giving the too powerful impetus that disturbs the balance, and establishes a permanent displacement. Thus a change of state is effected, and there can be no reversion to the old form except by the internal absorption of an equivalent of its loss. And, as there are new molecular strains to be overcome, the heat energy thus absorbed must be of a certain potential, and any lower temperature, however long continued, can have no alterative effect.

Applying this hypothethis to the case of steel, it is at once evident that the conditions are especially favourable. Here there is a small proportion of carbon intimately diffused through a medium of good heat abstractive power; and thus haplessly situated it cannot fail to suffer depredation. The iron, too, may suffer loss in a similar manner, but to a much less extent; and its molecular relations being powerful, and not easily disturbed, it would recover its lost energy at the further expense of the more amenable carbon.

The same reasoning applies to the chilling of cast iron. Since it contains a greater percentage of carbon, and is chilled at a higher temperature, we should expect to find it harder. This is attested by actual experience—a chilled iron tool having been known to cut where the hardest steel has failed. It is also noteworthy that the above argument anent the specific heats would set a limit to the intensity of the effect; the iron medium having a finite abstractive power, it could effectively chill only a definite quantity of carbon. As a matter of fact, there is such a limit: steel containing more than 1½ per cent. cannot be hardened by ordinary methods; chilling cast iron gives little more than a surface hardening, and I understand that only the whiter varieties can be chilled.

I intended to have made some reference to the natural formation of diamonds, in which I find much confirmation of my belief, but this letter has grown much too long already. **I. Q.**

LOGARITHMS.

[30111.]—WHY have the opening of the curve towards the left (letter 30085, page 372)? It is more convenient and natural for the numbers to read from left to right than from right to left. Turn the curve the other way, and then its equation is $x = a^y$, where a is the base of the system of logs., x the abscissa, and y the ordinate. In this case the ordinate is always the log. of the abscissa to the base a, and if the curve could by any means be accurately constructed, then the scale would be what "A Loggerhead" suggests. There is, however, a serious drawback to the plan. It would be next to impossible to measure, by ordinary means, the log. of a number to any degree of accuracy, say beyond three decimal places, and as logs. only abridge calculations when great accuracy is required, it is difficult to see the utility of such a chart. Besides, look at the cumbrous size of a chart containing the logs. up to 10,000: 10 mètres = nearly 33ft. long. Rather too much of a good thing when one is in the middle of an intricate calculation to run over 33ft. of paper in search of a log. correct to three places of decimals.

Camberwell. **A. H. G.**

IS THE STAIN HUMAN BLOOD?

[30112.]—THERE has always been a doubt whether it is possible to determine whether bloodstains are human; but I will venture to ask those of your readers who are competent to deal with the matter to read the remarks of Dr. Copeman, demonstrator of physiology and morbid anatomy at St. Thomas's medical school, a précis of which follows:—Dr. Copeman first drew attention to the various tests for blood in general. These he divided into (1) chemical, (2) microscopic, (3) spectroscopic. The guaiacum test was shown to be readily applicable and trustworthy within limits; but, inasmuch as the colour reaction might be given with milk, pus, and urine, it could not be accepted without corroboration. Attention was drawn to the fact that sometimes white blotting-paper gives a blue colour without the addition of blood, in which case Dr. Copeman said that the test must be discarded as useless. Dr. Copeman spoke of the possibility of mistaking for blood the red stain—e.g., that which might be found on linen through a red scarf having been worn upon a part bathed with perspiration. According to him, the best method of obtaining *hæmin* crystals from a small stain is by dissolving the colouring matter in glacial acetic acid without the aid of other solvents, and then, if the stain be an old one, adding a crystal of sodium chloride. Having heated the solution in a watch-glass, over which another glass has been inverted, to such a degree that the edges of the glasses are not too hot to be held between the fingers, a drop is placed upon a slide and covered with a slip. The crystals thus obtained are mostly in oblique rhombic prisms, but occasionally they are oval, and unlike crystals of uric acid as deposited in urine; but whereas hæmin crystals are dark brown in colour, those of uric acid are orange. Reverting to the aid to be derived from the microscope, Dr. Copeman referred to the unreliability of the size of the red corpuscles as evidence of absolute distinction between human blood and that of other mammalia. In the first place, the corpuscles in some animals too nearly approach in size human blood corpuscles. Moreover, the size of the corpuscles in any animal varies to some extent as the specific gravity of the blood, and this was shown to extend over a considerable range even in fresh healthy blood, whilst it was subject to even greater change in disease. Again, the treatment of old stains for the purposes of observation cannot be carried out to such a nicety as to exactly reproduce the effects upon the red corpuscles as obtains in the serum of recently-drawn blood. And finally, the corpuscles may break up in a few days, so that the question of their recognition and identity cannot be entertained. As yet the microscope enables us only to determine with certainty whether the blood is mammalian, or not. Some time since Dr. Copeman showed that the hæmoglobin of the blood, taken from patients suffering from pernicious anæmia, crystallised in from ten to forty-eight hours. Much information may be obtained from the use of the micro-spectroscope, and the instrument is essential to the demonstration of Dr. Copeman's discovery. Exposure to the air turns hæmoglobin to meth-hæmoglobin. The spectrum of oxy-hæmoglobin, or that of fresh blood, shows two absorption bands, whilst in meth-hæmoglobin there is only one band on the red side of D, a great part of the blue end of the solar spectrum being obscured. It is this meth-hæmoglobin spectrum which is generally obtained from old bloodstains. Reduction agents convert meth-hæmoglobin into reduced hæmoglobin, the spectrum of which has one broad absorption band between the D and E lines. The best spectrum given by blood is yielded by reduced *hæmatin*. To the blood solution add a drop of a saturated solution of hyposulphite of soda: this gives reduced hæmoglobin. If, then, a few drops of a strong soda solution be added, the result is *reduced alkaline hæmatin*, the spectrum of which shows two absorption bands, one well marked between D and E: the other shows but slightly in weak solutions. Heated to 50° C. the absorption bands vanish and reappear on cooling. Agitation of the fluid with air causes the bands to disappear, but a further addition of sodic hyposulphite accounts for their return. This spectrum can be obtained from putrid blood. Monkey's blood crystallises exactly as man's as regards the state of oxidation of the hæmoglobin; whilst, so far as Dr. Copeman's experiments go, this obtains in no other animal. Thus, then, we appear to have a most important aid in the differentiation of human and monkey's blood from that of other animals. Monkey's blood crystallises less easily with decomposing serum added than does human blood. Human hæmoglobin crystallises in rectangular plates. In monkey's the crystals are diamond-shaped or six-sided. The blood of many animals, however, particularly those which come under the term "domestic," altogether refuses to crystallise by the method that has been advocated for human blood, and consequently, unless we can control such negative experiments with some of a more positive kind, it would obviously be unfair to form any definite opinion upon the results obtained. For although, says Dr. Copeman, if we find that crystals are formed, and that they consist of reduced hæmoglobin, we may say, after excluding the possibility of the blood being that of a monkey, that it undoubtedly is human; still, on the other hand, if crystals are not obtained, it would, in the absence of evidence to the contrary, be unsafe to assert positively that it was not human. Fortunately, by Gamgee's method, modified somewhat—treatment with ether—the blood of all animals crystallises with certainty. The form of the crystals in all other animals than man differs from the rectangular prisms derived from human blood, and they always consist of oxyhæmoglobin; whilst, as Dr. Copeman has proved, in man and in the monkey they are formed of *reduced* hæmoglobin. This method then of treating the blood with ether is the one to be adopted in the procedure whereby it is sought to differentiate human and monkey's blood from that of other animals. F. R. M.

BRUCINE.

[30113.]—This salt, $C_{23}H_{26}N_2O_4$, which is extracted from nux vomica, consists of strychnine and brucine and insoluble matter. Brucine is also found alone in false angostura bark. It is more soluble in water and alcohol than strychnine, and it is also less poisonous than strychnine. Its formula is represented by $C_{23}H_{26}N_2O_4$. This salt I have found from experience a very reliable and sure test for nitric acid. With this I have been able to detect 1 part of HNO_3 in 10,000 of water. It strikes a bright red coloration. I am not aware that this has been practically put to the proof before, though it is noticed in Roscoe's "Chemistry." I shall be glad to hear of any other chemists' experiments with this. **F. W. Mason, F.S.S.,**
Consulting Chemist and Electrician.

ELECTRO-PLATING.

[30114.] I am working a large three-celled single-fluid battery of carbons and amalgamated zincs with a solution of sal-ammoniac in water, and 1oz. of chlorate of potash to every 12oz. of the sal-ammoniac. It makes no smell, and produces no gas, and the zincs keep clean and bright. I suppose that the action is—

$$6NH_4Cl + KClO_3 + 3Zn = 3ZnCl_2 + KCl + 6NH_3 + 3H_2O.$$

As I have never seen this arrangement described, would some of our friends kindly tell me what defects it has, or why it is not in common use. The current seems very steady and strong, but I have no way at present of actually measuring it.

The battery was a two-fluid bichromate one, but I found that the fluids mixed when the battery was not in use, and the zincs got awfully dirty, and seemed to waste when not in use. **Thalassa.**

Bichromate Batteries.—Prof. E. Laudmann states that the cells have a height greater than their diameter, and contain about six litres of a solution of 12 parts of bichromate of sodium in 100 parts of water, to which 25 parts of sulphuric acid is added. If about one square dm. of zinc is exposed to the solution, it will not need to be changed for two hours. Owing to their very low internal resistance these cells can be conveniently used for working glow lamps coupled in parallel. On account of the small quantity of material required, the difficulty of crystallisation, and the low price of the material, the bichromate of sodium is to be preferred to the potassium salt or to chromic acid. The depolarisation and E.M.F. is greater with porous carbon than with hard, close-grained carbon. The zincs used should be free from carbon and iron, since, if the cells are coupled in parallel, local action may be set up.

Locomotive Axles.—Major-General Hutchinson's report on the accident on March 30th, near Penistone Junction, on the Manchester, Sheffield, and Lincolnshire Railway, has been issued. The accident was caused by the fracture of the leading axle of the engine of the excursion train; and Major-General Hutchinson says:—Considering the long mileage of this axle, which had run no less than 619,414 miles, it should, in my opinion, have had the wheels removed from it when the engines were in the shops in January last, and then the extensive flaw at the left wheel seat would no doubt have been discovered, and the axle condemned in consequence. The occurrence of this accident again raises the important question of how many miles axles should be allowed to run before being submitted to an exhaustive examination as to the existence of flaws. This seems to me to be eminently a question to be settled by a conference of the locomotive superintendents of the various railways, and it would, I think, be attended with great public advantage if these gentlemen would undertake this important duty."

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[68133.]—**Grey Parrot.**—With proper treatment birds that are healthy when imported live to a great age, and those that die in eight weeks or so are those that fall into the hands of people who do not know how to care for them, and who do not take the trouble to find out. Feed your bird on canary and hemp seed mixed with cracked corn. Feed nothing from the table except a cracker occasionally. Keep him supplied with pure water, and always keep a small block of wood in his cage for him to gnaw. It is best to have a grating over the bottom of the cage as some birds eat their excrement, and it uses up their stomach. For diarrhœa, feed crackers and cayenne pepper. For constipation, give fruit of any kind. Treat your bird kindly, and let him know you are master. Don't plague him, or allow anyone else to. He will gradually become so tame that you can do anything with him. Don't expect him to talk for a year, although some talk earlier than that. He may go for months and not talk, and then commence and talk all the time. Be patient with him, and you will be repaid a hundredfold. No pet is more companionable than a well-trained and well-tamed grey parrot. F. S. Marton.

[68406.]—**Battery (Bunsen).**—Was answered on p. 307. F. W. Mason.

[68417.]—**Detective Camera (U.Q.)**—"Diol Ullec" will find that ordinary double-backs work more satisfactorily than most forms of changing boxes. If a short-focus lens is used, the box can be made long enough to contain two double backs beside the one in use at the time. It is not necessary to back plates for instantaneous work. F. 12 is quite rapid enough to satisfy the conditions named, but if the camera is to be used in the winter, or at any time when the light is not good, a larger aperture is desirable. The most rapid plates obtainable are necessary, except perhaps for sea-side work. There are many shutters in the market all equally good; but when size is a great object, "Lancaster's Instantaneous" or the form sold with Shew's Eclipse is probably the most convenient; the latter being preferable, as it works between the lenses.
F. H. L.

[68570.] — **Clock Dial.**—Clean the brass thoroughly, and rub with solution of silver cyanide.
Sm.

[68570.]—**Clock Dial.**—Use nitrate of silver, ½oz.; chloride of sodium, 20gr.; cream of tartar, 30gr. Mix into a paste with little distilled water.
F. W. Mason.

[68570 and 68954.] — **Clock Dial.**—These two correspondents are asking for information that is scarcely conveyable through the columns of the "E.M." As one who has had some experience in dipping, lacquering, and silvering clock-dials, I would advise each of them to employ some professional to do what they want. The cost of so doing would not much exceed the outlay of attempting to do them themselves, and the result would be much more satisfactory. Further information may be obtained from writer (whose address is in proper column) on receipt of stamped envelope.
Town Clockmaker.

[68570.]—**Clock Dial.**—The following is extracted from an horological work for the benefit of "Country Clock Dresser," and all others whom it may interest. To silver watch and clock dials: Dissolve stick nitrate of silver in half a pint of rain-water; add two or three table-spoonfuls of common salt, which precipitates the silver in the form of chloride of silver. Let the chloride settle till the liquid is clear, pour off water, taking care not to lose any chloride, add more water, stir, and again pour off, repeating the process until no salt is perceivable to the taste. After pouring off the water add two heaped spoonfuls each of salt and cream of tartar, mix thoroughly into a paste, which, when not in use, must not be exposed to the light. Re-wax the dial by treating it and rubbing it over with a stick of black sealing-wax until the engraving is filled. Then stone the dial straight up and down with bluestone until the dial is completely exposed with the exception of the figures. Take a small quantity of pulverised pumice-stone and rub slightly up and down, which tends to make an even grain. The hands must be free from soap or grease. Rinse dial, and put on a layer of fine salt, on a wad of muslin. When the surface is covered, put on the wad of cloth enough of the paste previously made, a piece the size of a marble, say, for a dial 3in. in diameter. Rub quickly; the brass will assume a greyish streaked appearance. Add cream of tartar to the muslin quickly, moistened to a thin paste; continue rubbing till all is evenly whitened. Rinse quickly in a copious stream of water, and dip it into water as hot as the hands will bear, to dry it quickly. Shake off the water, and wipe with a clean, dry towel; heat it over a spirit-lamp, and lacquer with a thin coat of colourless lacquer, taking care not to melt the wax. C. A. J.

[68592.]—**Tinning Case-hardened Articles.**—Any method of tinning by heat would spoil the hardening, so that you have only open to you the protochloride of tin process, which puts on a very thin coating, or by electrolytic deposition. I make no doubt that if you made your wants known to some of the large Birmingham electro-platers, they would do what you require cheaply and well.
S. Bottone.

[68600.]—**Annual Winding Clock.**—Will send sketch and dimension of an electro-motor used with a Leclanché cell. The motor is used by the Anglo-American Clock Winding Co., and we had the contract to make a few thousands. Yaro.

[68612.]—**Flattening Wood.**—Wet the concave side, and hold convex side to fire. If this does not answer, try wetting as before, and place between boards under heavy weight. Sm.

[68612.]—**Flattening Wood for Fretwork.**—Why didn't you say so afore? No doubt some of our readers will help a lady, at any rate with suggestions; but I can tell you that it is difficult to keep even well-seasoned wood from warping, or twisting. For instance, I have a fret front to an organ, which is made in the best way, of two layers glued together the reverse way of the grain; but I can't prevent that twisting if the sun or the fire plays on it. Even the boxwood blocks for such engravings as you find in the *Graphic*, although in small pieces bolted together, will warp and twist. The remedy for all such things is to damp the concave side, place it on a flat slab, and weight down; or place in a press between two plates which can be screwed together. Then they will warp afterwards. Now, who will help a lady? Nun. Dor.

[68626.]—**Incubator Regulator.**—The best regulator is Hearson's. You can buy a shilling book from Hearson's—will give you all particulars, and very good hints in general. Yaro.

[68643.]—**Faulty Steam-Gauge.**—If you had said what kind of gauge yours is—viz., whether with plate spring or bent tube—I might have been able to say what is wrong with it, as I know Schaeffer and Budenberg's make. If of the plate-spring type it is worth repairing, but not otherwise. I expect, from the price, yours has a bent spring tube. In this case the failure arises from the constant heat having lowered the temper of the spring-tube. It will cost more to fit a new tube than to buy a new gauge. Most gauges only last accurate two years. A. F. Shakespear.
Lüttichaustrasse 14, Dresden.

[68648.]—**Watch and Clock Springs.**—Put barrel and fusee in with chain attached, then set up spring by the barrel arbor within a tooth of the top of the spring. You put adjusting-rod on fusee arbor before this so as to keep fusee from going round, holding it in your hand. You then move the weights to nearly end of rod and let mainspring pull it round, catching rod with finger each revolution and trying strength of spring. You will find the top turns the strongest, so that the rod will not be carried round as the spring gets to the bottom. That, however, you will see, for you use the turns with the least variation. You can turn the fusee threads slightly if the force wants decreasing at a particular point. You only use four turns in a watch, so you have two turns to spare. Mr. Saunier (vide treatise) constructed a curve showing the variation in the bending moment of a spring. It was nearly a straight line in the middle, and varied sharply at each end. C. A. J.

[68683.]—**Boiler Flanges (U.Q.)**—Angle-iron can only be bent between rolls. I know no other way by which a satisfactory ring can be made.
A. F. Shakespear.
Lüttichaustr. 14, Dresden.

[68690.] — **Pocket Coil.** — The method of charging Gaiffe's cell has been frequently given, and will be found on p. 373. T.

[68694.]—**Boiler.**—Full details of various sizes of boiler have been given in back volumes; but really, a man who is presumably going to make a boiler to work at 120lb. pressure ought to know what he is about, and not need to ask what thickness the plates should be. No boiler made by anyone who has to ask such a question should be allowed to be worked at 120lb. C. That.

[68698.]—**Pewter Solder on Glass.**—I think Mr. Wenham answered this question some years ago, and if my memory does not betray me, the method adopted is to get a bead of molten solder on the backing or frame, and then slide the glass as it were through the solder—that is, put it on sideways instead of dabbing it on. It is much the same process as that of backing glass with quicksilver amalgam. Of course, the glass must be chemically clean. Nun. Dor.

[68697.]—**Paper Bottles.**—I do not think the bottles are exactly of what is understood b "paper"; but are made of the same material as paper, and are moulded up to shape without cementing material. In fact, they are made of papier mâché, which can be varnished and protected from the effects of water in any of the ordinary ways. Cupra-ammonium is a suitable waterproofing agent; but that, applied to the purpose, is a patent, the property of the Willesden Paper Co.

NUN. DOR.

[68705.]—**Hydrocarbon Engine.**—The "precautions" that "Cyrus" had better take are, first, to leave the idea alone; secondly, not to have anything to do with such an engine; and, thirdly, to study the subject from an elementary point of view. T. P.

[68708.] — **Grease Tinning.**—"Grease" tindinning is simply the ordinary plan for tinning iron plates. The iron must be cleansed thoroughly with sand (if necessary), pickled in the acid solution, washed thoroughly, dipped into hot grease, and then directly into the bath of molten tin.

NUN. DOR.

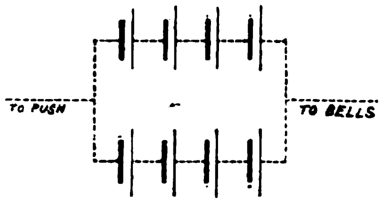
[68716.]—**Piano.**—The mere cracking of the soundboard will not make much difference; but as to "fastening the tuning keys," that is funny. I suspect it is the wrest-plank that has cracked—not the soundboard. S. P. M.

[68720.]—**Man and Truck.**—The force required to pull a truck with a man in it is merely that sufficient to overcome the extra resistance due to the man's weight; whereas the force required by the man to walk is the amount of energy necessary for him to lift his weight, and propel it forward.

Q.

[68727.]—**Moulds.**—Melt some wax; pour it into a mould, and when it is nearly about to set press the hand into it. The hand should be previously well wetted with paraffin-oil. G.

[68729.]—**Electric-Bell Fixing.**—If "R. C." places his bells in parallel, as shown in Mr. Mason's sketch, he should use a battery consisting of eight of the Indiarubber and Guttapercha Co.'s agglomerate block Leclanché cells (the size known as No. 666), and arrange them as shown in the accompanying sketch. It is absurd for Mr. Mason to think that he can ring 24 bells in parallel with 16 cells in series. When his mistake is pointed out to him, he then advises 40 cells in series, which only makes matters worse. Does not Mr. Mason know that, in a case like this, for every cell he adds to the series, though he increases the E.M.F. of the battery, yet he also increases the resistance of the circuit by an almost corresponding amount? He might put 500 cells in series in the case referred to, yet he would be no better off. I presume Mr. Mason would not use a 40-light Brush arc machine to light 500 incandescent lamps arranged in parallel, yet he is advising a similar thing.



F. C. ALLSOP.

[68730.]—**Mildew in Clothes.**—Dust the spots with flowers of sulphur, or if the fabrics will stand washing, treat them with carbolic soap. S. P.

[68732.] — **Petroleum Engine.** — There are petroleum engines; but they are scarcely suitable for a boat 4ft. long by 7in. beam. I do not know of an engine worked by colza oil, except the colza is used as a means of heating water in the boiler to drive a steam-engine. The querist had better, I think, put in a clockwork motor, or, if he does not mind the expense, an electro-motor.

NUN. DOR.

[68733.]—**Moulding Rubber.**—Dust the mould with French chalk. C. T.

[68740.]—**Steel Name Stamps.**—These stamps, when about to be engraved, are as soft as they can be made, and the letters are formed with gravers, files, and drills—the letter O obviously requiring a drill or rose bit as the simplest tool. When finished they are hardened and tempered in the usual way. NUN. DOR.

[68743.]—**Large Tree.** — The Wellingtonia (Sequoia gigantea), also known as Washingtonia, mammoth tree, big tree, has no botanical connection with the Eucalyptus (nat. ord. Myrtaceæ). It is the noblest of all the conifers, and must be the largest tree in the world, though the Eucalyptus amygdalina, growing to 500ft., overtops it in height. The Wellingtonia seems to grow well in England in a good soil and in a situation where it can get enough of the autumn sun to ripen the wood. Some very large measurements have been given by members of the State Geological Survey, and others in Tulare county, and the Caleveras Grove and the Mariposa Forest, of trees 108, 110, and even 120ft. in circumference of trunk, and 320ft. in height. The name "Sequoia" is supposed to be derived from a Cherokee Indian chief. I have two trees of the beautiful Eucalyptus globulus planted out in the garden. They are growing very rapidly, but I fear the winter here (Liverpool) may prove too much for them. They are very ornamental, and the leaves are highly scented. A. E. B.

[68747.]—**Violin Strings.**—These are made of the intestines of the sheep, cleaned thoroughly, twisted up tightly, and strained by suspending a heavy weight to them. P. Q. T.

[68759.]—**Oculist's Formula.**—In answer to "L. C.," I would state that the unit of the "Dioptric" systems is the mètre of 39·37in. To convert the "dioptric" into inches simply divide 39·37in. by the number given. For example: – 2·50 diop. would be 39·37 ÷ 2·50 = 16in. minus focus; + 1·75 diop. = 39·37 ÷ 1·75 = 22in. focus. To find focus of convex lens, hold the lens so that the sun's rays passing through it may strike upon a wall. Move the lens nearer to, or away from, the wall, until the image is reduced to its smallest point. The distance from image to lens is the focus. It can be done with candle or gas, provided the flame is at least 10ft. away. Hold the lens till you see the inverted image of flame on the wall. Move the lens till the image is perfectly sharp, and measure as formerly. With a concave lens which gives no image the case is different. Take a card and cut a hole ½in. dia.; on the wall mark a circle 1in. dia. Place the lens against the hole in the card and move it till the rays fill the 1in. circle, and measure. Another plan is to test it by convex lenses. Try, by placing a convex lens against it, to find one that entirely counteracts it. The focus of the two will be the same—the one + the other —.

BON-ACCORD.

[68796.]—**Mensuration Problem.**—"Elag's" solution is very neat, but he has expanded both $(a + b)^2$ and $(d + e)^2$ wrongly. Also d = 10⅜ft. should be $d = {}^{50}_{3}$ft. The solution given by me on p. 333 is applicable "without a scale" to the case of a field of area 6,000sq.ft., having across it a narrow footpath of 10in. width. The error is 1 in 12,000.

Liverpool. J. C. Q.

[68796.]—**Mensuration Problem.**—"Elag's" solution is apparently founded on the assumption that the small triangle (referring to "W. E. H.'s" diagram for use of letters) A E F is similar to the triangle C D A. It is not, however. Its sides are proportioned as those in the triangle C D F, sides D F and C F of which are unknown. The triangles are similar, because the angles A F E, C F D are vertical angles, and therefore equal. A E F = C D F, by construction right angles; therefore, remaining angles E A F, D C F are equal, and triangles are similar, therefore, as regards their sides. A. W. LAMBERT.

[68840.] — **Flat Mirror for Newtonian.**—I must demur to the statement by "Ecnal," on page 375, that the size of flat mirror I gave on page 354 is too large. Taking into consideration that the actual diameter of the reflected cone of rays from the moon would be 2·33in. at 12in. within the focal plane of a 12¼in. mirror of 14ft. focus, I must say again that a flat mirror of which the minor axis is 2½in. is fairly large enough; but not too large. Possibly "Ecnal" has not taken into account that while the image of a star is practically a point, that of the moon or sun is approximately 1·6in. for 14ft. focus, and he can prove this very easily. In fact, if we take the decimal ·0093 as a constant, and multiply it by the solar focus in inches of any o.g. or speculum, we obtain the size of the image given by the sun or moon. Further, I cannot agree with "Ecnal" that a flat mirror should be used which in minor axis is exactly the size of the diameter of the reflected cone of rays at the point where it is desired to place it. With an equatorial mounting this might do very well, because the object can always be kept central in the field of view; but with an altazimuth mount it is troublesome to do so, and the least deviation from the central position, such as allowing the object to travel across the field, causes the reflected cone of rays to travel along the major axis of the flat, and this leads to a greater loss of light than would be experienced by making the flat somewhat larger than he approves of. Of course, the best results may be looked for when the object is kept central in the field after the mirrors have been carefully adjusted, and it is too much to expect that the image of an object will bear exactly the same (good) appearance when allowed to travel to the edge of the field, for not only does it suffer from a serious diminution of light, but the rays falling somewhat obliquely upon the field lens of the eyepiece, a certain amount of distortion results, rendered more or less painfully evident by magnification. Further, as the cone of rays from the large mirror is not truly cylindrical, but a cross section at any angle to the central axis being really an oval and not a true ellipse, the flat mirror must either be slightly larger in minor axis than the breadth of a true cross section of the cone, or the flat must be ground into an oval shape to correspond, as one ingenious contributor actually proposed a few years ago. As Mr. Westlake intimates, the subject was strongly discussed in these pages in 1883, and was pretty well threshed out, I believe. Going through the figures "Ecnal" gives in his own case, it is true, as he says, that the diameter of the cone of rays from his 12¼ of 103in. focus, at 14in. from the focal plane is 1·7; but in the case of the sun or moon, this cone at the same position is 2·3in., so that "Ecnal" loses light in the proportion of $2{\cdot}3^2$ against $1{\cdot}7^2$, probably 50 per cent. This does not much matter on the sun; but on the moon it is serious, not from want of light exactly, but the mirror, if good, would give vastly better defining power if the light were all utilised in place of being partially wasted. I hope "Ecnal" will be convinced; if not, I will show him more clearly where he is in fault. As regards the correction by "F.R.A.S.," I would point out that the usual plan is to express the value of the *minor* axis of the flat mirror, the major axis following, as a matter of course, by multiplying that by $\sqrt{2}$, or 1·4 in the case of the Newtonian telescope, where the flat is placed at an angle of 45° with the optical axis of the large mirror.

Ramsgate. J. C. LINSCOTT.

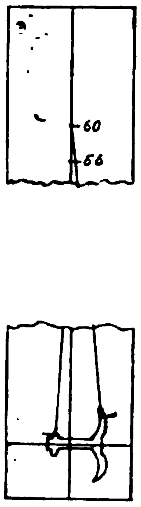
[68840.]—**Flat Mirror for Newtonian.**—"Ecnal" has forgotten that a cone of rays is only identical with a cone of the same dimensions when the image reflected or refracted is a point; and further, following this, a flat of the same size as the cone at the point of intersection would only reflect a point perfectly when exactly in the centre of the field. He will see that if he is observing the sun or moon, these objects have an angular diameter of 32′ of arc; and consequently, every part of their surfaces reflects its own image in his field of view. This is readily apparent when observing a cluster of stars of this angular dia., say the great cluster in Perseus. Here every star reflects its own image on all parts of his field of view, which must be also one of 32′, if he wishes to take them all in (supposing the object to be 32′—the double cluster in Perseus is more). It is evident, therefore, that here are separate images, forming different focus points, strewed all over his field, and as they are to be viewed simultaneously, his flat to take them all must be sufficiently large to take in the cone of rays which is formed by the focal image, made up of all those separate images. The focal image of the sun is, therefore, not a point, but varies in size in proportion to the focal length of the instrument, and the rule for ascertaining this is: multiply the sine of 16′ (half the angular dia. of the object) by the focal length, and this by 2. This gives a focal image, as named in my last, of 1·5638in., and the dia. of a cone of rays due to this at 12in. from the focal image is 2·3271in. So that nothing less than a 2½in. flat is large enough. The correct size flat is, therefore, absolutely, in any particular case, that due to the focal image of the dia. of the field of the eyepiece with which you are observing—that is, if you wish to observe the object equally well in all parts of the field. P.S.—In my answer on this subject in last week's "E.M." (68840), for "taking the dia. of the sun and moon at 32 *feet*," read *minutes*.

Fordingbridge. T. WESTLAKE.

[68858.]—**Horses.**—The late Mr. Lord, who held a rather high position as a cavalry vet., practised the homœopathic system of medicine amongst the horses under his charge, and with great success. A Mr. Moore was another homœopathic vet.; both of these gentlemen published books on the science, and which may be obtained from any homœopathic chemist or from booksellers. Dr. Ruddock also published a similar work. This system has the great advantage of doing away with the horrible torture of "drenching," a punishment which nervous horses never forget. Hydropathy is of the greatest possible value in subduing inflammation; it can be seen in practice in many of the London mews. I have again and again known "cripples" bought a little above shambles price, put under hydropathy, and resold in a few weeks for three or four times the original cost. A bit of old sack scientifically applied did the trick, just as licking his finger "removes the fire" when accident burns the finger of THE LYDNEY DISPENSER.

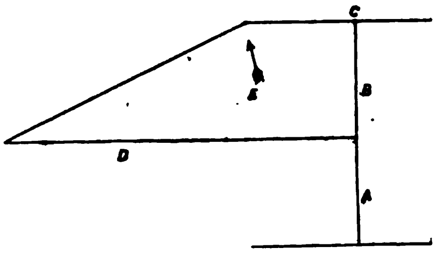
[68878.]—**Lightning Conductors.**—I beg to thank the several correspondents who kindly replied to the above query recently. I should be glad of the particulars Mr. F. W. Mason mentioned. What I want to know is if the three-cell Leclanché and bell will be a sufficient test? which, from the replies, I gather they will not be. The instrument mentioned by "Engineer" appears to be just the thing. If he will—at his own convenience, and with the Editor's permission—kindly send sketch and details, I am sure he will be obliging many other readers besides myself. I am sorry I misled him with regard to my conductor. It has not two "earths," but only one "earth" and two tops. One, which I may call the main conductor, is fixed to a chimney about the middle of the roof, and runs along the slates and down to the ground; this is fitted with points. Then there is an iron weathercock, which, as it stands a little higher than the conductor I had connected to it, the connection being about half-way down. The conductor is copper-tape ¾in. by ⅛in. I wish to be able to ascertain if the connections are good, and if the "earth" is good. How can I obtain a resistance of two ohms? What length of wire (iron or copper) will represent that resistance? How can I find out roughly how many ampères, or what fraction of an ampère, my bell will ring with? How can I tell, approximately, if the earth be under two ohms resistance or not? These are some of the questions I should be glad to have answered. Joiner.

[68888.]—**Bicycle Spokes.**—If you will take the trouble to set out a board as sketched below, which will only take an hour or two, you will save yourself a lot of trouble. Get a piece of board about 4ft. long and a foot wide; draw a line down the centre, and another line at right angles near one end of the board—the latter will be the centre line of hub. You can draw half of spindle with one flange, measuring the distance between flanges and diameter of flange; then mark depth of hole to be tapped for spoke. Now up the centre line of board mark off half the diameter of the different size wheels you are likely to use, allowing for rim and rubber. When you want to measure your spokes, take sight, and measure from rim to a little less than the depth of hole in flange; test these, and if right go ahead; but if not quite correct, you will have very little trouble to get right—anyhow, much less than a week will be required. If you particularly wish to cover all the thread, you might recess out the holes to the depth of about two threads; but if you are careful in your measurement, making all your spokes the exact length, you will be able to get the thread well up. I may add that you could mark off one side of your board for ordinary bicycles, the other for safeties; and a similar board, or one marked out in the same way, will help you to get the correct length of your fork sides.



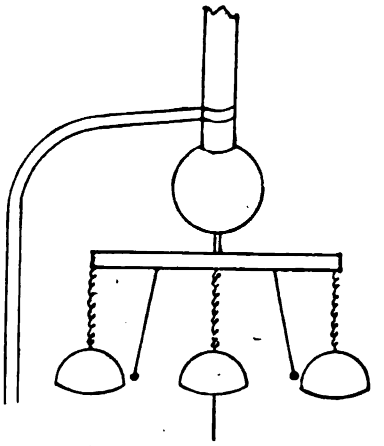
A. M. M. A.

[68888.]—**Bicycle Spokes.**—If A. F. Shakespear will do as I have done on dozens of wheels, he will get the length of his spokes near enough for him in a few minutes. First make the steel tire as true a circle as possible, and the holes in the tire all countersunk to one depth; then take two spokes and put one in one side of the tire, and the other exactly opposite, lay the tire flat on the ground; the two spokes you have put in should be longer than half the diameter of the wheel; now shorten each spoke till they just touch each other; when they are both of equal length take the two spokes out and put them in again, ten or a dozen holes further round, and see if they touch each other there; after you have tried them in three or four places round the tire, and they touch, or are within a fraction either longer or shorter, according to the truth of the tire to a perfect circle, then take a smooth board, draw a line a little longer than your spoke, at right angles across one end of the line, draw another line A B, this line should be as long as the distance from the centre of the spoke holes on one brass to the centre of the spoke holes on the opposite brass; at right angles to the line A B draw another line the same length as the diameter of one side of hub C. Now take one of the two spokes and lay it on the top of line D, bring the end of the spoke to be screwed exactly up to line B, then hold the head of spoke down to the line and move the screwing end of the spoke towards C until it reaches the end of the line C; at the point E make a small scratch with a saw-file on the spoke, and that is the height to which you must screw your spokes. Cut off the spoke, say, ⅜in. longer than mark on spoke, drill hub ⅜in. deep, and tap countersunk hub about ⅛in. The reason I recommend to drill the hub so much longer than the spoke is screwed, is because lately I have put wheels together: the spokes for 30in. wheels have stretched a full ⅛in. when one spoke was taken out after the wheel was trued. In screwing the spokes by hand take the spoke you have marked and screw the screwing plate on to the spoke till spoke comes level with the plate, then count the number of turns you give the plate till you get to the mark on the spoke; serve all the spokes in same way.



Cycle Fitter.

[68892.]—**Franklin's Experiment.**—A conducting-rod, similar to a lightning conductor (except that it must be insulated from the ground), is erected. To the lower end of this, which should terminate in a rather large metal ball, is attached a metal bar, about 9in. long by 1in. section. To the centre of this is attached, by means of a white silk thread, a circular gong, the same as an electric-bell gong. This gong has depending from it a chain, which puts it in metallic communication with the earth. At each extremity of the bar is placed another gong, each of these gongs being attached to the bar by a chain or other conductor. Between the gongs hang little metal clappers, as shown in the cut, suspended by silken threads. When the bar is electrified, the clappers are first attracted by the two outside gongs, and then discharge themselves by striking the middle gong, to be again attracted and repelled so long as the bar remains electrified. S. Bottone.



[68894.]—**Frosted Silver.**—Try ammonia and chalk (applied with a brush). If this does not clean it, lay it in a pickle of dilute sulphuric acid (about five parts acid in 100 parts water) for an hour or two, then rinse in hot-water. Major.

[68897.]—**Constant Current Batteries for Medical Purposes.**—Try the battery of Mr. J. Gardner, recommended by me in letter 30059.

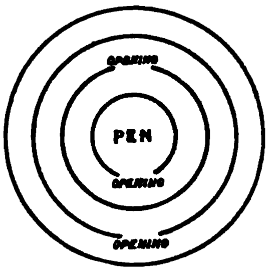
F. W. Mason.

[68908.]—**Scotia Camera.**—No special lens is required for this camera. It depends on the kind of work to be done. If chiefly landscape, then a single lens will be as good as any; but if rapid work is wanted, then a Rapid Rectilinear lens will be best. Get a good one—not necessarily an expensive one. James Thomson, Camera Maker.

Portgordon.

[68910.] — **Gas-Engine.**—To "Yarg." — I would advise "D. C. I." to have as few joints as possible in a gas-engine, and especial cylinder. I dislike inverted cylinders. They always leak and fill cylinder full of water, or at least enough to rust or damage cylinder. My sketch I sent to "E. M." a few months since was properly designed to do away with that nuisance, and secondly to do away with a frightful amount of fitting and turning. Patterns for my sketch are easily made. Cylinder and water jacket combined only require boring, and bottom flange of cylinder and water jacket just cleaned up a bit to make a joint. Then forearm, you see, from cylinder to water jacket can be cored out or drilled for inlet of gas and air, and one for exhaust. Now, the uprights to carry the crank-shaft are bored in a lathe, and are very easy fitted on to cylinder, and fastened with a couple of set-screws and a steady pin; then bore them out in their place, except you have the machinery to do it with. Get as much water space as you can, as too little water is too much oil. I have had cold water constantly flowing through water jacket and found one oiling of cylinder lasted for many hours, as before I never had oil-can out of my hand many minutes. By kind permission of our Editor, will send sketch of a very handy boring-bar suitable to bore above cylinder, for hand or power, self-acting; can be used for nearly any work, taper or straight-boring. Yarg.

[68903.]—**Pigs in Clover.**—This puzzle consists of a round box containing three concentric card-board rings, A, B, C, having openings left in sides as shown. The innermost ring is covered, forming the "pen." Three or four marbles are placed in the outermost ring, the box being then shifted about to get them all into the "pen." It is not so easy as it looks. N.B.—The "pigs" must not be touched by hand when manipulating the box. M. L. Z.



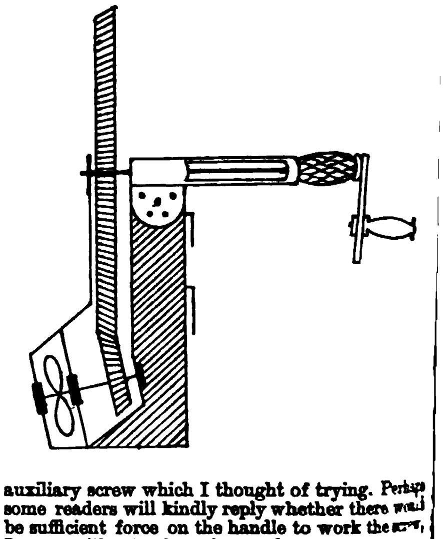
[68903.]—**Pigs in Clover.**—Place the so-called "pigs" (which are marbles) in the outer ring, and then so manipulate the board, without touching the marbles, as to get them all in the innermost inclosure, or "pen," at once. R. S. Bruce.

[68927.]—**Pump Valve.**—We made two last week for coal-pit, driven by electric-motor; valves 2¼in., pipes 1½in. Give valves $\frac{3}{16}$in. lift.

Yarg.

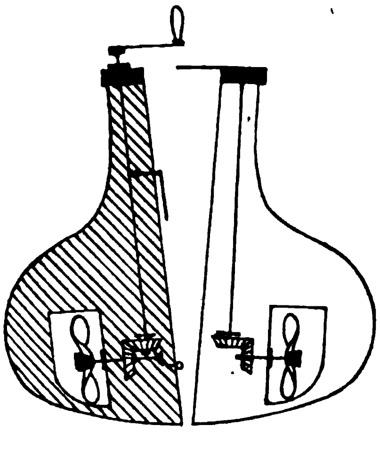
[68933.]—**Electrical.**—Will "Ignoramus" explain how he makes his phosphorus and silver, as I have never had much trouble with it, and I have used it a few scores of times. F. W. Mason.

[68915.]—**Auxiliary Screw.**—In reply to "Tredagh," I cannot see how his spiral F would stand the force. I send a sketch of my idea of an auxiliary screw which I thought of trying. Perhaps some readers will kindly reply whether there would be sufficient force on the handle to work the screw, I mean without exhaustive work.



F. C. Baker.

[68915.]—**Auxiliary Screw.**—Some years ago I gave many hours of thought to this subject, which is now introduced by "Tredagh," and I should have written to the "E.M." but for the conviction that more could be got out of one little paddle than out of a costly screw rudder; but if "Tredagh" intends to experiment on it he must change all the arrangement, which is far too complicated, and involves a maximum of friction. I would suggest his rudder being made in two half-parts [illegible] plank, to be screwed together after [illegible] ⅜in. rods and sundry bearings fitted in. [illegible] must be shrunk on rods and gear-[illegible] keyed on; the screw put in place and fixed with a nut. Tiller may be placed right over the head, having a bearing to take down rod. The handle to



work right on the top of rudder; thus four bearings and four shrunk-on washers are all the friction to overcome. **WM. HOSKEN.**

[68932.]—**Deafness.**—The fact of deafness being a result of numerous utterly different disordered actions and conditions of the aural structure, being in this instance, as in all other heal-alls, most audaciously ignored. Were it not for the credulous incredulity of those suffering from bodily infirmities and from defective physical action of one or other of the orders of nervous sensation, &c., and from the failure of those M.D.'s who are specialists for the said disorders to benefit these sufferers, such impudent charlatanism would never find room even for primary existence. In order that the querist may recognise the plausibility of the so-called invention, a study of one or other of the numerous engravings, illustrating what is known of the phenomena of the aural sense and its mechanism is desirable. Page 649 in Beard and Rockwell's "Medical Electricity" shows the ear in section. I have seen an admirable sketch of the ear and its mechanism in one of Cassell's popular educational works; but the pamphlet by Dr. Hayward, of 17, Grove-street, Liverpool, price 6d. only, has the most simple illustration, and is most free from terms such as are intelligible only to those acquainted with the jargon of medical vocabularies. In the Royal College of Surgeons' Museum, Lincoln's Inn-fields, Holborn, London, is the collection of anatomical specimens illustrating the mechanism of the ear, prepared by the enthusiastic aurist, poor Toynbee, who lost his life while in pursuit of aural remedies. But I question if their inspection would instruct "Aurist" much unless he had previous study. Dr. Cooper, an aurist of some standing, takes the aural cases at the London Homœopathic Hospital, Great Ormond-street (medicine and advice four weeks for 1s.); but many hospital and dispensary patients cannot put up with the waiting, &c., this entails, while the said patients have sometimes ample cause for complaint for—well, the *brusquerie*—of some of the staff. That Dr. Cooper may peruse this, and take the hint, is the hope of **THE LYDNEY DISPENSER.**

[68936.]—**Nickel Crucibles, &c.**—Experience same as yours with regard to crucibles. Use powdered and well-dried bichromate, and not fused. What do you mean by the native state of the iron and manganese? In presence of strong acid solution, HCl, H_2S throws down Pb as a red ppt. **F. W. MASON.**

[68938.]—**Electrical Heating.**—It cannot, in my idea, be done to be called economical. But if "One Half-Informed" will advertise his address, I will try to help him, as here it would take up too much space. **F. W. MASON.**

[68942.]—**Centrifugal Force on the Moon.**—Wm. Hosken is under a misapprehension respecting the air—if there be any—on the moon. The moon must be a prolate spheroidal body with the longest axis pointing towards the earth. This appears from two quite different reasons. The great probability is that, as to her mean surface, she is very slightly egg-shaped, with the smaller end of the egg directed towards the earth. This is the form that she would assume under the earth's tidal action if she began her career in a fluid condition, which can hardly be doubted. If there were an atmosphere on the moon, it would be tidally deformed similarly to the body of the moon, and it would have two maxima of depth—viz., one at the middle of the side turned towards, and the other at the middle of the side turned away from, the earth; the former being the greater of the two, though the difference would be exceedingly small. "W. H.'s" question was answered by anticipation a few months ago in the ENGLISH MECHANIC. But to avoid taking up space by repetition I would beg to refer him to a lecture by Prof. G. H. Darwin on "The Rings of Saturn," to the Midland Institute, Birmingham, Nov., 1887, which, it so happens, is printed in *Harper's Magazine* (American) for this present month of June. "W. H." will find what he wants on p. 70. Wrong things have indeed been said about centrifugal force; but we need not, therefore, avoid the guarded and unobjectionable use of the expression. Darwin does not do this latter, though telling us at the same time that "centrifugal and centripetal force are simply two views of the same thing—namely, the tension of the string." Taking the moon's orbit as circular, for simplicity, the earth's attraction and the c.f. are equal at the centre of the moon; but on the near side of the moon the earth's attraction is greater, and the c.f. less, than at the centre, resulting in an upward tidal force; and at the far side of the moon the earth's attraction is less, and the c.f. greater, than at the centre, resulting again in an upward tidal force. No one need fear to use this language after Prof. G. H. Darwin, who is as fully alive as anyone can be to what c.f. is not, as well as to what it is. **DUBLINIENSIS.**

[68945.]—**Dynamo.**—You do not say what type your dynamo is, and seeing that I have described at least a score in the "E.M.," I am rather puzzled to know which "the dynamo" is. However, presuming it to be the old H Siemens, I may tell you that by using the laminations or punchings so often recommended by me, you will entirely obviate all injurious heating. **S. BOTTONE.**

[68946.]—**Acids.**—No one can answer an unintelligible query. If you will explain what you want to know, I will help you. **SM.**

[68947.]—**Manchester Dynamo.**—To MR. BOTTONE.—The proportions of sketch are fairly good, except in two points. 1st. The field magnet cores are too small in diameter; they should be at least 2in. in section, and need not be more than 5¼in. in height. 2nd. As you will not get sufficient wire on a 3½in. armature to do much good with 20c.p. lamps, I should advise you to get a 4½in. set of punchings, and wind these with as much No. 20 wire as you can get on, say, about 4lb. On the field magnets you must put on at least 15lb. No. 22, and connect up in shunt. Remember that the wires from the two F.M.'s must be so connected to each other as to produce consecutive poles of one name above and of the other below. The probable output will be 5 ampères, at 50 volts pressure. **S. BOTTONE.**

[68950.]—**Brush Dynamo, &c.**—To MR. BOTTONE.—I wish I could compress as much information into my reply as you have managed to ask for in your queries. 1st. No. 14 wire is too thick, unless you want the machine for electrolysis and plating. 2nd. As you do not say the size you propose for your F.M.'s, I am at a loss to say whether they will answer. For an 8in. armature they should be at least 5in. wide and 1in. thick. You should be able to get on from 5lb. to 6lb. of No. 18 on the armature, if nicely wound. The field magnets, if separately excited from three chromic-acid cells in series, should be wound with 10lb. No. 14. 3rd. But why separately excite them? It would be far better to wind them with 15lb. No. 20, and connect them in shunt with the brushes. 4th. To get the full power out of such a dynamo you would need nearly ½H.P. engine. Of course, you can drive it a little by hand, when you might get at most 3 or 4 ampères at 20 volts pressure. 5th. You will find very exhaustive details as to mode of winding Brush armatures in Prof. S. Thompson's "Dynamo Electric Machinery." 6th. The resistance of the armature will be while running approximately 1·5 ohm. 7th. Run by hand, you might expect to get sufficient E.M.F. and current to light three or four 10c.p. lamps of about 20 ohms resistance; run from an engine, you should be able to light five or six 20c.p. lamps of 48 ohms resistance. 8th. My new depolariser is a mixture of several highly-oxidised bodies, which, parting readily with oxygen, remove the hydrogen liberated in the battery. **S. BOTTONE.**

[68952.]—**Tinning Case-Hardened Articles.**—It is not the actual tinning that would soften the articles, but the pickling process that they would have to go through before the tin would "take." Neither would an electro deposit be satisfactory on the case-hardened surface without a previous pickling, and this pickling takes the hardened surface off—that is the "crux." **BIJLI.**

[68954.]—**Eight-Day Clock Brass Dial.**—See reply to "Country Clock Dresser." If it has been lacquered before, the old lacquer may be taken off with strong hot soda-water and a brush. Are you sure it's not gilt? I suppose you mean the circle, not the figures, is white. **C. A. J.**

[68953.]—**Differential Equations.**—In the first case let the distance x (measured from the starting point, in a direction at right angles to that of the current) be steamed in the time t. The effective speed of the boat, which is in the direction x, is b cos. θ. Let this be denoted by v. Then—

$$\frac{dt}{dx} = \frac{1}{v} = \frac{1}{b\cos.\theta}; \quad \frac{dx}{d\theta} = \frac{D}{\sqrt{2}}\,.\cos.\theta,\text{ and}$$

$$\frac{dt}{d\theta} = \frac{dt}{dx}\cdot\frac{dx}{d\theta}$$

Hence $$\frac{dt}{d\theta} = \frac{D}{\sqrt{2}\,.\,b}.$$

Integrating from $\theta = 0$ to $\theta = \frac{\pi}{4}$, and multiplying by 2, we have—

$$T = \frac{\sqrt{2}\,.\,D}{b}\cdot\frac{\pi}{4}.$$

In dealing with the second case, suppose the starting point to be the origin, x measured, as before, in a direction across the river, and y at right angles to x. The boat will describe a curve to which the direction of its motion is always a tangent. Therefore θ is the inclination of this tangent to the axis of x, or $\frac{dy}{dx} = \tan.\theta$. Hence, giving tan. θ its value, we have—

$$\frac{dy}{dx} = \frac{\sqrt{2}\,.\,x}{\sqrt{D^2 - 2x^2}}$$

$$\therefore y = -\frac{1}{\sqrt{2}}\cdot\sqrt{D^2 - 2x^2} + C.$$

But when $x = 0$, $y = 0$. Therefore $C = \frac{D}{\sqrt{2}}$, and the equation reduces to

$$x^2 = \sqrt{2}\,.\,Dy - y^2.$$

This is the equation to a circle, of which the radius is $\frac{D}{\sqrt{2}}$. The arc, evidently, is limited to that of a half quadrant, since the greatest value of θ is $\frac{\pi}{4}$; but by taking the middle point of the boat's course for a new origin, we find that the second half of that course is through another quadrant, equal in radius to that of the first, but inverted (with regard to curvature) in position. The keel of the boat, as she crosses the middle point of her course, is a common tangent to both of the circular arcs.

Charing. **J. R. C.**

[68953.]—**Differential Equations.**—If the boat is x miles from the shore, the rate of the stream will be cx miles per hour, where c is some constant. Taking θ for the inclination of vessel to direct perpendicular course sin. $\theta = \frac{cx}{b}$, and the simultaneous values $\frac{D}{2}$ and $\frac{1}{\sqrt{2}}$ of x, and sin. θ enable us to determine c to be $\frac{b\sqrt{2}}{D}$. The forward velocity of boat across stream is $\sqrt{(b^2 - c^2x^2)}$, hence the time of crossing half over—viz., $\frac{T}{2}$, is—

$$\int_0^{\frac{D}{2}} \frac{dx}{\sqrt{(b^2 - c^2x^2)}} = \frac{1}{c}\int_0^{\frac{D}{2}} \frac{dx}{\sqrt{\left(\frac{b^2}{c^2} - x^2\right)}}$$

$$= \frac{1}{c}\sin.^{-1}\left(\frac{cD}{2b}\right) = \frac{D}{b\sqrt{2}}\cdot\frac{\pi}{4}$$

The boat, of course, takes $\frac{T}{2}$ hours to do either half of the distance, for its speed at points equally distant from centre of river are the same; therefore—

$$T = \frac{D\sqrt{2}}{b}\cdot\frac{\pi}{4}$$

Suppose the starting point be the origin and the perpendicular course across to be the axis of x. Then—

$$\frac{dy}{dx} = \tan.\theta = \tan.\sin.^{-1}\frac{cx}{b} = \frac{x}{\sqrt{\left(\frac{b^2}{c^2} - x^2\right)}}$$

Therefore—

$$y = \int\frac{x\,dx}{\sqrt{\left(\frac{b^2}{c^2} - x^2\right)}} = -\sqrt{\left(\frac{b^2}{c^2} - x^2\right)}$$

Now take the constant so that x and y vanish simultaneously; this gives for the equation to the curve—

$$y = \frac{b}{c} - \sqrt{\left(\frac{b^2}{c^2} - x^2\right)}$$

That is—

$$y = \frac{D}{\sqrt{2}} - \sqrt{\left(\frac{D^2}{2} - x^2\right)}$$

The arc of this curve represents the course from the bank to centre of river, and is a half-quadrant of radius $\frac{D}{\sqrt{2}}$. It would be interesting to know what curve the vessel must be made to describe so that the time of crossing may be a minimum, the current running as usual. Would it be the straight line course as in the case just considered?

Portsmouth. A. M.

[68955.]—**Barlow Lens.**—I have used a Barlow to slightly increase size of image in order to make one revolution of micrometer screw correspond to 10sec. of arc. The position of lens in eyepiece tube was found by trial. Thus: The distance between two stars in Pleiades was measured by micrometer, with result that one revolution of screw, or 100 divisions, was equal to about 8½sec. of arc. On inserting Barlow a new value was obtained, and the lens was pushed in or drawn out until the right position was found. Sm.

[68956.]—**Electro-Plating.**—Try an ethereal solution of wax. Sm.

[68956.]—**Electro-Plating.**—No protection is needed except shutting the lid; the outside will eclipse the inside. This is the cause of the inside not being originally plated. Bijli.

[68956.]—**Electro-Plating.**—Use shellac, 2oz. (dissolved in methylated spirit); ordinary red sealing-wax, ½oz. Give three coatings. When work is finished spirit will dissolve it out.

F. W. M.

[68957.]—**American Organ.**—The questions asked under this heading cannot be satisfactorily answered without the assistance of a diagram. If "Welsh Leek" can procure Vol. XXVI. of the English Mechanic, he will find some very useful information, and also in many of the back volumes. The querist should have gained a full knowledge of the construction of such an instrument before he commenced the work. Better arrange the stop work at the sides, and not over the manual, if you intend at any future time to add a second manual, so as to be able to bring the keys of upper manual as close as possible to those of lower manual.

Swansea. G. Fryer.

[68958.]—**Pumps.**—The volume of a cylinder is ascertained by multiplying the volume of the base by the height, and the area of the base is expressed by $\pi\rho^2$, where π is 3·1416, and ρ = radius. If the pump is double-acting, the second stroke pumps less water, as the volume of the piston-rod must be deducted. Suppose you have a pump 20in. high 8in. diameter, then volume will be—

$$
\begin{aligned}
V &= h\pi\rho^2 \\
V &= 20 \times 3{\cdot}1416 \times 16 \\
V &= 1005{\cdot}3\text{cub.ft.} \\
V &= 6273 \text{ gallons.}
\end{aligned}
$$

Conversely, to find diameter—

$$
\begin{aligned}
\rho^2 &= \frac{V}{h\pi} \\
\rho^2 &= \frac{1005{\cdot}3}{20 \times 3{\cdot}1416} \\
&= \frac{1005{\cdot}3}{62{\cdot}832} \\
\rho^2 &= 16 \\
\rho &= 4 = \text{radius} \therefore \text{diameter} = 8\text{in.}
\end{aligned}
$$

Sm.

[68960.]—**Arsenic in Sulphuric Acid.**—The simplest method I know of is to make a solution of sulphuretted hydrogen by passing the gas into water, then put a little of this solution in a test tube, adding your sulphuric acid. If arsenic is present, a yellow precipitate of arsenious sulphide is formed; this will dissolve in ammonia liquor. There are other tests; but this is to my mind the easiest.

Operative.

[68960.]—**Arsenic in Sulphuric Acid.**—You can either use Marsh's or any other well-known test. In a hydrogen-gas apparatus put a few pieces of granulated zinc (which must of course be free from arsenic), then connect to the outflow a small glass tube drawn out into a fine jet; pour the suspected acid on to the zinc, and, after a few minutes, ignite the gas coming off. To this jet of gas, while still burning, hold a small, clean porcelain dish. If arsenic is present it will be deposited as a darkish grey metallic coating on the white surface of the dish. This test is a sure one; but "Apprentice" had better read up some book on chemistry, as there are a lot of little details that must be attended to, and likewise there is a chance of a novice mistaking arsenic and antimony, as they behave somewhat similar, and are only to be discerned by means of other chemical tests.

F. W. Mason.

[68961.]—**Soap-making.**—"Fat" had better advertise his address. F. W. Mason.

[68961.]—**Soap.**—Take ½lb. of 98 per cent. caustic soda, and empty into it 1 quart of cold water; by stirring it will instantly become hot; let it stand till it is cold: this is called the lye. In a large basin melt 3lb. of your fat, let it stand till it is just warm, then pour the lye into the melted fat in a continuous stream, stirring it till it becomes like honey; then pour the mixture into a wooden box, and cover with old blanket, and let it stand.

H. Hine.

[68962.]—**Bichromate Battery.**—What has this query to do with the heading? It evidently refers to a coil of some kind. The primary seems all right, since it works the clapper; but the secondary appears either to be broken or else wrongly connected. It should be entirely distinct and separate from the primary, and the beginning and end connected to two terminals.

S. Bottone.

[68963.]—**Filter for Waste Oil.**—A better way to free oil from dirt and impurities is to stir it up with a hot solution of washing soda, and settle in a warm place until the oil is quite clear, then run off the water off the bottom of the vessel. If you prefer to filter it, a very simple filter is made by knocking out the bottom of a box and covering it with gauze wire; then place a layer of cotton wool over this, and pass the oil through it. The former process is much preferred, although it is more troublesome, because it not only extracts the solid dirt, but also extracts dirt out of solution in the oil.

Broxburn. Thomas Clarkson.

[68967.]—**Batteries.**—To Mr. Mason.—The query of "Back-parlour Shopman," I am afraid, to answer properly would really take up too much space; but, nevertheless, I will give him a few wrinkles, which, if not sufficient, he had better advertise his address, when I shall be more able to help him. I should advise the use of accumulators charged by a strong primary battery, as these could be made small and portable for travelling, and could also be charged at home by means of the battery. Twelve cells would be sufficient, of the following proportions: 12 zincs ¼in. thick, 3in. by 4in., 24 carbons ¼in. thick, 6in. by 4in. Arrange the twelve containing cells in a box, to which there is a lid; in this lid drill twelve holes exactly coinciding with the centre of each cell. In each of these holes fix a small piece of ¼in. brass tubing rising 1¼in. above the lid and ¼in. under the lid. These brass tubes should each have holes tapped and screws in them at their upper extremities. The zincs are attached to pieces of $\frac{3}{16}$in. of brass rod about 12in. long. These brass rods pass through the brass tubes, and so can be held by their corresponding screws at any height in the cell. Encircling these zincs underneath the lid is a U-piece of copper $\frac{1}{16}$in. thick, and attached to the lid by means of screws. It is to this piece of copper that the carbons are connected; but before you can connect these to the copper you must first of all copper your carbons. To do this you must make use of the electro-deposition process. Make up the following solution:—Copper sulphate 9oz., sulphuric acid 1oz., water 1 pint. Use one Bunsen cell; connect carbon to wire from the zinc of cell, and a piece of copper-plate to the carbon of the cell, and then immerse in copper solution. In about one hour you will have a fine firm deposit of copper on the carbon, and so will be able to join it to the copper strip of your battery. By means of ordinary solder and spirits of salts you will be able, with these proportions and sizes, to copper two carbons at a time. Of course, to do all at once, you would require stronger solution, larger containing vessel, and stronger battery. The carbons should also, before they are joined to the battery, be waxed for about 2in. at the coppered end. I should also have stated that the carbons should only be coppered for about 1in. at one of their ends. The carbons should be arranged one on each side of each zinc, and be connected as follows, leaving one zinc free:—Connect the carbon strip to the zinc, and the next carbon to the next zinc, and so on. You will thus have a carbon free at the other end. This is the other terminal. The connections should be made from the copper strip to the brass tube (soldered). You have thus your battery complete with lifting arrangement for your zincs (which should, of course, be amalgamated with mercury). Use a solution of bichromate of potash 3lb., sulphuric acid 2lb., water 1¾ gallon. This allows a little more than a pint of solution to each cell, and will last you for about four or five hours' work if you lift your zincs out of solution every time you do not require them. You could also use the following solution, if you prefer it to the above. Permanganate of potash 4lb., sulphuric acid 1½lb., water 1¾ gallon. The cost of the above solutions would be: bichromate solution 2s. 3d., permanganate of potash solution 9s. 2d. So that you will see that the bichromate is the cheapest, and that will come dear when you come to use it a few times. So that you will clearly see that electric lighting by means of batteries is not a paying game. Your battery should cost you—

12 cells at 2d. each	=	2	0
12 zincs at 2d. each....	=	2	0
24 carbons at 6d. each .	=	12	0
Battery	=	16	0
" solution ..	=	2	6
Total		18	6

You could then charge your accumulators by means of this battery. This arrangement would charge 12 small ones, and the number of these that you would want would depend on the number of lamps and their voltage you would want alight at one time. I will suppose that you do not want more than 24 volts at one time: this would mean the employment of 12 accumulators, and as you do not want them for more than one hour, they could be made very small, and so could be made very portable. Of course, with this arrangement, you would have to make the necessary connections by means of a suitable switch. Make the accumulators as follows:—Make a box with lid (lock and key, &c.) of the following dimensions: 1¾ft. long by 6in. broad and 6in. deep. This should be made of ⅛ wood, and is to contain the small cells. The small cells should, if possible, be made of ebonite. If this is too dear, obtain them of well-dried wood, well put together, and well waxed. These should have small lids made to be screwed down, and with indiarubber padding between the lid and cell to prevent acid oozing out. Their size should be 5in. deep by 3in. long and 2in. broad. There should be 12 of these, and they should be arranged in the box by means of partitions (two abreast); each cell should contain two lead plates, fixed to the lid and attached to two terminals. Join these plates up as battery, leaving two leads free; attach these to two terminals on the outside of the box three-quarters full, the small cells with a mixture of sulphuric acid 5 parts, water 2. Mark one terminal + and the other −, and if at the commencement you attach the + terminal to the carbon of the battery, and the − terminal to the zinc of the battery; always follow the same rule in after charges; the accumulators rapidly improve by constant usage; charge for two hours. Any further information shall be pleased to give, but you had better advertise your address.

F. W. Mason.

[68968.]—**Optics.**—If "Sol" will construct on paper a triangle with a base of 3in., and a height of 22in., making the apex ½in. broad, in place of a point, he will find that at about 7in. from the apex, the diameter will be 1in. The exact distance from this place (measured along a central line, and not along the slant sides) to the apex, will give the radius of the curve the concave lens must have on both sides to produce the parallel beam of light "Sol" wishes for in conjunction with the convex lens he proposes to use.

Ramsgate. J. C. Linscott.

[68970.]—**Springs.**—You cannot better steel, either painted or plated. The copper is short and crystalline, and would break if hard enough for springs. Bijli.

[68971.]—**Zincs in Gassner's Battery.**—I believe not. None that I have seen has been.

S. Bottone.

[68972.]—**Locating Site of Slide-rest Nut.**—You should have fitted the stem of the nut into the top slide before you bored the hole in it to receive the screw. The nut could be fitted with more accuracy and less trouble if you would get another forging in place of the one you have with the hole in it. After you have got this, put the slide together, and through the slot along which the screw passes in the bottom slide scribe two lines on the bottom of the top slide—one close to each side of the slot. Now take the slide to pieces, and get the centre between the two scribe lines by means of dividers; also find the centre of the slide lengthwise, and where the centre of the breadth and the centre of the length cut, put a dab. In this dab you can then bore the hole for the stem of the nut, and after you have the nut filed up, turn the stem to fit this hole. When this is done put the slide together again, and put the nut firmly into its place (the stem or tang of the nut is usually made long enough to pass through the top slide, so that the tool-box can be secured by it; in this case, see that the tool-box is put on the tang and properly fastened up). Next push the top slide along the bottom one until it is stopped by the nut coming against the end of the slot in the bottom slide; then put a scriber through the hole in the end of bottom slide in which the screw works, and scribe a circle on the face of the nut. Now pull the top slide as far as you can in the opposite direction, and scribe the other face of the nut in the same manner as the last. The nut can now be taken out and a dab put in the centre of each scribe circle. Get a ¼in. drill and bore the nut half-way through from one side, then reverse, and bore from the other side until the holes meet. You can then put through the proper sized drill, and after the hole has been tapped and the nut put in its place, the screw should work all right in it. J. M. Wellwood.

[68975.]—**Tinning Brass Wire.**—Boil the wire in a copper pot with a solution of oxalic acid, add a grain tin and a bit of argal. Bijli.

[68974.]—**Harmonium Reeds.**—The manner in which this query is worded is rather amusing. If the querist has been "stuffing the bass notes with cotton wool," as he says, that operation is, in itself, quite sufficient to effectually stop all "strength of tone." However (without joking), he had better divide the bass notes from the treble, adopt the use of a valve-board, and allow less wind to enter the bass register. I consider this the best plan to accomplish what the querist desires. If he [illegible] send his address, or write to me, I will explain matters clearly. I am willing to answer any reasonable question on receipt of stamp to pay postage.

Swansea. G. FRYER.

[68976.]—**Finger-Nails.**—"Beta" will find, on observation, that very great variety as to shape, strength, tint, thickness, reproduction, &c., exists, both in the human nail and in the animal hoof, the chemical composition being in each very similar. Not only is a departure from a healthy standard found in mankind, but notably so in horses, sand-crack (a split in the hoof) often bringing down the value of a 100-guinea horse to shambles price. Broadly speaking, defective finger and toe-nails indicate some defect or failure in nutrition. Seeing that the process of animal and human nutrition is really one of those secrets of nature still a mystery to man, the query can only receive a reply conjectural as to cause, while as to remedy the analytical chemist may say "that one or other of the salts would be deficient in quantity; therefore give, as a medicine, the said salt in a concentrated form." This sounds well in theory; but in practice it has again and again proved worse than failure. Dr. Marsden, of Malvern, and of Grosvenor-square, London, used the indications afforded him by the finger-nails as a great guide in prognosis and in treatment, also in judging of his patient's character, &c. It is some 25 years ago that I experienced his suggestions in such matters, of which I have received many telling confirmations. That some drugs have, when injudiciously applied, an adverse action on the nails, a reference to any one of the Materia Medicas of Homœopathy would make clear to the inquirer. The boy's age being about 14, the critical period of puberty is probably at hand. During the next few years the condition complained of may disappear. Anyhow, an elementary acquaintance with the theory of human nutrition, and with the homœopathic treatment of the every-day ailments of the human system, may be of much use to "Beta." That vegetarianism is curative of all bodily ills the presence of sand-crack, &c., in a horse's hoof is a poser anent that theory, and an item that has often been advanced for argument with Dr. Allinson by me. An item by Sir Alfred Garrod, M.D., in the *Lancet* of April 6th, alludes to the action of sulphur on the finger-nails. This alone shows how allopathy is adopting the teaching of the homœopaths. THE LYDNEY DISPENSER.

[68977.]—**To Electricians.**—Why go such a roundabout way? Here you are depending on a lot of variables. The dynamo resistance may vary; the ammeter may be faulty, the proximity of dynamo or leads may affect both. Why not rig up half a dozen Daniell cells, even if made with tobacco-pipe bowls for porous cells? Then you would get a fixed and definite E.M.F. of 1·079 volt per cell.

S. BOTTONE.

[68978.]—**Vaccination.**—(1) Yes, till successfully done. (2) Yes, you can, but don't; and you can also get summoned and fined repeatedly till he is vaccinated. Have it done with calf lymph, and be thankful. BIJLI.

[68978.]—**Vaccination.**—In answer to "W. W. W," I have had exactly similar experience, and have got rather further than he appears to have reached yet. Children when taken to be vaccined at a public station have to be taken a week after to have a portion of the matter removed, according to discretion and needs of the doctor. I have heard of mothers bathing the punctures with cold cream immediately after first operation is over, with view of modifying effect, but best way is not to have it done. In most parts of England public opinion is averse to continued punishment for the same child, and if "W. W. W.'s" son is in good health, by all means keep it so, and do not run risk, which is undoubted, of making it a permanent cripple or introduce some foreign poison into its system which may or may not be readily thrown out. I have been fined 10s. twice for two children, costs 12s. 6d. in each case, and I think that peace of mind and healthy bodies insured cheap at the price. Up to the first interview with the Bench I had given the subject very little thought; but a neighbour of ours also having a child a month or two older, and as we both had the same doctor, he being engaged for the job, I thought he might commence on my neighbour's, and I would await result. They got the so-called pure lymph from the calf, and immediately after the operation the child broke out all over its body with boils and sores, and for a fortnight its parents were up night and day with it, hovering between life and death. They ultimately pulled it through, and the doctor says "it hasn't taken, and will have to be done again." What its father said had best not be written; but he declined, and was ultimately haled before the Bench and fined because of the omission. This convinced me to let it alone, which I did, and have done since. I had several conversations with the doctor, who always advised me to have the child vaccined, but I declined. The gist of the talk was, That the bad matter that broke out of the youngster was something that was in it before, but of which he was unaware. As far as he knew, there was nothing in our youngster of an impure character that had to come out, so I decided to have none put in. The subject is certainly in an experimental stage, and we may have some additional light thrown on it with Royal Commission just appointed.

R. H. B.

[68978.]—**Vaccination.**—On the principle of *endosmose* or *exosmose*, a piece of lint or towel folded, say, four times, wrung out of cold water, applied instantly over the seat of insertion and repeatedly renewed would be calculated to absorb the vaccine fluid. Back numbers three to four years ago have some items by me describing how inoculation by Jenner himself was prevented in a regiment of soldiers by the men having taken sulphur daily for some days previous to the operation. In case "W. W." desires to put the latter item also to a practical use, a continued grinding of a few grains of sulphur with, say, 10 times its weight of some non-medicinal substance, white sugar or flour for instance, would give the sulphur in a homœopathic form, the dose of which may vary from one to five grains three times daily. Any homœopathic chemist would supply the drug if preferred. Better still, however, would be the frequent inhalation from a phial (see back numbers) of sulphur in the state of vapour, known chemically as sulphurous acid. This may also be used as a lotion to the arm. Some items illustrating the danger following vaccination shall follow this mem.

THE LYDNEY DISPENSER.

[68978.]—**Vaccination.**—You can have your son vaccinated with pure vaccine lymph. Only one operation is compulsory. Do not attempt to suck away the vaccine; such an attempt would be useless. Take the advice of one who has lived in a country where vaccination is not compulsory, and who has seen a whole community decimated with that awful disease, small-pox, and have the child properly inoculated. You will be thankful for it in after years. S. BOTTONE.

[68982.]—**Watch Trains.**—To "EX-WATCHMAKER."—Watch trains are usually 14,400, 16,200, and 18,000; the first named being a very slow train, giving 4 beats to the second; the second giving 4½ beats; and the last named 5 beats to the second—usually found in the "centre seconds" class of watches. I append a sample calculation in its simplest form, and I feel sure you will grasp the principle after a few minutes' study. Count the numbers of your wheels, commencing with your centre wheel, and jot down thus— $\frac{\text{centre}}{80}$ $\frac{\text{third}}{75}$ $\frac{\text{fourth}}{72}$ $\frac{\text{escape.}}{15}$ Do the same with your pinions commencing with your "third" pinion, thus— $\frac{\text{third}}{10}$ $\frac{\text{fourth}}{10}$ $\frac{\text{escape.}}{8}$ Now divide your centre wheel by the number of third pinion; multiply the product by the number of your third wheel, dividing this product by your fourth pinion, multiplying again by your fourth wheel, and dividing by escape pinion. Multiply this by 30 (double the number of escape-wheel), for each tooth gives two beats. You have now the total number of beats in an hour, or one revolution of the centre wheel. Of course you may vary the number between these trains—which are commonly called "bastard" trains—but I don't recommend any train for a lever watch under 16,200. Cement: A very good cement for ferrules and for chucking light articles in the lathe is made as follows:—In an iron ladle melt some best yellow rosin, and stir into it some good plaster of Paris; when about the consistency of treacle, pour out on cold slab; when cold it should break with a sharp metallic snap; if too soft put in more plaster; if too hard more rosin. Apply to ferrule by softening in gas flame; set your pinion or wheel true whilst warm, and when job is done melt off with oil in a small metal cup or ladle, held over gas, and made to boil; rinse in benzoline, and it is as clean as when you started. Sample calculation of a 16,200 watch train:—

$$\begin{array}{lrl}
\text{Third pinion} & 10)80 & \text{central wheel.} \\
 & \overline{8} & \\
 & 75 & \text{third wheel.} \\
\text{Fourth pinion} & 10)\overline{600} & \\
 & \overline{60} & \\
 & 72 & \text{fourth wheel.} \\
 & \overline{120} & \\
 & 420 & \\
\text{'Scape pinion} & 8)\overline{4320} & \\
 & \overline{540} & \\
 & 30 & \text{double the number of escape-wheel teeth.} \\
 & \overline{16200} & \text{beats in an hour.}
\end{array}$$

—EX-WATCHMAKER.

[68982.]—**Watch Trains.**—The number of rotations the wheels and pinions make is inversely proportional to the number of teeth they contain. The drivers multiplied together, divided by the followers multiplied together, gives you the value of the train, or the number of rotations the last follower makes to the first driver. In watches the wheels are the drivers and the pinions followers, for we work at what is called a "mechanical disadvantage," using more power in order to obtain more speed. The calculation for the main wheel is easy. It is equal to the centre pinion multiplied by hours of going, and divided by number of turns. Thus, $\frac{8 \times 30}{4} = 60$. That disposed of, you proceed to calculate for the number of vibrations per hour, and then, the wheels divided by the pinions gives you the vibrations; include among the wheels the 'scape-wheel teeth multiplied by two, for each tooth gives two vibrations. Thus—

$$\frac{\text{Centre wheel} \times \text{third} \times \text{fourth} \times \text{'scape} \times 2}{\text{Third pin} \times \text{fourth pin} \times \text{'scape}} = \text{vibrations per hour.}$$

I conclude with a few examples:—

$$\frac{64 \times 60 \times 56 \times 15 \times 2}{8 \times 8 \times 7} = 14{,}400 \text{ vib. per hour.}$$

Another—

$$\frac{64 \times 60 \times 63 \times 15 \times 2}{8 \times 8 \times 7} = 16{,}200 \text{ vib. per hour.}$$

$$\frac{64 \times 60 \times 60 \times 15 \times 2}{8 \times 8 \times 6} = 18{,}000 \text{ vib. per hour.}$$

CHARLES A. JONES.

[68983.]—**Dynamo.**—Theoretically, one layer of wire is the best. Practically, and especially in such a small armature, from three to five layers (not two or four) is the best. Put about 1lb. No. 22 on the armature, and about 7lb. No. 24 on the fields. Connect up in shunt with the brushes. You might, if your iron is very soft and your winding very close and neat, be able to light six or seven 10c.p. lamps of 12 or 15 volts each. You will have to drive at 2,500 revs. per minute. S. BOTTONE.

[68987.]—**Mongoose and Snakes.**—Mr. "E. L. G." is evidently not aware that the mongoose is common in India. I had a tame one about my bungalow for some years, during which time the "innocent little" cobra made himself scarce.

BIJLI.

[68987.]—**Mongoose and Snakes.**—In answer to "E. L. G.," there is an ichneumon which is common enough in India—namely, the grey or Indian mongoose, and it is the best of all for destroying vermin, such as rats, &c. All the ichneumons will kill and eat snakes and small reptiles. Besides the Indian mongoose there is also the Egyptian variety, the South African, and a larger black one found in West Africa, which is more delicate than the others. I have kept the three first-named varieties. They feel the climatic change in this country, and some of mine died of lung disease; but one Egyptian banded Mongoose lived for two years, and was very tame and affectionate, following its owners like a dog. Mongooses are sometimes sent to the Colonies and to the Sandwich Islands by a well-known importer of animals in Liverpool. I should think Australia ought to suit them, they drink very little water. They are credited in India with killing the cobra, and I have no doubt they do. This snake is very slow in striking, and the mongoose is very active and perfectly fearless and courageous. I do not know if it is true that when bitten by a poisonous snake, it seeks an antidote, as is sometimes stated. The acuteness of the sense of hearing and of smell in this animal is something wonderful. A. E. B.

Utility of Hobbies.—Said a gentleman who has seen much of human life, and was himself an enthusiastic student at threescore years: "No man in this world can be happy without a hobby." With this as a text, another scholarly and amiable hobby-rider said, as an introduction to a lecture upon his favourite study: "Indeed, for diverting our minds from the little crosses which we all have to bear, there is no earthly solace so healing as a subject in which we are intensely interested—something to which the thoughts may at any moment recur when weary of the suggestions we would escape. When, in addition to being an innocent diversion, ours is a useful study, we and our fellow-mortals are alike gainers. The person who passes through life without being an enthusiastic student of something loses more than he can appreciate. I emphasise the something, because nothing but natural selection can decide what ought to be each person's field of work. Nature is generous; the field is the world. With one it may be rocks or ferns, with another mosses or oaks; or, leaving untamed nature for applied science, it may be the steam-engine or the telescope, the field of language or the human form. No person has a right to say, 'My study is important, and yours is useless.' Each man's hobby is really for him the most valuable addition he can make to his own happiness, and the most precious contribution on his part to the sum total of human felicity and general knowledge."—*Universal Tinker.*

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "F. H. L." has replied to 68417; "A. F. Shakespear," 68683.

68426. Lamp, p. 183.
68442. Casting, 184.
68445. Dust, all About, 184.
68449. Watchmaking, 184.
68462. Turbine, 184.
68464. Oxyhydrogen Blowpipe, 184.
68469. Coil Boilers, 184.

68688. Making Pattern of Planer, p. 268.
68695. Naval Architecture, 269.
68700. Faulty Beam Engine, 269.
68701. Blast Fan, 269.
68715. Hot-Air Engine, 269.
68716. Piano, 269.
68720. Man and Truck, 269.
68722. Methods of Studying Organic Chemistry, 269.
68723. Collar and Shackle Illusion, 269.
68725. Sound, 269.
68739. Organ, 270.

QUERIES.

[68989.]—**Cooling Apparatus for an Invalid's Room.**—Information required how to make a punkha. Is clockwork actuated by a falling weight to be depended upon? I want to keep a room 25ft. by 15ft. by 15ft. cool for an invalid who has been, and is, suffering terribly from pain. He is now entirely confined to bed, and quite unable to stand or move out of bed. He suffers very much from the sweltering heat we are now experiencing here (Bath). I fear a refrigerating apparatus and engine would shake the room too much, and a fountain is too noisy. Any information would be greatly esteemed by—D. H.

[68990.]—**"Mona's Queen" Paddle-Wheel.**—Kindly give me weight of the paddle-wheel of the *Monas Queen* boat and oblige. The wheel came off during a trip from the Isle of Man to Fleetwood.—Thomas Cumming.

[68991.]—**Tempering.**—Many thanks to "Nun. Dor." for his information on hoes. I have already tried several years, but could not succeed to my satisfaction, and could not get hold of any one to show me properly; but hearing of the "E. M." I took several numbers in, to see how it worked, then I wrote my first query, hoping to get all the information required. Now, can "Nun. Dor." tell me if mill-bills are tempered only by practice and experience, or whether there are recipes for that purpose. I have tried them by hammering and tempering them as I would a cold chisel; and also by a recipe I got from a roadster; but all to no purpose. It would be a benefit to me; and also it would be convenient to the miller that lives close by, for he has to send his bills a long way to get them done. If "Nun. Dor." can give me any information whatever I shall be thankful, for I wish to be as useful as I can to the community that I live in.—W. F.

[68992.]—**Rendering Crude Carbolic Acid Soluble.**—I have tried in vain to render the crude carbolic acid soluble, so as to mix readily in cold water. How is it done? There is evidently in the market several preparations purporting to be carbolic acid for sheep-dipping purposes, &c. I have tried through Allen's "Commercial Organic Analysis," Vol. II., to find the line, but am baffled. Will some in the know kindly oblige?—Army Hospital Compounder.

[68993.]—**Gravitation.**—I believe it is stated that the height to which a stone is thrown may be estimated by recording the number of seconds from the moment it is ejected until it reaches the earth, and taking half the result. Am I correct if I estimate the progress of a stone in the following manner. If it were thrown vertically up, and it occupied a period of six seconds by the time it reached the earth, viz:—

	Feet.	
First second	80	Ascent
Second do.	48	
Third do.	16	
Fourth do.	16	Descent
Fifth do.	48	
Sixth do.	80	
	2)288	
	144ft.	

Of course this is taking 16ft. per second as being the rough estimate at which all bodies are attracted at the surface of the earth. Has this theory ever been proved by experiment, and is the speed in the ascent exactly proportional to the descent?—Heliostat.

[68994.]—**Magneto Bell.**—I have a short telephone line (about 50 yards in length), on which I want to use magneto-bells. Would Mr. F. C. Allsopp oblige me with a short description of a simple form of magneto-bell with generator?—Talibu-l'-ilm.

[68995.]—**Electro-Motor for Small Boat.**—Kindly oblige me with the proportions, weight, and size of wire of an electro-motor suitable for driving a small boat for four persons. The diameter of present screw-shaft at present driven by small steam-engine, is 1¼in. What surface of storage battery would be necessary; and would a duplicate of motor be suitable for charging storage batteries? Would it be advisable to make the motor on the lines of the model motor described by Mr. Bottone? I have plenty of power for charging. Suppose accumulators are charged, how long will they remain so before being used?—Mac Jute, Calcutta.

[68996.]—**Battery for Five-Candle Light.**—What is the most economical battery to use to light a five-candle light at intervals? I want it so I can touch a button, and have light enough to see the time in the night. It will need the battery but a moment; but I want a battery that can be left without care as long as possible. Will someone please describe battery, and name number of cells needed for the above light.—F. S. Morton.

[68997.]—**Lathe.**—What size iron wheel and weight would be most suitable for 4½in. centre lathe, for light work, wood-turning?—Baker.

[68998.]—**French Metal Factories.**—Can any readers give me any information respecting any iron and steel, or wire works in or near Paris; and is it possible to obtain admission to any of them while on a visit to the exhibition?—H. S. H.

[68999.]—**Hot-Air Engine.**—Will some kind reader please give me a slight sketch of a model hot-air engine suitable for driving small models, or boat?—O.

[69000.]—**Secondary Battery.**—I am extremely anxious to make a set of accumulators to give about 50v. 8am. I understand they are troublesome and expensive. I have been recommended to buy them. I am inclined to try and manufacture them; but I am somewhat afraid that my time, money, and patience would be thrown away. It would be interesting to electrical amateurs if someone who has tried will kindly give us the result of his experience, his failure, or success. I want to know particulars of make, number of cells, dimensions, and method of mixing and affixing the red lead, &c.—M. A. C.

[69001.]—**Problem.**—I have four weights, with which I can weigh any number of pounds, from 1 to 40 inclusive. What are the weights? Is this problem capable of mathematical treatment?—and if so, how would one proceed with it?—X.

[69002.]—**Bricks.**—Can any reader give me a description of the following bricks:—red and white Suffolks, red, white and black Rubbers, Cowley and Kent bricks, Sussex bricks, yellow and pale malms, Broseley and Staffordshire bricks, Ruabon, Gaults, and Berkshire bricks; also a description of the clays from which they are made.—Bricklayer.

[69003.]—**Piano Keys—Woodwork.**—I bought a piano a few weeks ago at a sale. On getting it home I noticed a discharge of very fine dust in front of the keys when played on. Searching for the cause, I discovered a number of minute circular holes, varying in size and quantity, in fully one half of the keys. I have been told by some it was dry-rot, by others that it is a wood-worm. Can any reader tell me definitely what it is?—and of any remedy to stay further destruction. I also bought a terrestrial globe, and two hall-chairs, which are in the same condition.—Anxious.

[69004.]—**Fluorine.**—Will, or can, any one tell me how to test the ash of wheat for fluorine, which is present in too small a quantity to detect it by adding H_2SO_4, and thereby etching glass.—Operative.

[69005.]—**Clock Cleaning.**—I have cleaned a clock which had been lying idle for a few years, and am in a fix about the striking part. For example, say at six o'clock it strikes six, and then at six-thirty it strikes seven. I think it should only strike the hour. Will some one kindly aid me, and be very explicit in replying, as I don't know the names of the works. This is my first attempt. The other part works well.—Endeavour.

[69006.]—**G.E.R. Single Drivers.**—Would any readers favour me with a sketch of any G.E.R. single, six wheels to tender; also numbers of any singles; also sketch of No. 59 Fairlie tank engine; also G.E.R.—R. S. B.

[69007.]—**Faulty Medical Coil.**—I have made a coil of the following dimensions: bobbin 7in. long, with 1in. core. I have put four layers of 24's cotton-covered wire for primary. Secondary is wound with one pound of 36's c.c. wire. I have wound it for four powers, allowing 4oz. to each, and have been very careful in soldering ends of each power together. I have a separate contact breaker in circuit with primary, and the primary circuit works very well. With two pint Bunsens I only get a very feeble current on first power, and only slightly more on the others. Will some friend kindly point out where my mistake lies, and greatly oblige.—G. Warren.

[69008.]—**Cubical Contents.**—Will some kind reader kindly give me rule for finding the cubic contents of the following frustum of a cone 14½in. diam. at top, 7½in. diam at bottom, 10in. deep, or any such cone, by decimals, as I do not understand anything else; also cubic contents of a true cone.—A. C. Chambers.

[69009.]—**Blowpipe for Brazing.**—Will any kind friend please inform me how to make an efficient and suitable blowpipe (such as I presume bicycle maker's use) for brazing together the various parts of a bicycle, as I have all the various rough parts of a safety bicycle to braze. A sketch with dimensions would oblige. I may state that I can obtain a good supply of gas.—W. G. O.

[69010.]—**Protecting Felt Hat.**—Will some kind reader say what is a good thing to protect a felt hat from the wet weather, &c.?—Working Man.

[69011.]—**Battery.**—Will S. Bottone or some other reader kindly tell me why 4 quart chromic-acid batteries will not light a 6-volt 5c.p. incandescent lamp properly, Edison-Swan? The batteries consist of two corrugated carbon plates, one each side of porous pot, with three parts of chromic acid, six sulphuric acid, and eleven water, and a rod of zinc inside porous pot, with one sulphuric acid to ten of water. The lamp when joined on a short circuit does not give out a light equal to an ordinary candle. I suppose a 5c.p. Edison-Swan lamp will give out a better light than one ordinary candle.—Tyro.

[69012.]—**Glazing Tiles.**—How are those earthenware tiles and fenders used in fireplaces glazed, and what is the glaze composed of, and what heat is required?—W. Wilson.

[69013.]—**Evaporation of Acid in Daniell Battery.**—Would feel much obliged if any of our readers would tell me how to prevent this in future. I have the battery set at a door working an electric bell. All the sulphuric acid and part of the cupric sulphate are evaporated in four days.—G. M.

[69014.]—**Lathe Adjuncts.**—Can any of your contributors inform me how to divide—for lathe work—the arc of a quadrant of an ellipse, of which the semi-axes are A and B, into *n* equal parts? Moreover, is there any mechanical contrivance that will accomplish this? Possibly "M.I.C.E. (Bath)," or "C.C.E." may be able to answe— W. A. K. G.

[69015.]—**Papier-Mache Lining for Tea Tra**—Would any one kindly tell me how to make pap mâché to be applied in thin layers, to make an article a thin tea-tray waterproof if possible. The article i question will have many curves.—W. L. C.

[69016.]—**Railway Gradients.**—Can any of yo correspondents give me a list of some of the steepe gradients on our railways in England, with their positio proportion of ascent, length, and to what line they belon Near here, at Broadway, in Dorsetshire, there is a gradi of 1 in 44 on a curve about a quarter of a mile lon Would this be considered too steep for convenient trav ling? What additional weight is put on the engine by gradient such as this? I think if Mr. Stretton or so other experienced correspondent could kindly give a answer to this query, it might be of great interest to othe besides myself.—W. E. C. B.

[69017.]—**Self-Steering for R.D. Safety.**—I a constructing a safety with a spring frame of my ow design, and I wish to include all the latest improvem Everything is settled but the steering gear. I wish, i possible, for an arrangement that will permit the hand being removed from the handles without regard to th speed of the machine. All the straight-steerers I hav seen will not run slowly, and they require the hands guide them clear of a stone. The frame is of the parallel gram type, with curved front forks and socket steering.—A. F. Shakespear, Dresden.

[69018.]—**Ferric Chloride Battery.**—Would M Mason kindly explain whether under the above nam [reply 30061] he means the single cell arrangement o carbon and iron, in which the ferric chloride is reduced b the iron to ferrous chloride, and is then renovated by bei exposed in flat vessels to the air, re-depositing the dis solved iron as ferric oxide. The only waste is in the iro and I think this arrangement would be useful in wor where ferric oxide and electricity are both used. Woul the above battery suit for lighting, say, 50 ordinary coa miners' lamps? What size and number of cells would b required? Being of small intensity, could not seve pairs be joined in series in each cell without much lea age?—Coal.

[69019.]—**Boiler Covering Composition.**—W any reader advise me as to a practical method of prepari a non-conducting composition for covering boilers a steam pipes. I have got back numbers for two years, b cannot find the above in them.—F. W. Bernard.

[Nothing beats Bell's Asbestos Boiler Covering Com position. We have recently re-covered our own boi with it, and it gives perfect satisfaction.—Ed. "E.M."

[69020.]—**Rat-Trap Bicycle Pedals.**—Is the any way of preventing the spikes piercing the shoe and sticking in one's foot. Could a steel sole be ma covered with rubber or leather?—A. F. Shakespea Dresden.

[69021.]—**Screw-Cutting.**—Will some practical la hand kindly explain the method of dropping nut in th right place for starting again, in cutting broken pitches, 4 1-5th threads per inch, with a lead screw ½ pitch: al odd threads as 7 per inch, lathe saddle run back b taking nut out of screw; also kindly inform me how regulate compound rest to give accurate taper in bor and turning tapers for good fits?—'Prentice Turne

[69022.]—**Instantaneous Photography.**—W anyone kindly inform me how to photograph a hor trotting; also which shutter is best suited for it? I hav tried it with a Lancaster's Instantograph and Revolv Shutter, but always failed to get a sharp picture, the ou line of the animal appearing very shaky and misty.—Amateur.

[69023.]—**Electric Launches.**—In view of the fa that electric launches are now successfully running on t Thames, and that convenient stations for recharging accumulators have been established there, many of yo mechanical readers might like to try their hand at co structing the requisite motor and other appurtenan Will some one kindly say if this work would come wi the province of a skilled turner, and give some instruc in relation to the electrical part of the apparatus, and where the castings and materials can be obtained. I ta it that the electric motor, &c., are less trouble and exp to make than a boiler and engine. As an electric lau has its machinery stowed away out of sight, and t whole length of the boat is practically open and u obstructed, I think that a vessel some twelve to fift feet long, to carry two or three people, would answer m amateurs' requirements; so perhaps some correspondent will give information of the electric machinery requir for such a boat, which I imagine would not present fo midable difficulties in its construction. I should als glad to know the best and simplest form of motor, batte &c., and the probable cost of same.—Punch.

[69024.]—**Gauging Keys.**—Will some kind frie please inform me of the best way to gauge Chubb's an other makes of pipe keys? When making extra one find in making solid pipe that a watchmaker's slid gauge is the best; but when I come to the pipe I hav goodly number misfits. I can account for it in this way that there is a variation in the substance which throws m out gauging over all.—H. A. Stanley.

[69025.]—**Chemical.**—Am desirous of making so corallin (yellow). Can any reader of the "E. M." sugge a method by which I can get a bath at 110° C.?—Chemica Student.

[69026.]—**Expansion Movement in Engine.**—I am desirous to fit expansion movement to the slide-valv of a small engine. Will anyone who knows kindly te me the simplest means of doing this, so as to cut off stea where desired. I have seen two eccentrics used for th purpose; but this seems far from simple.—T. C. G.

[69027.]—**Brazing Hearth.**—Will any brother rea explain a cheap form of blowpipe to use blast from ordinary forge, with hints on using same; also whethe brazing by gas blowpipe would be better and cheaper tha in forge fire?—Anthony, Essex.

[69028.]—**To Mr. Mason.**—I have a bell which don't work. It is mostly used for calling anyone from th workshop to the shop below it, and waking anyone up in th morning. For this purpose it is connected to a clock I ad one No. 1 Leclanché on it; but, as it did not work, I ut another with no better result. I have examined the ell; the connections are clean, but it will not work. The ammer sticks to the platinum screw; but if the hammer touched it works all right. I thought the spring might e too strong, and I made it weaker, but it is no better. Have tried suggestions in back numbers, but with the ame effect. Hope you will be able to help me out of he difficulty.—W. V.

[69029.]—**Tablets for Warnerke's Sensitoneter.**—I have a Warnerke's sensitometer, and the ensitive luminous tablet has been spoilt by the climate. As no tablet is likely to last many months here, could any me tell me how to make easily fresh standard luminous ablets?—Assam.

[69030.]—**Ironmongery.**—Being about to start in usiness on my own account as a small ironmonger and ealer in japanned wares, I should feel and esteem it a ery great favour if anyone can inform me what is the air profit to charge upon the wholesale price as a rule, as I have had no experience in the pricing of goods, and I hall only care to charge moderately. If you can help me in this, or point me to any work on the subject, I shall be much obliged. Then I require to know what books are necessary for the keeping of the accounts of a small business in correct state, and how to calculate the discounts when they run into fractions, such as 33⅓ per cent. I can do the whole numbers, but these fractions bother me. Do you know of a cheap book on the keeping of accounts?—G. J.

A paper on the "Surface Currents of the North Atlantic," was recently read before the Paris Academy of Sciences, by Prince Albert of Monaco. Of the 1,675 floats cast into the sea during the recent explorations of the *Hirondelle*, as many as 146 have already been recovered at various points of the seaboard, apparently demonstrating a circular movement of the surface waters round a point situated somewhere to the south-west of the Azores. The outer edge of this current sets east-north-east, to the neighbourhood of the English Channel, where it is deflected southwards along the coasts of Europe and Africa to the Canaries, thence trending south-east to the equatorial current, thus completing the circuit by merging in the Gulf Stream.

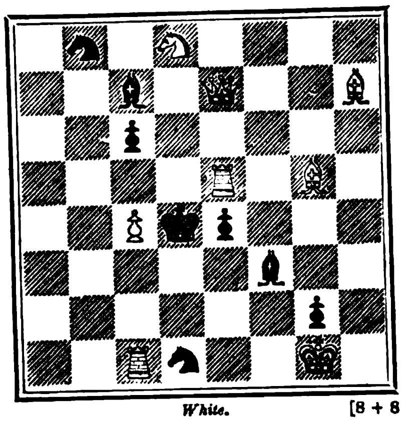
The Prophylaxis of Phthisis.—The Address in Medicine delivered at the thirty-seventh annual meeting of the Medical Society of the State of Pennsylvania on the 4th inst., by Dr. J. C. Wilson, Philadelphia, dealt with the subject of the Etiology and Prophylaxis of Tuberculous Diseases (*American Medical News*, June 8th). Dr. Wilson adopts to the full the bacillary origin of tuberculosis, and spoke most hopefully of the possibilities in the way of prevention which such a doctrine entails. He advanced a series of general propositions, which he discussed in ample detail—viz.:—1. Tuberculosis is a specific infectious disease. 2. The constitutional manifestations are not directly due to the bacilli, but to toxic principles evolved during their growth and multiplication. 3. Tuberculosis is directly and indirectly communicable from the affected to the healthy individual. 4. It is not in the ordinary sense hereditary. 5. A rational scientific prophylaxis is practicable both as regards individuals and communities. In the same journal, on another page, is given the text of an important report forwarded by request to the Board of Health of New York City by Drs. T. M. Prudden, H. M. Biggs, and H. P. Loomis. In that report it is stated that it has been proved "beyond a doubt that a living germ, called the tubercle bacillus, is the cause and the only cause of tuberculosis"; that tuberculosis may affect any organ of the body, but most frequently involves the lungs; that it is abundantly proved to be transmitted by meat or milk from tubercular animals. The report then goes on to show that the germs exist in the sputa, and in the air in the dried state, and that there is great danger of transmission by inhalation of air containing this dust. A liability to the disease is hereditarily transmitted, and the frequent occurrence of several cases in a family does not necessarily involve heredity, but rather the constant exposure to contagion. Hence they advocate the rigid official inspection of cattle, and destruction of all tuberculous animals. They also advise the destruction of sputum, by seeing that patients always expectorate into cups (it is suggested these be of wood or pasteboard, so as to be easily burnt), and where persons are not confined to rooms or homes expectoration into handkerchiefs, which should at the earliest possible moment be soaked in a solution of 5 per cent. of carbolic acid, then boiled and washed. A drawing is given of a pocket flask designed by Dr. Dettweiler (*Therap. Monatschrift*, May, 1889), holding about three fluid ounces, and intended as a receptacle for the sputum, so as to obviate the necessity of expectorating either on the floor, or street, or into a handkerchief. It is also pointed out that an individual who is recovering may, unless he take great care, reinfect himself. They further advocate thorough ventilation of large public buildings, the cleansing and disinfection of rooms in private houses and hospital wards occupied by the phthisical, and the obligation of steamship companies to furnish separate apartments for consumptives. The lines of the report thus follow closely upon those laid down by Dr. Cornet.—*Lancet*.

CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLVI.—By G. T. Slater.

Black.



White. [8 + 8

White to play and mate in two moves.

Solution to 1,154.

White.	*Black.*
1. Kt-Q B 3.	1. K takes Kt (*a*).
2. Q-K R 5.	2. Anything.
3. Q-Q B 5 mates.	
2. Kt-K 2. (ch) &c.	(*a*) 1. K-Q 5 (*b*).
2. Q-K 6 (ch) &c.	(*b*) 1. P takes Kt (*c*).
2. Q-Q B 7 (ch) &c.	(*c*) 1. P Queens, &c.

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,154 by W. Gleaver (dual if 1. P-Kt 8 (R or B); triple if 1. P-Kt 6), J. Bryden (ditto), Fr. Fernando, W. L. Martin, F. C. Cook (dual: remarkably good; very difficult), Janus; to 1,153 by Janus, W. Jay, E. Sanders (but wrong in 1. K-B 3, as the only play is 2. R takes P), J. Ough, and J. C. Bremner.

T. A. Pringle.—In your attempt at 1,154 there is no mate if 2. K-K 4.

F. C. Cook.—We are much obliged for your last three-mover. The sui-mates will come in very handy presently.

H. V. Tattersall.—How do you proceed in your solution to 1,153 if 1. K-B 5? In 1,154 you have not given Black his best defence on the second move. Suppose P moves?

Drilling Cast Iron.—Mr. L. B. Breckenridge, the instructor in mechanical engineering in the Lehigh University, has lately been making some experiments for the determination of the pressure exerted in drilling cast iron. He made a cylinder in which was a plunger having an area of 10sq.in. Three small grooves were turned in the plunger near its lower end, so as to prevent any leakage of the oil with which the cylinder was partly filled. Two holes were drilled in the cylinder near the bottom, and a steam gauge and an indicator were attached. The indicator cord was attached to the hub on the shaft of the quick-return motion lever in order to obtain diagrams of considerable length. When the piece to be drilled was resting on the plunger, a diagram could be taken which would show the pressure exerted in forcing the drill through the work. With ¼in. twist drills the greatest downward pressure was 400lb.; with ½in., 900lb.; with ¾in., 1,100lb.; with 1in., 1,450lb.; and with 1¼in., 1,800lb.

Grained Negatives for Zinc Etching Without a Screen.—According to W. T. Wilkinson, this is done by coating the plates with an emulsion containing sulphate of baryta in very fine powder, and well shaken up before coating. Pictures are taken upon these plates and developed and fixed in the usual way, but the image, instead of being smooth and nice, will be covered with myriads of fine pinholes. These negatives are used for printing on the zinc in bitumen, then etched in relief for type blocks. Instead of sulphate of baryta, carbonate of soda, &c., may be used in the emulsion, and, after fixing, immersion in weak acid will develop the pinholes. The bromo-chloride emulsion may be used upon collotype plates, followed by drying them in the oven at a high temperature, exposing under a reversed negative. Develop and ink up as for the paper; pull the transfers upon ordinary lithographic transfer-paper. To obtain a coarser grain, soaking in warm water will develop the reticulation.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 3, and unacknowledged elsewhere:—

Rev. J. H. Cole.—J. Williams.—Gunpowder.—H. C.—Orion.—E. J. W.—Alpha.—Locomotive.—D. B. L.—L. P.—Derfla.—A. E. B.—Novice.—Mapper.—A. R. M., Swansea.—G. B., Woodgreen.—Jack of All Trades.—Hallett.—Wari.—G. C. T.—F. Campin.—G. W. B.—Bon-Accord.—C. Detaille.—G. P. B. Hollowes.—T. Taylor, jun.—F. W. Mason.—C. F. D. Marshall.—A. H. G.—J. M. Bacon.

Assam. (As you are so far away, we will do what we can to help you, though the list we can spare space for will be rather short. You should apply to the publishers for their catalogues. As to telephones and microphones, you cannot have anything better than our back volumes; but Du Moncel's work, "The Telephone, the Microphone, and the Phonograph," Kegan Paul, and Co., 5s., is about the best book at a moderate price. 2. For lithographic printing get Richmond's "Grammar of Lithography," Wyman and Sons, 5s., and for the photo-zinco processes, send for Wilkinson's little manual, "Photo-Engraving and Photo-Lithography," from the author, W. T. Wilkinson, North Parade, Otley, Yorkshire. For the permanent photographic processes, better procure a list of books from Piper and Carter, Furnival-street, Holborn, E.C.)—Tom Wilson. (What arrangement do you think could be devised for assisting cycles up-hill? The power would have to be put into it before it could be got out, and then only a percentage would be obtained. Practical cyclists have always said: "If you can't ride the machine uphill easily, it is better to get off and push it up.")—Drugs. (We cannot determine as to the fastest steamer; but probably one of the boats which take the mail from Holyhead to Dublin.)—W. Burgoyne. (For a home-made incubator see Nos. 1195 and 1211.) John Kirkwood. (Suppose you try the experiment, instead of asking others to guess the result of your idea when put into practice? So far as we understand it, the current would simply keep the dart in the barrel instead of ejecting it.)—Ronald, Glasgow. (How can we say? It rests with the individual. You must learn the trade by getting employment at it, or by being apprenticed to it. The loss of an arm does not offer any insuperable objection, as some men with only one arm are more industrious than others with two.)—W. Walton. (You can procure the Rules for the Registration of Designs and Trade Marks from the Sale Office, 38, Cursitor-street, E.C.)—An Eager Reader. (We do not remember Prof. Guthrie's disinfectant that could be made at a cost of a penny a bucket. You probably mean what he called his "Penny Water Cleaner," which consisted of a large flower-pot with the hole broken out sufficiently to allow the corner of half a brick to project through. The pot is then nearly filled with pieces of broken brick varying in size from, say, walnuts to filberts, and is immersed for a night in a pail of hot water. Then allow it to dry, and it forms one of the best filters known. The bricks should be well-burned stocks.)—New Subscriber. (Stays have been recommended for indigestion; but it would be more advisable for one of the male sex to try a wholesome diet. Nevertheless, see the indices.)—Cosmopolite. (We cannot advise as to the sale of patents. The secretary of the Mutual Aid Association, 2, Gresham Buildings, E.C., might possibly help your friend.)—J. Baxter. (If you cannot get your goods, we should advise you to communicate with the police at Scotland Yard.)

Men who feel Weak and Nervous should wear HARNESS' ELECTROPATHIC BELT. It generates a mild, invigorating, galvanic current, which effectually restores impaired vitality, strengthens the nerves and muscles, and speedily promotes the health of the entire frame. For particulars, book of testimonials, or advice, apply at once to the MEDICAL BATTERY COMPANY, Limited, 52, OXFORD-STREET, LONDON, W. (the largest Curative Electrical Institute in the world.) Pamphlet and advice free.

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USEFUL AND SCIENTIFIC NOTES.

SUB-SURFACE floats are to be set adrift, by order of Lieut. Pillsbury, for the purposes of the United States coast and geodetic survey. These floats will be made of a 1½in. square white-painted pine staff, about 8ft. long. This staff will project from 1ft. to 2ft. above the surface, and be surmounted by a simple tin vane, and with four galvanised sheet iron wings at the lower end to receive the impulse of ocean currents. The staff carries five glass water-tight tubes, each held in a mortice by a copper wire. Each tube incloses an envelope, addressed to the department at Washington, and containing a leaflet of instruction to the finder in German, Spanish, and French. The *Engineering News* says the finder is supposed to break open a tube, fill the blank, noting position, &c., of the float, forward this form to Washington, and to set the float again adrift.

Patents.—The sixth report of the Comptroller-General of Patents, Designs, and Trade Marks has been presented to Parliament, for the year 1888, and is just published. Since 1884 the number of applications for patents has risen from 17,110 to 19,103, for designs from 19,753 to 26,239, and for trade marks from 7,104 to 13,244. Of the 19,103 applications for patents, 14,851 came from the United Kingdom, 341 from its dependencies, 2,422 from Europe, 8 from Asia, 15 from Africa, 1,565 from America (1,457 from the United States), and 1 from the Sandwich Islands. We are informed incidentally that the number of readers frequenting the Patent Office Library during the year exceeded 80,000, and that the receipts from the sale of the office publications amounted to £5,878. The large increase under the head of trade marks must be set down to recent legislation on the subject. The total receipts from various sources on account of trade marks amounted to £10,234.

IF it be desirable to make a large per cent. of middlings, then, a writer in the *North-Western Miller* says, the sooner we discard appliances which tend to reduce the amount the better. Millers are often blamed for not working the mill up to the capacity or grade intended by the builder, when in fact it is not the miller's fault. Indeed it is not the intentional fault of anyone. The reductions on the breaks may be of the best, but the stock runs down a long spout to the elevator, then up a long elevator to a reel, and before it gets into the reel it passes through a long conveyor to head of reel, then through a 10ft. hexagon reel with all the tumbling incident thereto, and under these conditions the miller is expected to make a large per cent. of middlings and first-class flour. This is evinced by the expressions we hear of the utility of the several sieve scalpers now offered. Whether the sieve scalper is universally adopted or not, they are tending to open our eyes to the fact that in practice we have been using too much surface on the break reels.

Showers of Sand.—Invalids, and even more robust residents, on the Riviera Levante, as the Italian seaboard from Genoa to Spezia is called, are sometimes unpleasantly conscious of sand-laden winds, which make respiration anything but agreeable. These, in the spring especially, from April to the middle of May, often end in veritable showers of sand, covering the foliage of trees, the roofs and terraces of houses, and, indeed, all exposed surfaces, with a thin stratum of finely pulverised, desiccated earth. The Padre Denza, of the Royal Observatory of Moncalieri, near Turin, one of the most distinguished meteorologists in Europe, has bestowed much attention on this phenomenon, which he traces to storms in the Grand Sahara stirring up the sand, which is carried thence on atmospheric waves of low pressure across the Mediterranean to the European, and notably to the Italian, shores. On May 12th, according to his recent report, a violent tempest raged over the northern surface of the African Desert, as was announced at his Observatory by telegrams from Biskra. This, advancing towards Italy, brought heavy rains and strong gales into the Alta Italia (Upper Italy), and therewith a fall of sand much denser than those which had been observed between the 8th and 10th. This fall was at its maximum on the night between the 14th and 15th, and extended from the Ligurian Apennine over Novi and Tortona to Milan, and even beyond it, covering with a fine coating the leaves of the trees, the house-roofs and terraces, and the marble statues in the public squares. Quantities of this African sand were collected by the Padre Denza himself and by the directors of the other observatories in the Alta Italia. The phenomenon, until explained by the Padre, was popularly ascribed to the *luna rossa* (red moon) of April, which still figures as the cause of it in the weather forecasts of the catchpenny almanacs of Southern Europe.—*Lancet*.

Yes, the Ruptured will still find Dr. SHERMAN at his London Office, 64, Chancery-lane, where his wonderful success draws the afflicted from all parts of England, and where you and all others should go who entertain the hope of ever being cured. Send for his books, English and American, post free, 6d., and inform yourselves.—[ADVT.]

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Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Gentleman will give some valuable **Watches** of the best makers for some high-class Model Engines, 2¼in. or 2½in. bore cylinders, suitable for a museum or exhibition. Will give guarantee with each.—279, St. Philip's-road, Sheffield.

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Water Motor wanted, one horse-power, one of Wheeler, Preston, make preferred. Exchange Gas Engine.—ROBERTS, Washington Hotel, Liverpool.

Photographic, Microscopic, and all kinds of Scientific Apparatus exchanged.—R. WHITE, 55, Albert-road, Croydon. See Sixpenny Sale Column.

Want useful exchange for new **American Orguinette** and Music.—FRANCIS, Rochford, Essex.

Splendid Gunmetal **Force Pump**, new, ¾ plunger, value 7s. Exchange, Governor and Valve Castings, suit ½H.P. engine.—WALLER, 55, East-road, West Ham, Essex.

Bow Zither, cost 22s. 20s. worth Music. What offers, Watchmaker's Tools? No rubbish. Stamp.—H. KNIGHT, 20, Llanarth-street, Newport, Mon.

Engine Gland Packing, patent rolled cloth (with rubber centre), best of packing, 37lb. total. Exchange for good Stocks and Dies.—TAYLOR, Wakefield-street, Warrington.

War Ships, unique models, magnificent speciality, no toys. Exchange Jewellery, Diamonds, microscope or such, and half cash.—Particulars, 19, Plymouth-street, Broughton, Manchester.

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Pair 2½ **Lathe-Heads**. Exchange Violin in good condition.—W. WILD, Daisymere Cottage, Fairfield, Buxton.

Good 3in. Compound **Slide-Rest**. Exchange for good scale set Locomotive Castings, or offers. No rubbish.—HAYS, 121, Blackburn-street, Bolton.

Lathe (foot), 4½ centres, planed bed, 2ft. 6in., heavy driving wheel, 2ft. 2in., quantity tools. What offers?—PAYNE, 100, Upper Charnwood-street, Leicester.

Heavy 18c. gold chronograph and Calendar **Stop** WATCH, nearly new, cost £20. Offers. Part exchange, lathe or bicycle.—LATHAM, 148, North Hill-street, Liverpool.

52in. **Bicycle**, perfect condition. Exchange for 12 by 10 Instantograph or other good Camera.—J. SANDERS, Quorndon, near Loughborough.

3-jointed **Jack Rod**, 9ft.; 2-jointed Roach Rod, 8ft.; both brass fittings; 3in. brass winch, with line.—D., 40, Woodberry-grove, N.

Small Brass **Flywheel**, with bearings, 6in. diameter, turned and polished, with 1in. crank, quite new. Exchange small Taps.—SHAW, Church-street, Padiham.

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Splendid Model **Beam Engine**, bright, 1[illegible]in. bore, 4½in. stroke, metallic piston, full motion, fitted with brasses, gun collars, gun-metal bearings, bright flywheel, all complete, with [illegible] loco. type copper riveted boiler, with fire-box, and [illegible] fittings, ¼in. thick copper, work at 100lb. Exchange to value [illegible]—279, St. Philip's-road, Sheffield.

Will give a high-class large-size 18-carat gold English Lever WATCH, with gold dial, full jewelled, the best watch money [illegible] buy, cost £16, warranted, in exchange for model Beam Engine [illegible] bore cylinder, with full motion, governors, and pumps. For window show.—279, St. Philip's-road, Sheffield.

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50in. special club **Coventry Bicycle**, balls both wheels, with stand, lamp, bell, pouch, and wrench. Exchange.—BLYTHE, 104, Middle-street, Norwich.

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Complete set of **Watch Tools**, and materials, with several watches and movements. Exchange Lathe, Camera, or [illegible] to value £10.—H., 164, Euston-road.

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Wimshurst Machine wanted. Air Cane Gem, Air Gun, also Water-Motor (half-horse), for half-horse Engine Castings.—J. SMITH, 1, Cholmeley-road, Reading.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JULY 12, 1889.

FRICTION RESISTANCE IN PRIME MOVERS.

IN all machinery the item of friction is a very important one, and although its action seems very simple, yet the amount of work absorbed by it is not always very easy of determination; and between the same surfaces the friction at different times will vary under apparently similar conditions. Of course, we know that the conditions cannot be exactly the same; but it is frequently difficult to ascertain the state of surfaces working together without loss of time and trouble. In former days, it was customary in trying a steam-engine to take an indicator diagram from it when doing no work beyond overcoming its own friction, and this was called the friction diagram, and was considered to represent the work lost in friction when the engine was doing its ordinary duty. After a while, however, the opinion began to grow that the friction of the machine would not remain constant, but increase with the load put upon the engine. In the course of the past two or three years, however, some experiments and observations on these machines have tended to confirm the older view—that the engine friction is practically constant.

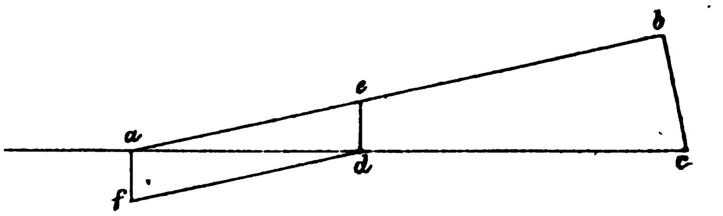
Prof. Thurston, in conjunction with several other engineers, conducted a series of very important experiments on engines of widely different types, and his results are most interesting as vindicating the use of the friction diagram. The engines tried included condensing and non-condensing engines of various sizes, the cylinder of the smallest tried being 6in. in diameter, with a stroke of 12in. The actual power was measured very carefully by a brake, and the result compared with the indicator diagrams. Running at full power, this engine showed a friction of 6 per cent. of the indicated power, and when running without load, at full speed, the indicated power was exactly equal to that absorbed by friction when running loaded, and at all loads the difference between brake power and indicated power was found to be constant. Similar results were found in trials of a 12in. diameter by 18in. stroke automatic variable cut-off engine, a 7in. by 12in. traction-engine, a 21in. by 20in. condensing engine, and a compound condensing engine driving an electric-lighting installation at Lansing. The friction of all these engines was constant at all loads, and this fact no reasoning of what should be, can overbear. Whether this result appears paradoxical or not depends upon the view taken of the character of the friction set up in the machine, and as is very common in connection with the steam-engine, upon the ascertained fact the theory must be built. The friction of solid bodies varies directly as the forces pressing their surfaces together, so long as the pressure is not sufficient to abrade or injure the rubbing surfaces; and from this fact it was argued that the friction must increase with the engine load; but the friction of liquids varies as the square of the velocity of motion, and is independent of pressure on the rubbing surfaces. The above-quoted experiments indicate that the friction in a steam-engine is of the nature of liquid friction, and there is nothing startling in such a conclusion. If the surfaces are separated by a layer of the lubricating unguent, it is natural to conclude that liquid, not solid, friction is set up, as the metallic surfaces are not themselves in actual contact. If this is so, the friction should rapidly increase with increase of velocity; but upon this point we have, unfortunately, no direct experiment to guide us.

It appears, however, if we follow these experiments a little farther, that in some parts the laws of solid friction apply, as it was found to make a very great difference, whether the slide-valve were balanced or not; when balanced in the small engine the slide-valve was responsible for only 2·5 per cent. of the total friction, but when unbalanced its friction was 26·4 per cent. of the whole. The state of lubrication of the slide-valve is one of those conditions which we cannot ascertain, and it is very probable that its only lubrication may depend upon the steam, and even greasy steam will probably not count for much in this direction.

The almost universal adoption of the slide-valve was undoubtedly due to its compactness and simplicity; but it is by no means without its disadvantages, and in its unbalanced form its great friction is a drawback. The coefficient of friction for the slide-valve may be anything from 0·1 up to 0·25, according to the method of lubrication, and when the valves are of large size the gross pressure will be considerable, and even if the valve is lubricated the total steam pressure acting upon its edges may be sufficient to squeeze out the lubricant, and so leave a metal to metal contact. In the case of the small engine above referred to, it must be taken that the removal of the balancing arrangement of the valve increased the total friction of the engine by 32 per cent., for the amount of friction of the other parts would remain the same, and that of the valve is stated as 26·4 *of the whole amount*. With the balanced valve the friction was distributed in the following proportions: Main bearings, 47 per cent. of the total friction; piston and piston-rod, 33 per cent.; crank-pin, 7 per cent.; slide-valve, 2½ per cent.; and the remainder in the cross-head and eccentric strap. In all the engines it was found that the main bearings took nearly half the total friction, and the piston and piston-rod together from one-fourth to one-fifth, and it is curious to notice that under increasing loads the friction on the main bearings diminished by the same amount that that on the pistons and valves increased.

When we come to analyse the conditions of friction by the light of these experiments, it is at once evident that they are not the same for all parts of the engine: that of the slide-valve follows the laws of friction of solids, while that of the main bearings obviously does not. The increased pressure of steam required, when the load on the engine is augmented, will not account for increased friction of piston, as its pressure cannot thereby be increased against the inside of the cylinder; this pressure, which will depend upon the packing rings, will be constant; but the correspondingly higher temperature of the steam may cause it, by promoting the evaporation of the lubricating material, and this is a circumstance that cannot be brought within the sphere of calculation.

In comparing the amounts of friction of the crank-pin and main bearing, it is interesting to inquire into its relation to the respective speeds of the parts. We will assume a case of a steam-engine having a piston area of 300sq.in., and a maximum pressure of 80lb. per square inch upon the piston; the total pressure on the piston will then be 24,000lb. Let us ascertain the size of crank-pin and main shaft suitable to resist this force. The force on the crank-pin will be of a shearing character, and the safe working stress may be taken at 6,000lb. per sectional square inch; the sectional area of the crank-pin then will be 24,000 ÷ 6,000 = 4sq.in., corresponding to a diameter of 2¼in.; add ⅛in. for wear, then the smallest part of the crank-pin will be 2⅜in. in diameter, and that will be at the part on which the connecting-rod bears. The stress upon the main shaft will be torsional, and its resistance vary, therefore, as the cube of its diameter; a bar of iron 1in. in diameter will break at 12,000 inch-pounds torsion; therefore 2,000 inch-pounds —one-sixth—may be taken as safe working load. The stroke being assumed as twice the diameter of the cylinder, the radius of the crank will be 20in., and therefore the maximum moment of torsion will be the force on the connecting-rod multiplied by 20in., this occurring when the crank is at right angles to the connecting-rod. The force on the connecting-rod will be equal to that upon the piston-rod multiplied by the secant of the angle of the connecting with the piston-rod produced (assuming that the engine is direct-acting, as was the case with the engine experimented on), the force on the piston-rod being resolved into two others —one on the connecting-rod and the other in a direction at right angles to that of motion—on the guide-block. In the position of greatest moment of torsion, the crank being at right angles to the connecting-rod, the length of the former divided by that of the latter, measured between centres, will be the tangent of the angle of which the secant is required. This may be more easily understood by reference to the accompanying diagram.



Let *a* represent the head of the piston-rod, *a b* being the centre-line of the connecting-rod, and *b c* that of the crank, *c* being the centre of the main shaft. The force = P on the piston-rod will then be resolved on the connecting-rod and guide-block thus: on the line *a c* mark off *a d* = P to any convenient scale; draw *d e* at right angles to *a d*, and complete the parallelogram *d e a f*; then *a e* will represent the stress on the connecting-rod, and *a f* that upon the guide block, and $\frac{ae}{ad}$ = secant of the angle *e a d*; but $\frac{ac}{ab}$ is also the secant of *e a d* or *b a c*. Let P_1 = pressure upon *a b*; then $P_1 = P \times \frac{ae}{ad} = P \times \frac{ac}{ab}$. But because *a b c* is a right angle (when the moment of torsion upon the main shaft is a maximum), therefore $ac = \sqrt{(ab)^2 + (bc)^2}$, and $P_1 = \frac{P \times \sqrt{(ab)^2 + (bc)^2}}{ab} = P\sqrt{1 + \left(\frac{bc}{ab}\right)^2}$. Let the connecting-rod be in length equal to 2½ times the stroke; then it will be five times the radius of the crank and $\frac{bc}{ab} = \frac{1}{5}$. Then $P_1 = P\sqrt{1 + \left(\frac{1}{5}\right)^2} = P\sqrt{1{\cdot}04} = 1{\cdot}0198 \times 24{,}000 = 24{,}475$lb. The least diameter of the main shaft will therefore be $= \sqrt[3]{\frac{24{,}475 \times 20}{20{,}000}} = 6{\cdot}25$in. Adding ⅛in. for wear, we have 6·375in. diameter for crank-shaft bearing. The crank-pin and main shaft each make the same number of revolutions in their bearings in a given time; hence the surface speeds have the ratio of 6·375 to 2·375, and $\frac{6·375}{2·375} = 2·68$. The square of this speed ratio is 7·18, and is therefore very near the friction ratio found in the experiments—that of 47 to 7 per cent., which = 6·71. This would seem to indicate that at these surfaces the law of liquid friction obtains. It was, however, noticed that under increasing loads the main-shaft friction *diminished*, and it would be satisfactory to know the reason of this. It is to be supposed that the journals are fitted to their bearings so as to touch them without shake, but not to have any initial pressure upon them except that due to weight. Now, when external force acts laterally upon the shaft, some amount of compression, both of shaft and bearing material, must occur, and this will tend to relieve the bearings from contact on the side of the shaft opposite to that of the greatest pressure, and the greater the pressure the larger will be the proportion of the circumference at which there is no contact, and thus reduced surface of contact would be coincident with reduced friction, which also accords with the action of liquids. Although we may thus account for the relative amounts of friction in different parts of the engine, we are yet without proper data to enable us to predict what the frictional resistance of any proposed engine may be, unless there is one exactly like it already at work, for it is very evident that we cannot assume any percentage resistance, as that would imply some proportion to the load upon the machine; and if this is the state of affairs with the steam-engine, why should it not be the same with all other machines?—in which case the whole question of friction in mill-work and machinery generally is, so far as our present methods of calculation are concerned, quite indeterminate, and we must begin again with fresh investigations, and look to the behaviour of the lubricants used to determine criteria of friction.

However this matter may ultimately be settled, it is not a question of erroneous theory, but of improper application of a theory, and the confused aspect it at present exhibits shows how utterly dependent upon actual experiment we are in framing rules for our guidance in connection with the construction and working of machinery. In view of what has been shown by Prof. Thurston's investigations, it certainly behoves students to revise their notes, and wherever opportunity occurs, endeavour to throw some additional light upon the subject under consideration. It may be that the friction of machinery, when exhaustively studied, may show a third condition of things differing from those which exist in the cases of solids upon solids, or liquids upon liquids, for in the latter class, if the liquids can wet the channels in which they flow, the friction is of liquid upon liquid; but should the liquid not be able to wet the surface over which it passes, then the friction will be between a liquid and a solid body.

In regard to the proposition that the friction of shafts may increase as the square of the velocity, it would seem that this point might be determined from traction experiments on railways; but a difficulty here occurs in the complex nature of the resistances to trains (that of the air being a very important element) and the obstacles opposed to the separate determination of any of them.

The coefficients of friction of lubricants will be very materially affected by viscosity and adhesiveness, and upon the latter will depend the pressures at which they will be expelled from between bearing surfaces, and it will be seen that what is really required to be ascertained is both the coefficient of friction of each lubricant, and the amount of pressure it will sustain, and still maintain its position between the bearing surfaces.

F. C.

REVIEWS.

Commercial Organic Analysis. By Alfred H. Allen, F.I.C., F.C.S., Public Analyst for the Borough of Sheffield, &c., Vol. III., Part I. London: J. and A. Churchill.

The previous volumes of Mr. Allen's work are well known and appreciated by all who are interested in the subjects of which they treat. From the preface of the part now issued it appears that the subject matter was found too extensive to allow of its publication in a single volume of convenient size, and hence Vol. III. has been divided into two parts; Part I., which is that now published, treating of aromatic acids, tannins, dyes, and colouring matters; while Part II., which will complete the work, will contain chapters on organic bases, cyanogen compounds, albuminoids, &c. Although the author states in his preface that he has found the adequate treatment of the chemistry of dyes and colouring matters very difficult, we must congratulate him on the way he has performed his task. The chemistry of the coal-tar colours is one of the most complex subjects in the whole range of chemistry, and previous authors have treated the subject either in a one-sided or an imperfect manner. The industry of the coal-tar colours is to a great extent a foreign one, and some of the manufacturers are the reverse of anxious that the chemical composition and analytical characters of their products should be accurately described. These facts, together with the large number of new colours which are continually being introduced, and the confusing practice of calling the same substance by several different names, cause the literary treatment of the coal-tar colours to be a task of exceptional difficulty. In the volume under review, the author commences with a description of the aromatic acids. After discussing the phenol-sulphonic acids, benzoic acid, oil of bitter almonds, saccharine, and other bodies of the benzoyl group are described. Cinnamic acid and aromatic balsams, salicylates, vanillin, gallic and pyro-gallic acids are among the compounds next considered. Then follows a very complete and carefully-written section on Tannins, for the perusal and correction of which the author acknowledges his indebtedness to Mr. H. R. Procter. Tanning matters, writing inks, and the examination of ink-marks are next considered, all in a lucid and practical manner. The chapter on "Dyes and Colouring Matters" covers 290 pages, and forms the greater part of the entire volume (431 pages). It is impossible to criticise in detail the enormous mass of facts the author has collated, but there can be no doubt of the immense labour represented by the work. After a preliminary section treating of the relations of colouring matters to fibres, mordants, &c., the author considers the various dyes of commerce under ten heads. Of these, nine are devoted to artificial colouring matters, and one to colouring matters of natural origin. The former sections show an intimate knowledge of the chemistry of coal-tar products, while in the latter there is the fullest description of the chemistry of indigo, archil, dye-woods, cochineal, turmeric, saffron, and other natural dyeing agents which we remember to have seen. In all cases the author gives directions for the examination and assay of the commercial articles. These points are considered in a more general manner in a subsequent section, and the book concludes with a reproduction of the tables of Hummel and Lepetit (intercalated, so as to render them continuous) for the recognition of colouring matters on dyed fibres. The volume ends with a very complete index, a necessary adjunct to a work of the kind. Altogether, we congratulate Mr. Allen, who will be remembered by many of our readers as an old and valued contributor to this serial, on having produced a volume which will be a necessity to every chemist and scientific dyer, and which is a worthy companion to the volumes already issued dealing with alcohols, sugars, oils and other important groups of organic bodies.

The Uses of Plants. By G. S. Boulger, F.L.S., F.G.S. London: Roper and Drowley.

This work might with advantage be widely circulated amongst the owners of land, who could then call the attention of their tenants to the uses of other plants than those generally grown. Mr. Boulger says that "it must be admitted that British agriculture during the last half-century has shown very little of that elasticity that has distinguished our importing and manufacturing industries;" but it should, in fairness to the British agriculturist, be pointed out that he is often hampered by the conditions of his lease, and that he has not, in the majority of cases, that freedom for the exercise of his skill which is the foundation of the success of the manufacturer. Mr. Boulger is Professor of Botany at the City of London College, and in this comparatively little work (224pp.) has contrived to compress a great deal of information. Necessarily, it is given in a concise and abbreviated shape; but there is sufficient to give an idea of the uses of plants, and to provide hints for those who have a free hand and are able to try crops which may pay better than those of the usual routine. The potato is said to have been brought to Ireland by Sir John Hawkins in 1565, and to England by Sir Francis Drake in 1585, and a year later by Sir Walter Rawleigh (*sic*). To many people it would be news to learn that the disease has little effect on the starch of the potato, and that even badly-diseased "tubers" can be utilised for making glucose, dextrin, potato spirit, &c. The work is divided into parts giving brief descriptions of the plants used for fodder, food-stuffs, and food-adjuncts; of those used as materia medica; of those from which oil, gums, dyes, tannin, fibres, &c., are obtained, and will be useful to those who want a sort of stepping-stone to the larger works on the uses of the members of the vegetable kingdom.

The Metallurgy of Silver. By M. Eissler. London: Crosby Lockwood and Son.

This work gives a practical outline of the treatment of such silver ores as are amenable to amalgamation or treatment by means of quicksilver, and is well adapted to those who wish to try their skill at discovering and working silver ores. It is freely illustrated, there being one hundred and twenty-four illustrations, and the author having been assistant assayer of the U.S. Mint at San Francisco, is in a position to describe accurately the processes carried on in the silver regions of America. The work is, in fact, a practical treatise on the Amalgamation, Roasting, and Lixiviation of Silver ores, including assaying, melting, and refining the metal.

Electricity: Theoretically and Practically Considered by the Aid of Thermo-Electricity. By Arthur Rust. London: E. and F. N. Spon.

This is an interesting little work, which is all the more valuable because it contains an account of the work accomplished by a scientific investigator. Many of those who think most about electricity are convinced that what we call "heat" is its foundation, and Mr. Rust's latest formula is this: "Electricity is a mode of motion, a flow of molecular vibrations produced by the friction of molecules against molecules (which by various methods have been brought into different conditions), and conveyed away by the

FIG 3

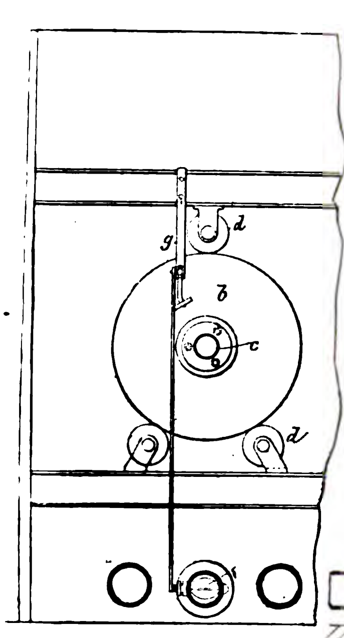


FIG 2

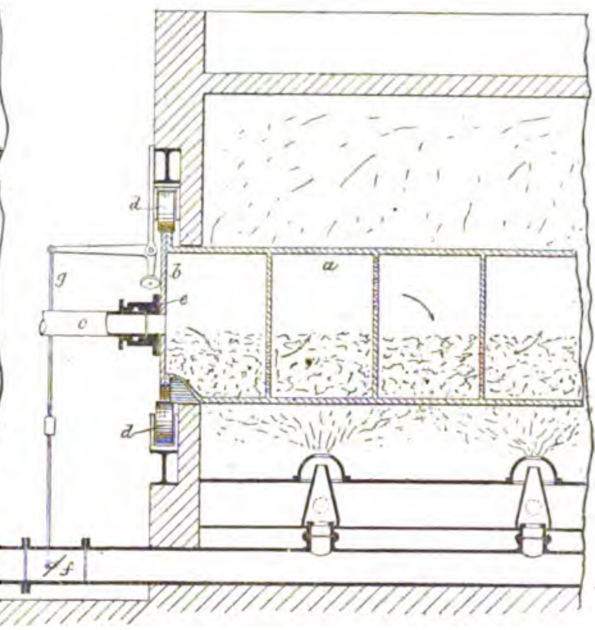
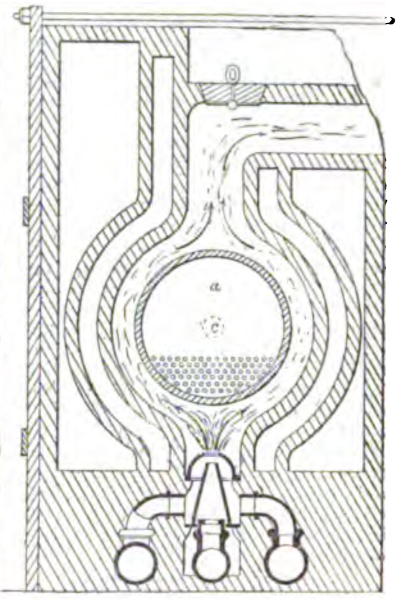


FIG 1



conductor." Thermo-electricity, as it is termed, appeared to him the best to work with the view of testing his theory, and whether his contentions will bear the test of time or not, we can recommend this little work to the attention of all students of electricity. An electrical furnrace or magnopile constructed by Mr. Rust gave in actual work 96 volts with a resistance of 11·5 ohms (which latter might have been less), and Mr. Rust says the cost was at about the rate of 6d. per 10 hours. He believes it will be a commercial success in the future.

We have also received *An Elementary Treatise on Heat*, by H. G. Madan, M.A., F.C.S. (London: Rivingtons), which in many respects is an excellent textbook on a subject which is of great importance. It is essentially a teaching book, as numerous experiments are given, and it will therefore be useful to the lecturer, the teacher, and those who have to study science in books.——*Gaseous Fuel*, by B. H. Thwaite, C.E. (London: Whittaker and Co.), is a lecture delivered at Manchester in the spring of this year, and deals with a subject of much importance, for gaseous fuel would save Londoners a great deal more money than they have had to pay in coal dues.——*The Pastrycook and Confectioner's Guide*, by Robert Wells (London: Crosby Lockwood and Son), is a practical work by an expert, and should be found useful by all who desire to make cakes, biscuits, jellies, pies, puddings, ice-creams, &c. There are over 300 recipes.——*The International Annual of Anthony's Photographic Bulletin* (New York: E. and T. Anthony and Co.; London: Iliffe and Son), is a collection of papers on subjects connected with photography, together with a number of useful tables, and several specimens of methods of printing illustrations obtained by the help of photography.——*Celestial Motions*, by William Thynne Lynn, B.A., F.R.A.S. (London: Stanford), is the sixth edition, revised and rearranged, of a "concise digest," as the author says, of the most important facts which have been discovered regarding the motions of the celestial bodies. The fact that it has reached the sixth edition shows that it is appreciated.——*Mines Surveys*, by F. J. Frankland, C.E. (Birmingham: Moody Bros.), is a practical manual describing an improved system of checked needle dialling, and will be of considerable interest to surveyors of mining operations. A second part is "in the press."——*The Smoker's Textbook*, by J. Hamer (Liverpool: Cope's *Tobacco Plant*), is a readable collection of all sorts of "bits" about tobacco and smoking, got up in the style characteristic of Cope Brothers and Co., Limited.——*First Lessons in Woodworking*, by Alfred G. Compton (New York: Ivison, Blakeman, and Co.; London: T. Laurie), is a manual for use in schools where handicrafts are taught, but will be useful to those who wish to learn the principles underlying the working of wood by means of hand-tools. The author is instructor-in-charge of the workshops of the College of the City of New York, and also professor of applied mathematics in that institution.——*Turners' and Fitters' Pocket-Book*, by J. La Nicca (London: E. and F. N. Spon), is a little book which can be recommended to those who want to calculate the change-wheels for lathes having all sorts of screws.

BRIN'S APPARATUS FOR THE EXTRACTION OF OXYGEN AND NITROGEN FROM THE ATMOSPHERE.

THE methods of obtaining oxygen and nitrogen, patented by the Messrs. Brin and others, are by this time well known (see p. 126, Vol. XXXIV., p. 188, Vol. XXXV., and p. 249, Vol. XXXVIII.); but inventors are still endeavouring to improve their processes, and the following description of a patent obtained by Mr. Arthur Brin explains how he extracts oxygen and nitrogen from atmospheric air. All the efforts so far made in the construction of apparatus for the production of oxygen have been directed towards the production of the largest possible amount of oxygen in the least time, and with the least expenditure of mechanical work. In his latest patent Mr. Brin describes the different parts of a rotary retort with several compartments, which he believes will realise completely the double effect of peroxidation and deoxidation of barium, no matter what amount it contains. The retort which forms the principal subject of the present specification is illustrated in the accompanying drawings, in which Fig. 1 shows a transverse section, and Fig. 2 a longitudinal section of one of the end portions. Fig. 3 is a front view. The retort *a* is of cylindrical shape, and formed of strong iron. The retort is closed hermetically at each end by a head, *b*, to which is connected an inlet or outlet pipe, *c*, for gas. The exterior diameter of the cover and flange of the retort *a* runs upon rollers *d* arranged circularly, which have for object to permit the retort to turn upon itself with slight mechanical effort. A section of this retort shows a number of compartments, of which the lower part and upper part of each alternate partition is pierced by a multitude of holes, in order to allow the air to enter under pressure, and to provide for the rapid production of vacuum upon each particle of barium the compartments contain.

In order that the effect of the peroxidation or of the deoxidation may be complete, one of these partitions will offer its openings to the passage of the air at the bottom, when the partition that follows it shall have its corresponding openings at the top. Then the openings in the partitions will allow the air to traverse all the compartments during the peroxidation, and it will be forced during the peroxidation and during the time of the rotation of the retort to travel from the top to the bottom in the compartments, while by the rotary movement imparted to the retort, all the portions of the barium that the compartments contain will be presented to the current of air or to the vacuum, in order that the air or the vacuum may operate rapidly upon each particle, whether with a view to deoxidation or peroxidation.

Rotary movement is imparted to the retort by an endless screw, receiving the necessary force from some motor engine. The central tube *c*, through which the air passes to the retort, is furnished with an elastic metallic spring washer *e*, which serves to make a tight joint and prevent leakage. The tube at the other end of the retort is provided with a safety-valve to avoid excess of pressure. The heating of the retort is so delicate a matter that every precaution is taken to avoid its exterior oxidation, which would bring about its complete destruction. This retort then is to be protected by a coating of asbestos, and silicate of potash or soda—the asbestos because it isolates the retort from direct contact with the flames necessary to heat it, and the silicate because it enables the asbestos to transmit rapidly the heat to the material that is in the interior of retort. The flames that heat the retort are produced by burners, as seen in Fig. 1, arranged at the base of the furnace, and these burners operate by means of the oxide of carbon, and of air which is heated beforehand in the pipes near which the warm gas circulates, which has resulted from the unutilised flames.

The temperature of 800° C. being known as the best for the extraction by vacuum of the oxygen previously fixed in the barium, it is well to arrest in time the increase of this temperature, which would result in the destruction of the retort. For this purpose a self-acting contrivance, shown in Fig. 2, is put in action by the coefficient of dilatation of the retort, and causes the arrest in time of the oxide of carbon and of the heated air in the burners of the furnace. This self-acting contrivance consists of a stop-valve *f* in the oxide of carbon supply pipe controlled by a lever *g*, one end of which bears against the head of the retort, so that the expansion of the retort operates the valve. It is furnished with a micrometric screw in order to regulate the points of contact, determining the unclosing and the closing of the openings, through which issue the gas for heating, the oxide of carbon, and the heated air.

It is evident that the gas, which has produced a temperature of 800° C. in the interior of the retort, may, after the partial giving-out of its caloric, suffice to generate steam for working a fan or pump, which is necessary to the peroxidation. The difference of temperature being given which exists between the peroxidation and the deoxidation of barium, practically the retorts ought to be arranged in three separate furnaces, divided by walls of some refractory material. Let us suppose the peroxidation in No. 1 furnace is proceeding, while at this same time the furnace No. 3 will be in deoxidisation, and No. 2 in the repose necessary for the lowering of the temperature from 800° to 600°. When the deoxidation of No. 3 is effected, the change of taps of the pipes will deoxidise No. 2, and at the same time the contents of furnace No. 1 will be peroxidised by the fan or air-pump. It is thus that the pumps of deoxidation and the pump of peroxidation will be transferred by the movement of the taps from No. 1 to No. 2, and from No. 2 to No. 3, without any stoppage of the production of oxygen or of nitrogen. The patentee thinks he has united in this arrangement the principal elements necessary for the continuous and practical production of oxygen and of nitrogen.

A MODEL LOCOMOTIVE.—XII.

Joints and Covers.

We left our cylinder bored and faced on steam-chest, on valve faces, and frame plate flanges. We now turn it quarter-way round (Fig. 61) on the lining-off table, and set these faced flanges at right angles therewith, using a square for the purpose, and blocking the cylinders until the centre line that was previously vertical is brought perfectly parallel with the table, and the centres of the bores at each end at precisely equal heights from the table. No time must be grudged in such setting, because it is the basis of the work to follow. When in this position carry the horizontal centre line along the valve face A with the scriber, and also right round all the flange faces and over the faces of the stuffing-boxes for the valve-rods. Likewise set off and scribe lines, B B, equidistant above and below the centre line on the valve face, to which lines the guide strips for the slide-valve edges have to be machined. We also mark the horizontal lines of centres of the bolt holes on both sets of longitudinal flanges at this setting, making use of the scribing block for the purpose. We shall also, if the end flanges have not been already faced in the dog chuck, bring over and carry up the lines near the ends, to which the end flanges have to be planed. Measuring either from these or from the centre line C, we prick off the bolt centres on the horizontal lines, and also mark the vertical centre line D, common to the exhaust and steam ports, and scribe them each with square from the marking-off table.

We can now either finish the port edges in the steam-chest, or bolt the cylinders together, and plane them off. To finish the ports we first plane or file the edges B of the guide strips to the lines just scribed. Then instead of attempting to scribe the lines of the finished port edges by dividing off directly and marking them with a small square, we mark out a templet, Fig. 62, to fit within the planed strips, and having the port openings marked and cut out in it. Placing the centre line of this to coincide with the line marked on the cylinder, we thus scribe the ports directly therefrom. The templet must be very thin in this case—sheet zinc or tin will be best. The edges of the ports must be filed very carefully to the scribed lines.

Next drill the bolt and stud holes for the union of the steam-chest flanges. Those drawn plain, Fig. 61, are bolts, those shaded are studs; the latter being required where the back face of the flange is covered with metal, as where the steam passage block in one cylinder comes against it. We cannot be too careful in the drilling of these to centres, because if they are out of truth to any sensible extent, the bores of the cylinders will be a-twist in relation to one another, and the pistons will in consequence work hard. Pop the centre of each hole deeply, and enter the drills carefully and slowly at first, until we see that they are boring concentrically. If they begin to run out, punch the centre towards the side where the drill ought to go, holding and driving the punch sideways for the purpose. If all the holes are drilled carefully, then when the cylinders are brought together all their centre lines will coincide. It will be well to test this at an early stage by bringing the steam-chest flanges together, and thrusting a bit of wire, of the diameter from which the bolts are made, through corresponding holes. Then notice if the axial centre lines of the cylinders, and also the scribed end lines representing the faces of the flanges, coincide. They ought to do so precisely; and if they do not, then the two cylinders should be adjusted, and the holes reamered out, and larger bolts of the next gauge of wire used.

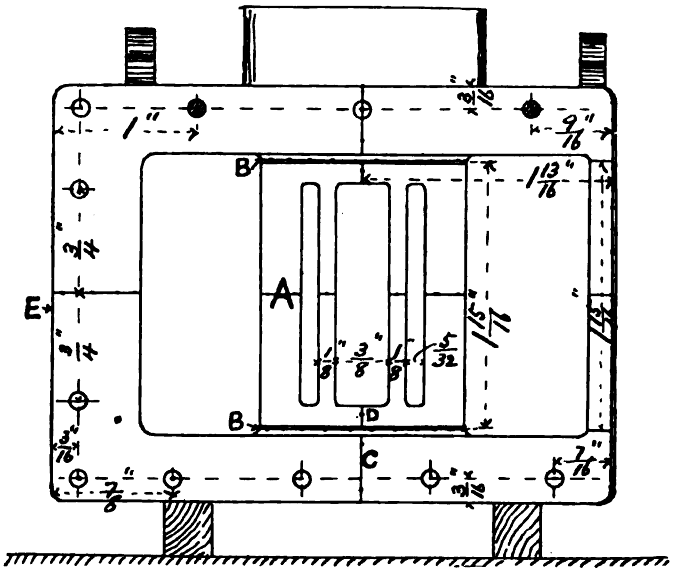


Fig. 61.

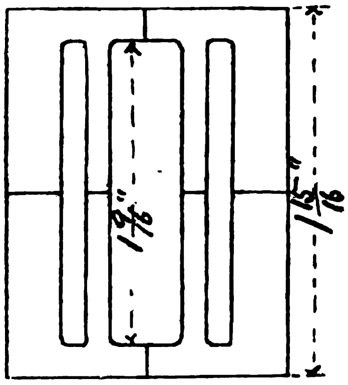


Fig. 62.

Having the cylinders bolted together, the next stage is the planing of the ends. If the lines were scribed truly when the cylinders were on the marking-off table, no other guide or checking is necessary; but we can plane or file right off to these at once. In the absence of a planer or shaper, the cylinder ends thus bolted can be faced off in a 5in. lathe, with back gear. They would be secured by methods described in the last article. It would be, however, a heavy task for a treadle lathe. Perhaps three successive cuts would be necessary. In a shaper or planer one cut would suffice; but two would be better. If the cylinder-ends are faced in the lathe, it will be impossible to finish the hinder end right across, because the flanges E stand partly in the way. But the larger and most important section can be done, and the remainder finished by filing.

If these directions are carefully followed, the result will be two cylinders whose faces are at right angles or parallel to each other, whose bores are true and parallel, and whose cardinal dimensions are all correct. The remaining work will be of a comparatively simple character.

The three front covers are shown in Figs. 63 and 68. The only difference in patterns and castings is that allowance is made for machining and polishing, and that the stuffing-boxes in the steam-chest cover are cast solid—that is, without cores for the recessed portion.

To turn the cylinder covers, two chuckings will be required. At the first, the check that fits within the enlarged mouth, and the face that comes against the cylinder end, are turned. While performing these operations the cover will be held by the outermost edges, either with dogs (Fig. 64) or in a hard wood chuck. When turned

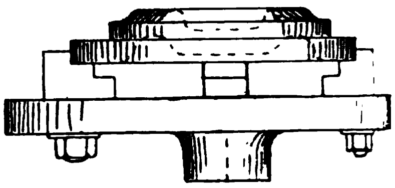


Fig. 64.

run round the centre line for the bolt holes reverse in the chuck, and clip by the edge just turned, holding that either with dogs or in a block of hard wood, as in Fig. 65. While the

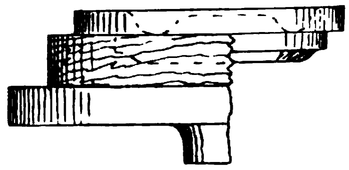


Fig. 65.

held the outside end and various curves will be turned and polished, polish being imparted with emery-cloth.

The inner faces and edges of the steam-chest

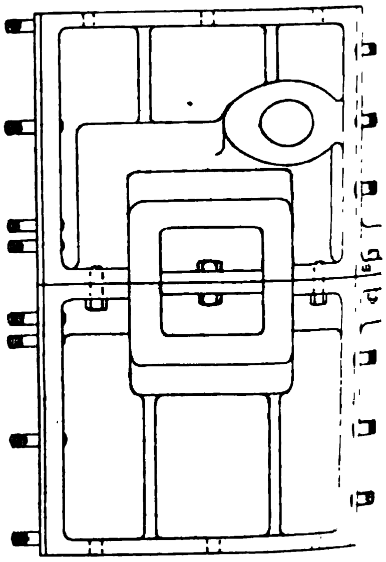
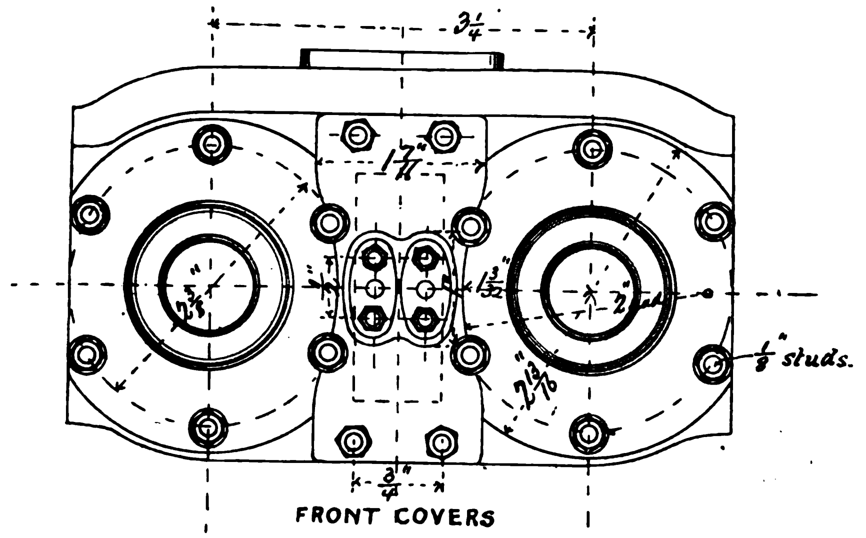


Fig. 66.

cover are fitted by filing to the cylinder faces and to the strips cast just within the chest. Then the waved edges of this cover, and the

Fig. 63.



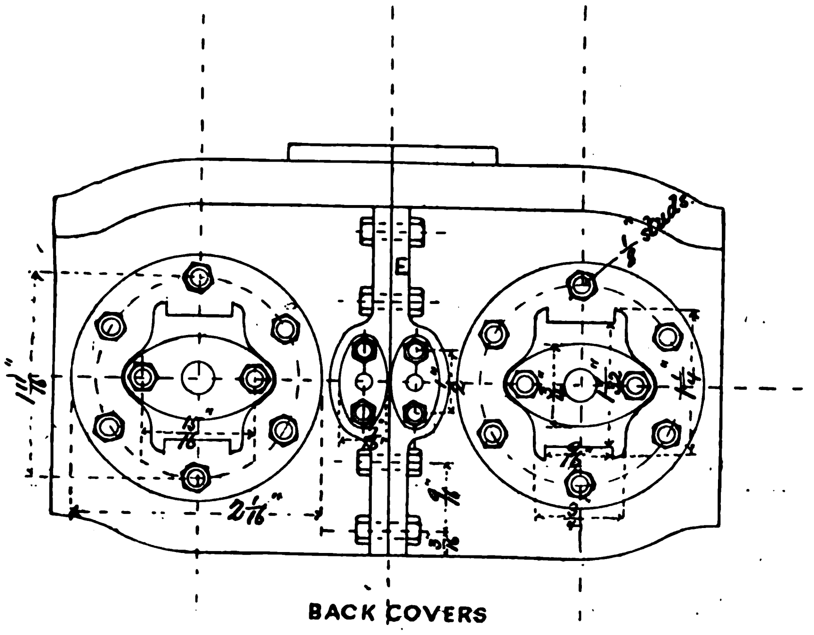


Fig. 67.

orresponding edges of the cylinder covers, are iled to make neat joints with each other, Fig. 63. Then we can mark out the stud centres on the vers and drill them, and, returning them into itions, mark the corresponding stud-holes in cylinder ends directly therefrom. A neat y to do so would be to turn up a miniature tre punch to just fill the drilled holes, and use that for punching the centres on the cylinder ends. Drill one hole for each cover, and insert either its stud or a plain pin temporarily, and then with each cover thus set, and pinched with a small clamp, drill the remaining holes, the drill being guided by the holes in the covers.

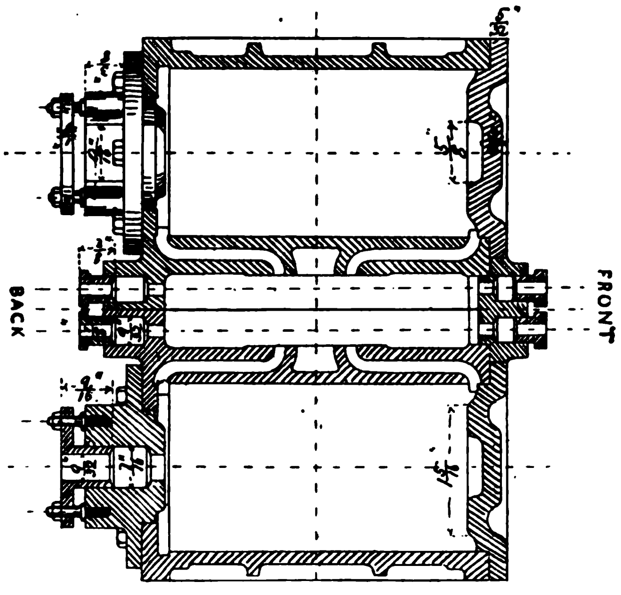


Fig. 68.

It will save much trouble to let the holes go right through the thin flanges of the cylinder, and neatly round off the ends of the studs where they come through at the back, Fig. 66, which shows the cylinder in readiness to receive the covers.

The hinder covers are shown at Figs. 67 and 68. The patterns also resemble their castings, except in being cast without holes. It is seen that they are intended for single guides only, as giving less work than pairs of guides. The chucking, turning, and fitting of these is in the main a repetition of that involved in the front covers. But there will be, in addition, the boring out of the stuffing boxes, and of the holes for the piston rod, which will be done with drills held in the slide rest, and fed up to the revolving work. In each of these covers a more perfect steam-tight joint will be made if the surfaces and the flange faces corresponding therewith are scraped and fitted with red lead and oil, a very thin film only being used.

The next section of the work is to mark the centres of the stuffing-boxes on the steam-chest cover. (Fig. 63.) To do so, lay the cylinders on the table, and block up until the centre lines of the bore across the ends are brought into one plane—that is, horizontal, and parallel with the table. Then scribe a line continuous therewith across the centres of the stuffing-boxes of the steam-chest cover. This, then, will exactly correspond with the similar line previously scribed across the stuffing-box bosses, on the back end of the cylinders. (Fig. 67.) Then turn the cylinders up on one of the planed longitudinal feet, and set the scriber successively to the two centres of the stuffing-boxes on the back end, and transfer these centres to the cover on the front end and scribe them across. Then drill the stuffing-box recesses first, and follow with a small drill for the holes that go right through for the rods themselves. These would be bushed with gun-metal in practice; but we need not do this.

Into the back cylinder-covers, and into the valve-rod stuffing-boxes at back and front, their appropriate glands are fitted ready for being screwed down on the packing. These small castings may be gripped in a dog-chuck by the edges of the oval flanges, turned and bored, and then rechucked to turn the flange faces. I show studs and nuts as employed in practice. But if desired, the trouble of tapping in the gland-studs and of tightening up the tiny nuts in somewhat awkward positions, may be avoided by making the glands of the form shown in Fig. 69.

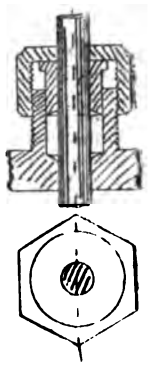


Fig. 69.

In these articles I have frequently had to consider how far I might depart from the original in minute details without detracting from the educational value of the model. My endeavour is to adhere as closely as possible to actual practice without involving excessively minute details. In these cylinders there are several cases in point. The general practice is to support the valve-rod in stuffing-boxes and glands, both at back and front, for the purpose of equalising the wear of the valve edges and of the valve rods as much as possible. This in our scale makes a good deal of tedious work. But it is quite within the limits of practicability, and I therefore show this arrangement. But those who desire to avoid so much work may leave the front covers plain, and cut the valve-rods to come within the steam-chest. Again, there is usually more work involved in fitting the covers than I show. Generally they fit against a narrow facing on the cylinder flanges, which facing is very carefully scraped to a fit. But it simplifies matters for us to face the cylinder ends right across, and so fit the covers. Facings or thin bosses surrounding each bolt hole are also omitted from all the flanges. Observe, too, how close the contiguity of our cylinder covers to the steam-chest cover. In any inside-cylinder engines of narrow gauge there is close work here, and the practice generally is to set out the bolt holes and then curve the edges of the covers in and out alternately to inclose and clear these bolts. We can only do this in the model by leaving the metal extremely weak at the edges of the holes. I therefore adopt another method sometimes practised, that of inserting a few bolts in the joints of the covers (Fig. 63). With the covers faced to the same thicknesses, the nuts will bear equally on each face.

In the number of bolts used I depart somewhat from accurate proportions. The nuts are troublesome to make, rather expensive to buy, and there is no need to adhere exactly to numbers in such a matter.

J. H.

GOOD'S IMPROVED CAMERA.

THE invention patented by Mr. H. N. B. Good, of Devizes, consists of improvements in those photographing arrangements which are known as continuous films, in which a series of pictures are taken upon a strip of sensitised material, the position of which can be adjusted as desired. In such cameras the strip or film of sensitised material is generally wound upon a roller which is inserted into a separate slide and attached to the camera, and is wound off the roller as required, and rewound (after the pictures have been obtained upon the sensitised surface) upon another roller carried by the removable slide. The present invention has for its objects novel methods of construction by which the camera and lens, and the devices for carrying and moving the film as required, are united in one, instead of being separate, space is greatly economised, and the entire apparatus is cheap, light, portable, and effective. It is more especially applicable to small cameras in which a series of instantaneous pictures can be taken at any desired moment. The improved apparatus consists of a box or case of suitable size, preferably rectangular, and of wood or other material. In front of this box there is an opening provided with an instantaneous or other shutter of any of the ordinary well-known kinds by which the opening can be opened or closed for the purpose of obtaining a picture. Behind the shutter is arranged in the box a transverse partition carrying a lens of the required size and focus, and at the back of the partition two lateral vertical partitions, the front edges of which join the front partition at each side of the lens, whilst the back edges separate until they nearly reach the sides of the box at a short distance from the back. In the angular spaces thus formed behind the front partition is arranged the holding roller or spool and the receiving roller respectively, the former having the sensitised strip or film wound upon it, the end of the strip being led from it backwards, then across the space between the back ends of the lateral partitions, and again forward to the receiving roller, to which it is fastened, so that when the latter is turned round the strip is wound upon it, and at the same time unwound from the full roller or spool. At or near the back edges of the lateral partitions are vertical rollers or guides, preferably of glass, or of wood or other material covered with glass, round which the film passes and is guided with very little friction or risk of abrasion. Upon the interior surface of the top and bottom of the box or camera, just in front of the sensitised strip or film, as it passes across the back, are two transverse strips of wood or other material, behind the edges of which the edges of the strip pass, and against which they are pressed with sufficient force by a flat plate of vulcanite or other suitable material, which is pressed against the back of the strip by a screw passing through the back of the box, or by other equivalent device. At the back of the vulcanite plate a transverse metal spring is arranged, one end of which is fixed to one edge of the plate, whilst its other end is pointed, and is sufficiently long to be bent forward and to project slightly in front of the plate.

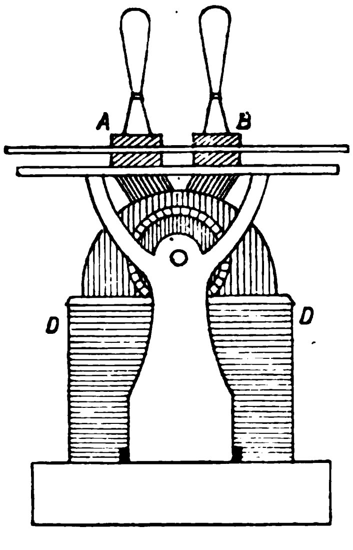
When the film or strip has been adjusted in the proper position to receive a picture from the lens, the vulcanite plate is pressed forward by the screw so as to hold the edges of the film firmly in position against the top and bottom strips, the point of the screw first pressing forward the spring, the pointed end of which marks the paper from the back sufficiently to indicate the position of the picture upon it when it is ultimately removed from the rollers for the purpose of being cut up and developed in the usual way. Small springs are arranged to press back the vulcanite plate from contact with the back of the film when the pressure of the screw is withdrawn. In one of the angular spaces first described, between the front partition and the lateral vertical partitions, is arranged a vertical roller, against which the film or strip presses, which is made to revolve by such pressure when the rollers are made to revolve and draw the strip forward. The axle of this roller passes through the top or bottom of the box or camera, and is provided with a toothed pinion actuating an indicating device, by which it can be seen when the film has moved exactly sufficiently forward to present the proper surface for a new picture, and also, if desired, to show the number of exposures which have been made and pictures taken.

The rollers which carry the sensitised strip or film are made readily removable, so that they can be taken out and replaced as desired, their centres turning upon screws in the top and bottom of the box or camera, which can be screwed up or unscrewed as desired. The receiving roller is fitted at one end to a socket, either end of which can be turned round by a suitable key or handle for the purpose of turning the roller and so causing the strip or film to pass behind the lens. Either or both the rollers may be provided with ratchet wheels and pawls, or their equivalents, by which the rollers are prevented from turning in the wrong direction, and spring or other brakes may be arranged so as to press the strip upon the rollers, or upon brake wheels on the roller sockets, and so keep the rollers from too easily unwinding and thus allowing the strip to be imperfectly stretched. A flat piece of transparent glass may be arranged in front of the strip or film, the latter being pressed against it by the vulcanite plate at the back.

THE PARIS EXHIBITION.—II.

Electrical Welding.

MUCH progress has been made in this branch of science. The heat generated in a given time T by a current passing through a conductor is $\frac{1}{J} R I^2 T$, where R is the resistance of the conductor, I the intensity of the current, J the mechanical equivalent of heat. The quantity of heat thus produced has been most ingeniously utilised for welding metallic bars and tubes. The Thomson International Electrical Welding Company (Gallery of Machines, American section) exhibit their apparatus for welding, and also several interesting specimens. In the case of bars of small diameter, the current of a small dynamo suffices. The bars are gripped in two jaws, which are in communication with the collecting brushes of the dynamo. The two jaws may be moved so that the two bars to be welded are brought into contact. The current is made to pass, and the joint is welded by the heat electrically produced. The proper temperature is attained by a commutator which introduces a greater or less resistance in the circuit. For wires and small bars the whole apparatus—dynamo, supporting table, movable jaws—are brought together in a small compass, as is shown in the annexed schematical figure. The two jaws A B are in direct communication with the brushes of the dynamo D D.

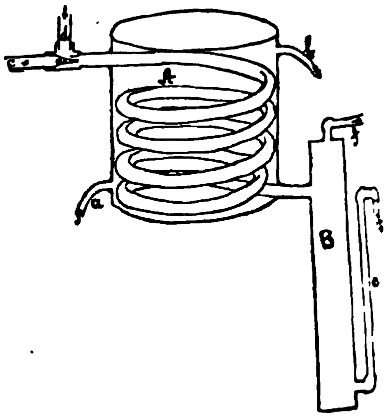


For welding larger bars very intense currents are required, and the apparatus can no longer have this simple form. An alternating current dynamo is employed, but not in a direct manner. The current is first sent into an electrical transformator, the induced current of which gives an intensity of 50,000 ampères with a very low electromotive force (about 1 volt). Such a current will weld bars of iron over 2in. in diameter. All sorts of metals and alloys can be welded electrically.

C. Detaille.

STEAM SUCTION BLAST AND STILL

THE accompanying cut illustrates an apparatus in use in the analytical laboratory of the St. Louis Ore and Steel Co. Their chemist (Mr. A. Van Zwaluwenburg, Ph.D.), under whose direction



the apparatus was constructed, states (says the *Pharmaceutical Era*) that it has been in use during the last two months, and has given perfect satisfaction.

A is an ordinary condenser with the cold water inlet at *a* and the exit at *b*. Steam enters the coil of the condenser through the tube *c*, which at *c* is reduced in size to ⅛in.; *c* is connected with the coil by a ⅜in. T. As the steam is injected into the coil it carries with it air, which is drawn in through *d*, creating a suction that may be used as a filter pump. As the mixture of steam and air passes through the coil, the steam is condensed, the mixture of air and water enters the separator B, the water is carried off through *e*, while the air is forced out of *f*, producing a blast that is sufficient to run six Bunsen blast burners.

This simple apparatus, though not entirely new, is an excellent combination, furnishing a good filter pump, a steady blast, and distilled water. The apparatus may be made by any steam fitter at small cost.

ASPIRATORS FOR LABORATORY USE.*

WHEREVER a head of water of 10ft. or more is available, an aspirator is by far the most convenient instrument for producing a vacuum for filtration and fractional distillation. It is also adapted to a wide range of physical experiments.

Besides the advantage of convenience and compactness, the aspirator has the further advantage over piston air pumps in the matter of cost. They may be had at prices varying from 1·50dol. to 4dols. or 5dols.

Two kinds are in general use—one of glass, known as Bunsen's filter pump, and shown in Figs. 1 and 2; the other of brass, shown in Figs. 3, 4, and 5. The glass aspirator can be purchased of almost any dealer in druggists' sundries or chemical glassware. Any expert glass-blower can make it in a short time.

This instrument consists of an elongated bulb terminating in a crooked tube at the bottom and having a tapering nozzle inserted in the top and welded. The lower end of the nozzle is located directly opposite and near the crooked discharge tube. A side tube is connected with the bulb at a point near the junction of the nozzle and bulb.

This aspirator is used in the manner indicated in Fig. 2—i.e., the upward extension of the

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* By Geo. M. Hopkins, in the *Scientific Am*

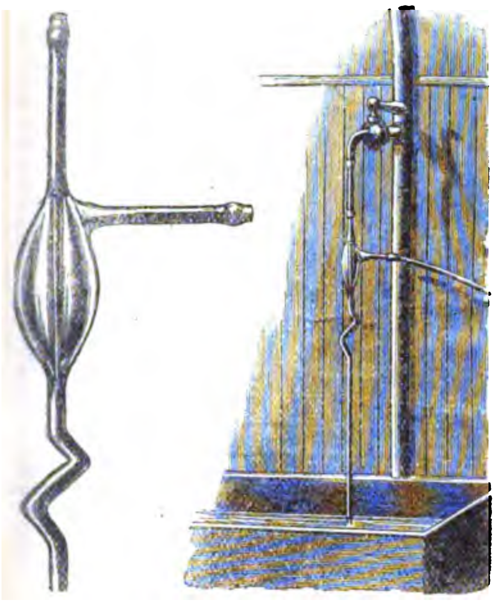


FIG. 1.—Bunsen Filter Pump.—FIG. 2.

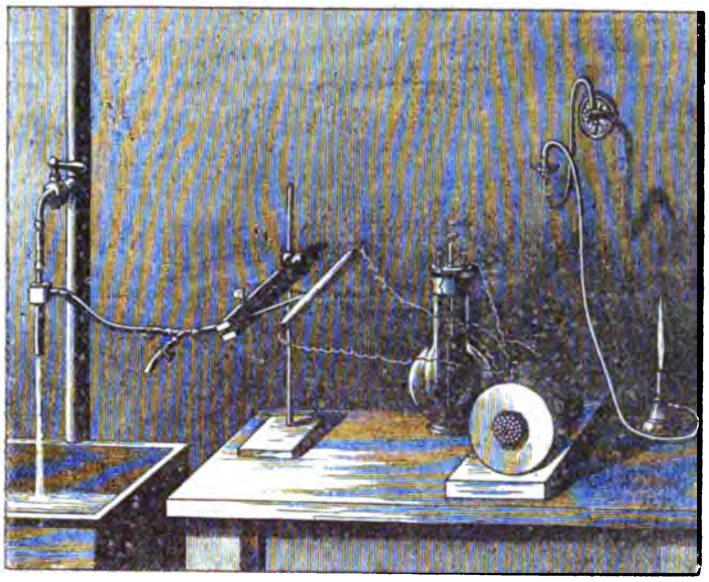


FIG. 4.—Exhausting Geissler Tube.

connected with a tap by a short piece of rubber tubing, and the side tube is connected by a piece of rubber tubing, with the vessel to be exhausted. When the water is allowed to flow through the aspirator, it leaps across the space between the nozzle and discharge tube, and carries with it the air from the bulb, which is continually replaced by air from the vessel being exhausted.

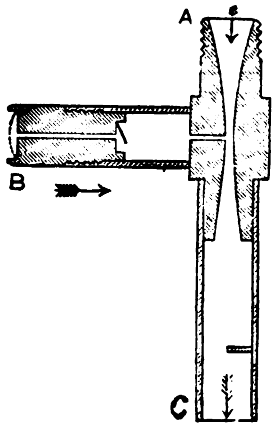


FIG. 3.—Metal Aspirator.

It is necessary to securely fasten the ends of the rubber tube connected with the tap, or the water pressure may force it off, thus causing the breaking of the instrument. To secure the best effects with this pump, it is necessary to connect a vertical tube 25ft. to 30ft. long with the discharge end of the pump.

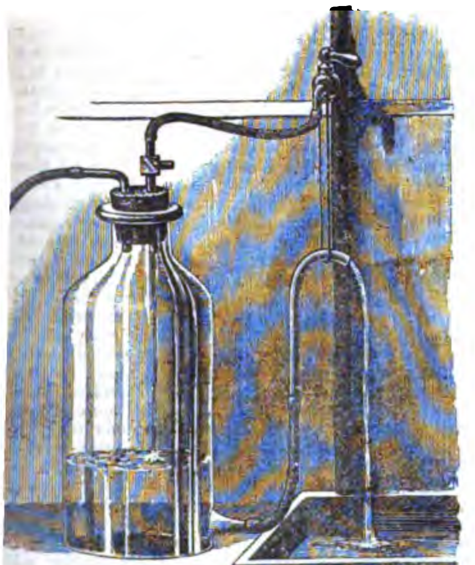


FIG. 5.—Blast Produced by the Aspirator.

The metallic aspirator shown in Figs. 3, 4, and 5 is, of course, free from all danger of being broken in use, and it has other qualities which render it superior to the glass instrument, one of which is a much higher efficiency, another is its ability to retain the vacuum should the flow of water be accidentally or purposely discontinued. It can be screwed directly on the water tap, and needs no additional pipe to cause it to work up to its full capacity; and where a head of water is not available, it may be inserted in a siphon having a vertical height of 10ft. or more.

This instrument is made by Mr. E. C. Chapman, of Brooklyn, N.Y. Like all instruments of its class, it is based on the principle of the Giffard injector. Its great perfection, however, is due to Mr. C. J. Lawler and to its manufacturer. The construction of the aspirator is shown in section in Fig. 3. The water enters at A, as indicated by the arrow. The air enters at B, and both air and water are discharged at C. The water in going through the contracted passage forms a vacuum at the narrower part, into which the air enters. The starting of the instrument is facilitated by a diaphragm, which half-closes the discharge tube. The water is prevented from entering the air pipe by a small check valve, shown in the interior of the lateral tube. Much of the efficiency of this instrument is due to the accuracy with which the contracted passage is formed. A slight change in the shape of this passage seriously affects the results.

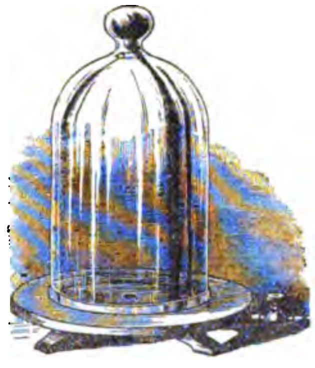


FIG. 6.—Plate and Receiver for Aspirator.

The vacuum produced by this aspirator is equal to that of the mercurial barometer, less the tension of aqueous vapour. That is to say, when the barometer is at 30in., the vacuum produced by the aspirator will be about 29½in. Such a vacuum can be produced by water under a pressure of 5¼lb.

In Fig. 4 is shown the aspirator applied to a Geissler tube. It quickly exhausts an 8in. tube, so that the discharge of an induction coil will readily pass through. By placing a tee in the connecting pipe, the Geissler tube can be filled with different gases. Each will exhibit its peculiar colour as the spark passes. The vacuum is not high enough for a perfected Geissler tube, but it is sufficient for the greater part of vacuum experiments. The aspirator can be arranged to produce a continuous blast sufficient for the operation of a blowpipe, and for other uses requiring a moderate amount of air or gas under pressure.

The method of accomplishing this is illustrated in Fig. 5. The instrument is arranged to discharge into a bottle or other vessel having an overflow, and the air for the blast is taken out through the angled tube inserted in the stopper of the bottle. The amount of air pressure is regulated by the water pressure and the height of the overflow pipe.

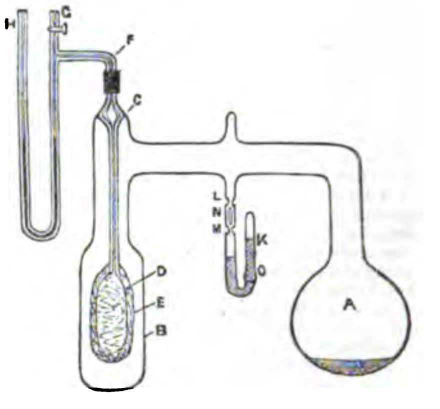
For many vacuum experiments a plate provided with a central aperture, and having a tube extending from the aperture to the edge of the plate, will be found useful. The tube is provided with a suitable valve, which closes communication with the aspirator, and which also serves to admit air, when required, to the receiver fitted to the plate. This plate and various accessories are like the plate and accessories of a piston air pump. Communication is established between the tube of the plate and the aspirator by means of a pure rubber tube which is practically airtight.

APPARATUS TO ILLUSTRATE THE INFLUENCE OF PRESSURE ON THE VOLATILISING POINT OF ICE, AND OTHER PHENOMENA.

By Prof. SYDNEY YOUNG, D.Sc.

IT was first observed by Carnelley that when a block of ice with a free surface for evaporation is exposed to pressures lower than 4·6mm. it cannot be melted, no matter at how great a rate heat is supplied to it by radiation.

At a meeting of the Owens College Chemical Society, eight years ago, I suggested that the maximum temperature to which ice can be heated under any given pressure lower than 4·6mm. could be ascertained from the curve representing the vapour pressures of ice at different temperatures, just as the boiling point of water under any pressure is given by the curve of vapour pressures of water.



In 1883 Dr. Ramsay and I proved experimentally that this is the case, and we determined the temperatures of volatilisation of ice and other solids, obtaining in the following year an experimental proof of the fact previously predicted from thermo-dynamical considerations by Prof. Kirchoff and Prof. James Thomson, that the vapour pressure of a substance in the solid state at a temperature below its melting point is lower than that of the substance in the liquid state at the same temperature.

Inasmuch, however, as a good pump is required to reduce the pressure sufficiently, and as the experiment by which these facts are proved is in other respects rather troublesome, it has not, I believe, been usually admitted in an ordinary course of lectures.

It seems possible, therefore, that an apparatus which I have constructed to illustrate the effect of pressure on the volatilising point of ice may prove useful to other lecturers, more especially as it serves to illustrate some other interesting points. The apparatus is a modification of Wollaston's cryophorus and of that employed by Dr. Ramsay and myself in our investigations. The bulb A is similar to that in the cryophorus, but in place of the second bulb there is a wide cylindrical tube B. At C is fused a tube of narrow bore (say 1mm.), to which is sealed a wider tube, D, closed at the end.

This tube contains air, and acts as an air thermometer; it is covered with cotton wool, which is to be saturated with water before beginning the experiment. The narrow tube is open at the upper end, and is connected by an indiarubber tube with the gauge F G H, which contains sulphuric acid coloured with indigo as an indicator. The gauge is open at both ends; but is provided with a stopcock at G.

As in the cryophorus, the apparatus must be absolutely free from air, and the cotton wool should be well washed with alcohol and ether to remove all grease; otherwise it may be difficult to saturate it with water. The pressure in the apparatus may be indicated by a mercury gauge K; but obviously both the construction and the manipulation of the apparatus are rendered somewhat less easy by the addition. The gauge, if added, should have a circular constriction at L and a flattened constriction at M, a narrow tube N, closed at both ends, being placed in the tube between the constrictions.

When the apparatus is in its usual vertical position, the little tube N rests on the flattened constriction, and there is free communication between the gauge and the rest of the apparatus; but when in the transference of water from one bulb to the other the apparatus is inverted, the tube N, falling against the circular constriction closes the tube and prevents the escape of mercury from the gauge. For further security an air or vapour trap may be placed at O.

Description of Experiment.—The cotton wool is thoroughly saturated, and the rest of the water is then transferred to the bulb A. The gauge is connected with the air thermometer and the stopcock closed. The bulb A is then immersed in a beaker of water cooled by a little ice; the diminution of pressure in the apparatus, consequent on the lowering of temperature, is at once indicated by the mercury gauge, and as the boiling point of water is lowered by reduction of pressure, the temperature of the air thermometer is at once seen to fall. (The bulb B may be heated by boiling water or to any desired temperature during the whole experiment). When, by further addition of ice, the temperature of the bulb A sinks to 0°, the pressure in the apparatus—if air has been completely expelled—falls to 4·6mm., and the temperature of the air thermometer becomes constant. The stopcock is then opened so that the sulphuric acid may be at the same level in both limbs at this temperature, which is afterwards shown to be 0° C.

If we now replace the beaker of ice and water by a freezing mixture at — 5°, the pressure in the apparatus will be still further reduced, and the temperature of the air thermometer will again fall, but the water will not freeze. We can therefore show—I find with perfect certainty—the cooling of water below 0° without freezing, and also the reduction of the boiling point of water below 0°.

When the temperature is still further reduced by substitution of a colder freezing mixture, the water in A solidifics, and it will be seen that after the temperature of the air thermometer has fallen a little lower for a moment or two, it suddenly rises to the zero point already determined. After remaining constant for some time, until the whole of the water on the cotton wool is frozen, the temperature falls rapidly, and it is now found to depend solely on that of the bulb A, even though the bulb B be strongly heated.

A third determination of the zero point may lastly be made, if sufficient ice remain on the cotton wool, by removing the freezing mixture. The temperature of the air thermometer slowly rises to 0°, and remains again at that temperature until the ice is melted.

The following facts are therefore clearly demonstrated by means of this apparatus:—1. That the vapour pressure of water (and of ice) depends on the temperature, and that the boiling point (or the maximum temperature to which water with a free surface for evaporation can be heated) depends on the pressure. 2. That the vapour pressure of water at 0° is 4·6mm., and that under a pressure of 4·6mm., water boils at 0°. 3. That the boiling point may be reduced below 0°, the water remaining liquid; but that when solidification begins the temperature suddenly rises and remains constant for a considerable time (it is assumed that this temperature is 0°). 4. That the volatilising point of ice, like the boiling point of water, depends on the pressure, and that if the ice has a free surface for evaporation the walls of the vessel surrounding it may be strongly heated without affecting its temperature.

Many of these points may be proved, though not in all cases so directly, without the mercury gauge. The apparatus is a little troublesome to construct; but once made, the experiments may be conducted with almost as much ease and with quite as much certainty as that with Wollaston's cryophorus.—*Chemical News.*

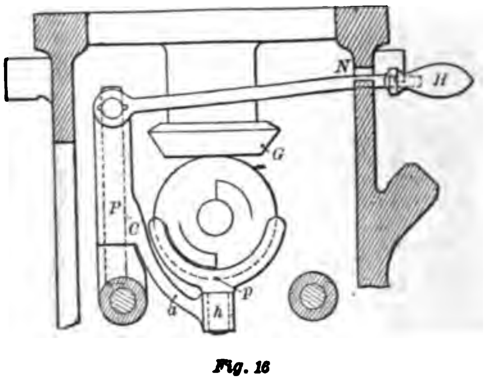
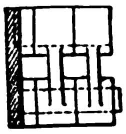


Fig. 16



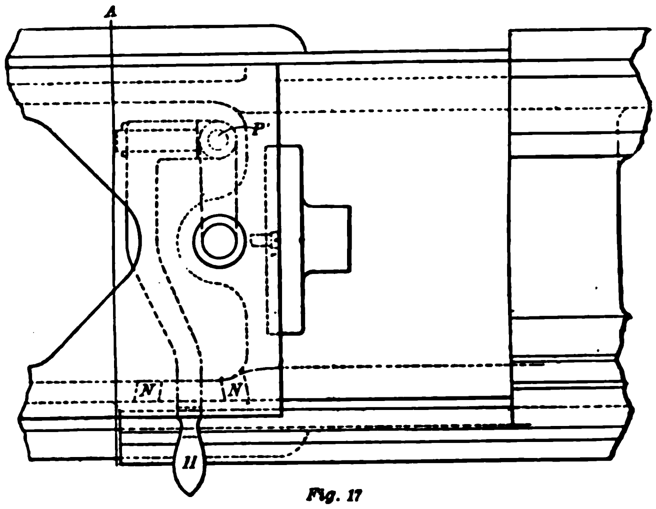


Fig. 17

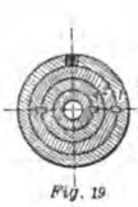


Fig. 19

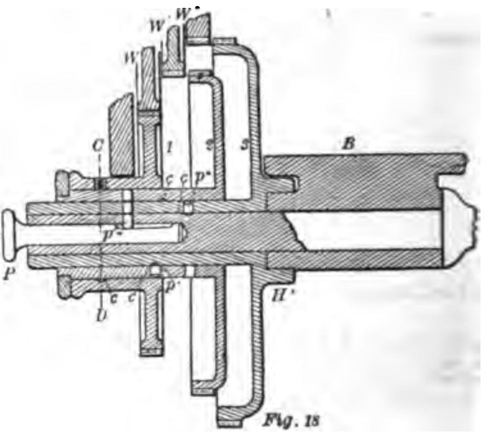


Fig. 18

DETAILS OF SWEET'S 16in. ENGINE LATHE.*

THE transverse section A B, Fig. 16, which is between the gear train and reversing cam, shows the method of attaching the hand lever to the device. The steel cylinder C has the projecting arm A, which terminates in the hub *h*, in which the grooved half-ring *p* is placed. A hole is drilled through C, which fits a pin shown in dotted outline at P, Fig. 16, and P', Fig. 17; also previously shown at P, Fig. 13. A second pin, perpendicular to the axis of C, receives the handle H, and allows it to be raised over and lowered into the notches N, Figs. 16 and 17. The bevel gear G, Fig. 16, is that one previously described as having a square hole in it, and receives a similar wheel on either side of it. In Fig. 18 we have a longitudinal section through the end of the screw, and a part section of the wheels W, with which they work. In Fig 19 a transverse section C D shows the method of fixing an invariable relation between the wheels themselves and the screw. Three fixed keys are placed—one in the screw, one in the hub of the next wheel, and one in the second wheel. Each of the gears 1, 2, and 3 will slide endwise on its key. Owing to the dish-shape of 2 and 3, they will all slide together, so that the edges of their rims are in the same plane. The pin P is fitted to a hole in the end of the screw, but has an inclined plane milled at its inner end. On this plane three round pins *p'* rest. They are placed in holes drilled, one each in the hubs of the No. 2 and 3 gears, and one on the screw. When in the position shown, the withdrawing of pin *p'''* will force them out, and, of course, hold No. 1 tightly in place. To prevent more than one of these gears getting in mesh at the same time, a very neat arrangement is provided, which, for simplicity, cannot be easily excelled. Two small rims, conical at each end, is nearly all there is of it. They are shown in position at *p'* and *p''* at Fig. 18. In length they are equal to the thickness of the hubs of the wheels 2 and 3, plus the height of one of the cones. This excess of length is provided for by countersinks *c c c c*, drilled on the inside of the hubs of each wheel, and also on the outside of the screw. It will be seen that the pin *p''* is shown in the countersink of the screw, and that wheel No. 3 cannot be moved endwise. Also that No. 2 is held in the same way by pin *p'*; but by pushing in pin P, No. 1 gear can be moved until its countersink is under *p'*; then any effort to move No. 2 will force the pin out, and No. 2 can be put in place, and No. 1 cannot be moved again until No. 2 is brought back. No 3 can be moved by the same method. A section of the main journal box for the screw and of the thrust collar is shown in this figure at B. A short hub H' is on the back side of gear No. 3, into which the end of box projects far enough that the screw is not uncovered when the gear is in use, and is thereby protected from dust.

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* By Prof. C. I. King, in *American Machinist* (see pp. 345, 386).

SELF-PROPELLING UNICYCLE.

ACCORDING to an American paper, Mr. Breitenmoser, a St. Louis mechanic, is the author of numerous inventions. His last great work, however, is just now nearing completion, and while he does not claim to have solved the problem of perpetual motion, he thinks he has built a motor that will run itself an unlimited time and at an unlimited speed. He has not named it, but from a cursory inspection the name of self-propelling unicycle seems applicable. The working model, to which the inventor is putting the finishing touches, is a wheel 8ft. in diameter, composed of a framework of iron rods and braces, covered with canvas, with a hollow centre, where the saddle is located 3ft. in diameter. The outer edge of this big wheel narrows to a thickness of 2in., with a flange-like tire 6in. in width. The framework of iron rods forming this solid outer rim of 2¼ft. is arranged so that the wheel is about 16in. thick at the inner circle.

To prevent this wheel, thick in the centre and thin at the outer edge, falling down, there are two braces, one on either side, the upper ends of which are attached to the saddle, and the lower ends of which rest upon small wheels or travellers that run on the ground, a little in the rear of the centre of the big wheel. Now we come to the most difficult part for description. In the inner circle are two circular, or nearly circular, bands of iron or steel, very neatly fitting, but in no place touching the inner circle of the big wheel.

On these two iron or steel bands is balanced the saddle, with brass trunnion wheels or pulleys under it, four of them. In front, and half-way up the inner circle, is located a pair of brass ratchet wheels, 6in. in diameter, revolving on bands. The ratchets on these wheels work on a series of little bolts on the inner circle of the big wheel, in the manner of cogs. Now for the principle upon which the machine is expected to work. The saddle rests on four little trunnion wheels, the burden primarily falling on the two rear trunnions. These are considerably in the rear of and elevated above the centre. Now, the weight placed on the saddle, falling as it does on the rear elevated trunnions, forces them down and forward; this in turn forces the forward trunnion in front of and a little above the centre, and at the same time causes the ratchet wheels to revolve. This constant pressure forward, and the revolutions of the small ratchet wheel, cause the big wheel to revolve, and there you have your machine in motion.

To assist this downward and forward motion of the saddle, on which the inventor bases all his hopes for success, a pair of swinging foot-rests or stirrups are provided. These swing on either side of the wheel, from the outer ends of the axle on which the 6in. ratchet wheel turns, enabling the rider, when seated in the saddle, astride the inner circle, to throw his weight well forward by simply rising occasionally to a standing position, with his feet in the stirrups. These are intended for use in climbing hills, and the inventor says there is practically no limit to the impetus that can be given the machine by simply swinging the stirrups forward and elevating them. Swung as they are to the ratchet wheel axle, forward pressure on them pulls the big wheel forward, and causes it to turn at a speed only limited by the amount of pressure used.

THE DANGER OF WATER FILTERS.

IN a series of experiments with water filters reported to the Rhode Island Medical Society, Dr. G. T. Swarts has presented certain facts which are opposed to the general belief regarding the value and efficiency of filters as commonly used in the household for the purification of drinking water, and which, from their important bearing on health, are believed to be worthy of more general recognition. The results obtained prove that some filters when first used successfully remove a certain proportion of organisms from the water. Other tests made seventeen days later showed in every case a marked increase in the number of colonies in the filtered as compared with unfiltered water. For instance, the unfiltered water contained 36 colonies of growth, while the filtered water showed the presence of colonies to the number of 2,000, 9,000, and 10,000.

An examination on the seventieth day showed an increase in the case of one filter of 117,000 colonies. Another series of experiments was made to determine how far the consumer could cleanse his filter or sterilise it in some simple manner. The results showed, however, that, even with every possible precaution, the number of organisms in filtered water exceeded the number in unfiltered by several thousands. These investigations show conclusively that the organic matter retained in the meshes or interstices of the filtering media contains organisms which increase rapidly while the filter is or is not in use, and especially if its position is in a warm kitchen or in close proximity to a hot-water pipe. The lesson to be drawn from these experiments is obvious. Filters, by becoming clogged and from the impossibility of perfectly cleansing them, foster the very dangers to health they are designed to prevent. These facts should be of especial interest to physicians—[No! rather to those who drink the water]—since they are often looked to by the public for information regarding just such practical sanitary questions as this.

USEFUL AND SCIENTIFIC NOTES.

Gigantic Crabs.—The Bombay Natural History Society has received an interesting addition to its museum in the shape of four live crabs of gigantic proportions, from the Andaman Islands, presented by Mr. H. W. Searle, of I.M.S. *Investigator*. These remarkable crustaceans are known as the Robber Crabs (*Birgus latro*), and Darwin, in his book, "A Naturalist's Voyage Round the World," writes as follows regarding them:—"This crab has its front pair of legs terminated by a very strong and heavy pincers, and the last pair by others which are narrow and weak. It would at first be thought quite impossible for a crab to open a strong cocoanut covered with the husk, but Mr. Leisk assures me he has repeatedly seen the operation effected. The crab begins by tearing the husk, fibre by fibre, and always from that end under which the three eyeholes are situated. When this is completed the crab commences hammering with its heavy claws on one of these eyeholes till an opening is made; then, turning round its body, by the aid of its posterior pair of narrow pincers, it extracts the white albuminous substance. I think this is as curious a case of instinct as ever I heard of, and likewise of adaptation in structure between two objects apparently so remote from each other in the scheme of nature as a crab and cocoanut tree. These crabs inhabit deep burrows, which they excavate beneath the roots of the cocoanut trees, and here they accumulate surprising quantities of the picked fibres of the cocoanut husk, on which they rest as on a bed. The Malays sometimes take advantage of their labour by collecting the coarse, fibrous substance and using it as junk. These crabs are very good to eat; moreover, under the tail of the larger ones there is a great mass of fat, which, when melted, sometimes yields as much as a quart of limpid oil. It has been stated by some that *Birgus latro* crawls up the cocoanut trees for the purpose of stealing the fruit. I very much doubt the possibility of this; but with the *pandanus* the task would be very much easier. I understood from Mr. Leisk that the *Birgus latro* lives only on the nuts which fall to the ground."

The Kola Nut.—The value of the kola nut (seeds of Sterculia acuminata) as a dietetic and therapeutic agent has been recently tested by surgeon R. H. Firth. These nuts are allied in composition to cocoa, coffee, and tea, but contain a relatively large amount of caffeine. The properties ordinarily assigned to kola are those of a strong tonic and stimulant to the nervous system, counteracting and removing the sense of exhaustion after fasting and fatigue; it has also been credited with having an antagonistic action to alcohol, and it has been said to purify water. From his observations Surgeon Firth concludes that kola is in no sense a food; that it increases the total urinary water, with a slight reduction of its total solids and a marked reduction of the extractive; that it has a peculiar stimulant action on the nervous system, temporarily strengthens the heart beat, and increases the arterial tension. In times of exertion and fasting it wards off the sense of mental and physical depression and exhaustion. As a therapeutic agent in convalescence, and as an antagonist to alcoholic sequelæ, kola has not yielded any positive results in Surgeon Firth's hands. For the purification of water it does not appear to be superior to other mucilaginous seeds, its action being purely mechanical. In this report due prominence is given to the importance of separating seeds which contain no caffeine, such as Garcina kola and Sterculia cordifolia, as these would speedily discredit the employment of kola by the troops under conditions when it might possibly be of service. It appears that an infusion, from its astringent action, might be used for those suffering from diarrhœa.—*Lancet.*

SCIENTIFIC NEWS.

ANOTHER comet has been discovered, this time by Mr. W. R. Brooks, of Geneva, N.Y. The comet was picked up on July 6, 12h. 16m. L. M. T., in R.A. 23h. 45m.; S. Dec. 9° 10', the daily motion being + 1m. and + 5'. It is the fourth comet of the year. Dun Echt Circular, No. 173, states that the comet mentioned in Circular 172 is identical with comet 1889, 1.

At a meeting of the Liverpool Town Council on July 3, a letter was read from the Rev. H. H. Higgins, stating that Mr. G. Rylands, of Warrington, was desirous that his equatoreal should be made available for the benefit of the public under the direction of the Liverpool Astronomical Society, provided the Corporation would grant a site and assist in the erection of a public observatory, the Astronomical Society having the use of the observatory for their work for not less than three nights in the week; also stating that if the Council would grant a suitable site for an observatory, sufficient funds for carrying out the undertaking would be provided by the Astronomical Society and friends. On the motion of Sir James Picton, seconded by Mr. J. B. Smith, the letter was referred to the Parks, Gardens, and Improvement Committee. The telescope is of considerable size, and is worth at least £500.

The annual report of the Director of the Mauritius Observatory for the year 1887 shows that the mean temperature of the year was 1·4° below the average, and that the temperature was below the average in every month; the greatest deviation being 2·5° in August. No storm passed near the island, which has not been visited by a hurricane since March, 1879. During the year 1887 the velocity of thirty miles an hour was reached only once—in June. Rainfall is recorded at seventy-five stations, and Dr. Meldrum states that the comparisons made during the last ten years show conclusively that there is a close connection between the rainfall and the malarial fever on the low lands.

Astronomers all the world over will regret to hear of the death of Miss Maria Mitchell, LL.D., directress of Vassar College Observatory, Poughkeepsie, N.Y. She was the daughter of William Mitchell, astronomer, and was born in Nantucket, Massachusetts, August 1, 1818. She developed such remarkable talents that early in life she was able to assist her father in his mathematical and astronomical investigations. At the age of 18 she was appointed librarian of the Nantucket Athenæum. Since then she has made careful original observations, and devoted considerable time to the examination of nebulæ and the search for comets. In 1847 she made the important discovery of a comet, for which she received a gold medal from the King of Denmark and other distinctions. She went to Europe in 1858, and visited the principal observatories of Great Britain and the Continent. Miss Mitchell was the guest of Sir John Herschel and Sir George B. Airy during her stay in England, and also visited Leverrier in Paris and Humboldt in Berlin. In 1865 she was called to the Professorship of Astronomy at Vassar College, which, with the post of director of the observatory, she retained until January, 1888, when she received a long leave of absence. In addition to her teaching, she devoted much labour to the study of sunspots and the satellites of Jupiter and Saturn. The degree of LL.D. was conferred upon her by Hanover College in 1852, and by Columbia College in 1887. She was a member of various scientific societies, and was the first woman to be elected to the American Academy of Arts and Sciences. She took a prominent part in the movement to elevate woman's work, having held the presidency of the American Association for the Advancement of Women at the Syracuse meeting in 1875, and at the Philadelphia meeting in 1876. She contributed numerous articles to the scientific serials.

A distinguished English engineer long settled in Russia has passed away in the person of Mr. John Hughes, in the 75th year of his age. He was the originator and managing director of the New Russian Company's immense iron and steel works and rolling mills, the largest in Russia, situated on the Steppes of Ekaterin oslav, near Mariopol and the Sea of Azof. The rapid development of the metallurgical and coal industries of the basin of the Donetz has, in fact, been greatly due to the strong initiative and practical skill of John Hughes, ably seconded by his four sons. When he first began work, 20 years ago, there was nothing on this now flourishing spot (named after its founder as Hughesova) but the wretched hovels of a few shepherds with their sheep and dogs. The indomitable perseverance and untiring energy of John Hughes soon created a busy and populous settlement out of a vast and dreary wilderness; and the great industry which he founded now supplies the Russian railways from St. Petersburg to Samarcand. The Russians had no reason to refuse him their support, as he worked entirely with Russian materials produced on the spot. The deceased was born at Merthyr. At an early age he entered the Cyfarthfa and the Ebbw Vale Works, and afterwards started a mechanical factory of his own at Newport, Monmouthshire. Subsequently, he became well known as director for many years of the Millwall Iron and Ship-building Works, where he invented the hollow stringer, and constructed the celebrated Millwall shield, which withstood the tests better than any other armour in England. This brought orders from the Russian Government, and through acquaintance thus made with the Russians, Mr. John Hughes was induced to go out and make a personal inspection of the rich mineral deposits of southern Russia. Eventually he formed a company in London, and concluded a contract with the Russian Government in April, 1869, for the establishment of the works already described.

From Dr. Fridtjof Nansen, the now famous Greenland explorer, Messrs. Perken, Son, and Rayment, of Hatton-garden, have received a valuable testimonial. The distinguished traveller says "that the instruments supplied by you for the expedition—namely, the three aneroids and the pocket sextant—have been proved to my entire satisfaction." It seems there was not time to have the instruments verified at Kew, so Dr. Nansen had them tested at the Meteorological Institute in Christiania, and he goes on to say that in spite of the necessarily severe usage and tests from the rather unexpectedly high altitudes reached (upwards of 9,000ft.), and the great range of temperature—varying from + 55° to − 55° Fahr. in the day and night—to which they were exposed—they worked admirably together, and on again reaching the sea level they differed very slightly. "The pocket sextant also—the only instrument we had for fixing our latitudinal position—proved invaluable to us, and justified fully the excellent workmanship and finish."

A Lloyd's telegram states:—"A letter, dated Whale's Point, Stans Foreland (Spitzbergen), May 29, has been received within the last few days by the Geographical Society of Bremen from Dr. Kukethenthal, who, in company with Dr. Watter, has undertaken an exploring expedition in the Arctic Sea. The expedition was cruising off the south and west coasts of Spitzbergen. Many gales occurred. In Magdalena Bay, on the west coast of Spitzbergen, in lat. 79° 35′ N., the expedition fell in with an English sailing vessel. Mr. Pike, hunter and sportsman, had been wintering on West Spitzbergen with some people. The winter had been very mild, but sport was not very good." It is to be hoped that the "party" contained some scientific observers, as information of the climatic conditions of West Spitzbergen during winter is always useful.

There exist at the present time, counting the Institut Pasteur, Paris, more than 20 anti-rabic institutes scattered over the world. There are six in Russia—at Odessa, St. Petersburg, Moscow, Cracow, Samara, and Tiflis; five in Italy—at Naples, Milan, Turin, Palermo, and Bologna; one each in Vienna, Constantinople, Bucharest, Rio Janeiro, Buenos Ayres, Havannah, Chicago, Malta. Two new laboratories are in course of organisation.

The executive committee of the Middlesex County Council under the Contagious Diseases (Animals) Act have unanimously adopted the following resolution:—"That this authority, considering the terrible character of hydrophobia and the increase which has occurred in the present year, both in that disease and in canine rabies, and the danger of still greater increase of those diseases, desires to urge most strongly upon the Privy Council the necessity for such prompt action as will insure the proper muzzling of dogs and their proper control throughout the United Kingdom, and the prevention of importation of dogs from other countries unless under strict quarantine regulations. The committee also call attention to the need of fresh legislation for the effectual carrying out of these objects, as well as for making owners more responsible than they are at present for injuries done by their dogs." The clerk of the council was directed to forward a copy of the resolution to the Privy Council. It is considered by some that a stricter quest after the tax would check the spread of rabies, while others contend that the unlicensed dogs would then be more strictly confined and become mad in consequence. That might be as effectual as muzzling, though rather hard on the poor dogs.

At a meeting of the Russian Mineralogical Society, K. D. Chrustschoff, it is said, demonstrated the existence of a new metal which he has just discovered and named "russium." It approximates closely in its properties to thorium, and its existence was predicted by Mendeléeff.

The Armourers and Braziers' Company have decided to hold in their hall in the City of London, in March next, an exhibition of modern armour and blades, and of art work in brass and other yellow metals. The object of the scheme is to encourage British craftsmen, apprentices, and designers to produce really first-rate work. This exhibition will also afford British workmen an opportunity of showing that they can make swords and bayonets, in spite of the statement made by a member of the Government.

A Parliamentary paper has been published containing regulations made by the Board of Trade as to life-saving appliances which are to come into force in March next year. The rules are made in pursuance of the provisions of the Merchant Shipping (Life-Saving Appliances) Act of 1888, and arrange merchant vessels in seven classes according to their size, method of motion, the service in which they are employed, and the number of passengers carried. The general rules appended provide for the boats being properly constructed and equipped, and for the lifeboats, jackets, buoys, and rafts to be carried by each vessel. These rules are the result of a report made to the Board of Trade by a committee of which Mr. T. H. Ismay was chairman. The committee think that if these rules are adopted, ships of different classes will be provided with such appliances for saving life at sea as are best adapted for securing the safety of their crews and passengers.

It is stated that in Brooklyn an enterprising auctioneer utilises the phonograph to repeat the "conditions of sale," thus saving his own breath.

The Governor of New York State has signed the Bill permitting street railway companies to substitute mechanical motive power for horses. Probably there will be a development at first of the cable system of traction, but ultimately electricity will no doubt supersede all other modes of traction—at all events, for street railways.

The MS. of Galvani recently discovered in the Commercial Library at Bologna is not, it appears, unknown. It was published about the end of last century, but it is, nevertheless, interesting, as it contains a number of marginal notes by Galvani.

At a recent meeting of the Paris Academy of Sciences M. Gaudry drew attention to the discovery of a gigantic mastodon (Dinocera mirabile) by the American palæontologist, Prof. Marsh, who sent M. Gaudry the elements necessary for its reconstruction. Mr. F. Darwin was present at the meeting and heard M. Gaudry, who expressed the opinion that it is certainly the most gigantic being of the Miocene epoch, and interesting to note that it became rapidly extinct, notwithstanding its enormous strength and the length of its powerful tusks. Here the correctness of Darwin's theory was called into question. M. Gaudry observed that "the struggle for life" should have saved this species so well prepared for combat, and caused other species much less endowed to disappear. Hitherto no ancestor of the Dinocera mirabile has been discovered. It appeared suddenly, and disappeared in the same way—at least, no trace has been found of any transformation either before or after its appearance on the globe. The simple comment is that D. mirabile was not the "fittest." Mere brute strength has nothing to do with the theory.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE REPORT TO THE VISITORS OF THE OXFORD UNIVERSITY OBSERVATORY—THE ECCENTRICITY OF THE EARTH'S ORBIT—HEIGHTS OF FIRE-BALLS AND METEORS ABOVE THE EARTH—FINDING THE POSITION OF THE MOON OVER THE EARTH'S SURFACE—THE BARLOW LENS—NUMBER OF VISIBLE STARS—FLAT FOR NEWTONIAN TELESCOPE—STARS IN DAYLIGHT—WHAT DO WE SEE?—THE HORIZON OF THE EIFFEL TOWER—CENTRIFUGAL "FORCE"—GRAVITATION—UNIFORMLY ACCELERATED (OR RETARDED) MOTION.

[30115.]—The report of Prof. Pritchard to the Visitors of the University Observatory at Oxford, if not a very lengthy document, is full of interest. It is gratifying to learn, in the outset, that the educational function of the observatory continues to be well and efficiently discharged, and that additional lectures and receptions have attracted large numbers of students and others. Preparations are being made for joining in the international scheme of stellar photography, and the Savilian professor is only waiting for the completion of an object-glass by Grubb to commence the preliminary operations. In connection with his account of the additions to his instrumental appliances, he expresses a regret for the loss of Dr. De la Rue which will be shared by every English astronomer. In the details of astronomical work done during the past year, Prof. Pritchard naturally gives prominence to that determination of stellar parallax by photography with which his name must be imperishably associated. Astronomers in all parts of the world will be glad to know that the volume containing the results of no less than thirty distinct determinations of stellar parallax is now passing through the press, and will very shortly be issued. The originator of the most trustworthy method yet devised of ascertaining this dubious and difficult element remarks with justifiable pride on its adoption at other well-known observatories. He then proceeds to refer to a projected scheme of photographic observations of the planetoid Victoria, with a view to the determination of the solar parallax; to the adoption of his wedge photometer at Poulkova, and to aid rendered in the erection and adjustment of a Dallmeyer equatorial at Keble College. And next he makes reference to the admirable and most ingenious planisphere which he has invented, and which was exhibited at the May meeting of the Royal Astronomical Society. He then devotes two successive paragraphs to the subjects of buildings and finance, and finishes with a graceful little reference to the election of his assistant, Mr. W. S. Plummer, to a seat on the R.A.S. Council. As I began by saying, the interest of the report before me is decidedly in excess of its length. I am delighted to see that Prof. Pritchard adheres to the time-honoured practice of speaking of an equatoreal in contradistinction to the equatorial relations of the instrument. The recent use of the adjective for the substantive seems to have come to us (with some other questionable orthography) from the other side of the Atlantic.

Whence in the world did Mr. Bone (letter [illegible], p. 369) obtain the information that "200,000 years ago the eccentricity of the earth's orbit was [illegible] instead of ·168, as now"? At present, it is 0·01[illegible], and the limits of its variation lie between zero and 0·07, a surprisingly different condition of things to that which he affirms.

Can Mr. Cowan (letter 30083, p. 370) be ignorant of the fact that the paths and parallaxes of a considerable number of the most conspicuous fire-balls and meteors have been observed and computed with very considerable accuracy? A little study of the literature of the subject could hardly fail to be of advantage to your correspondent.

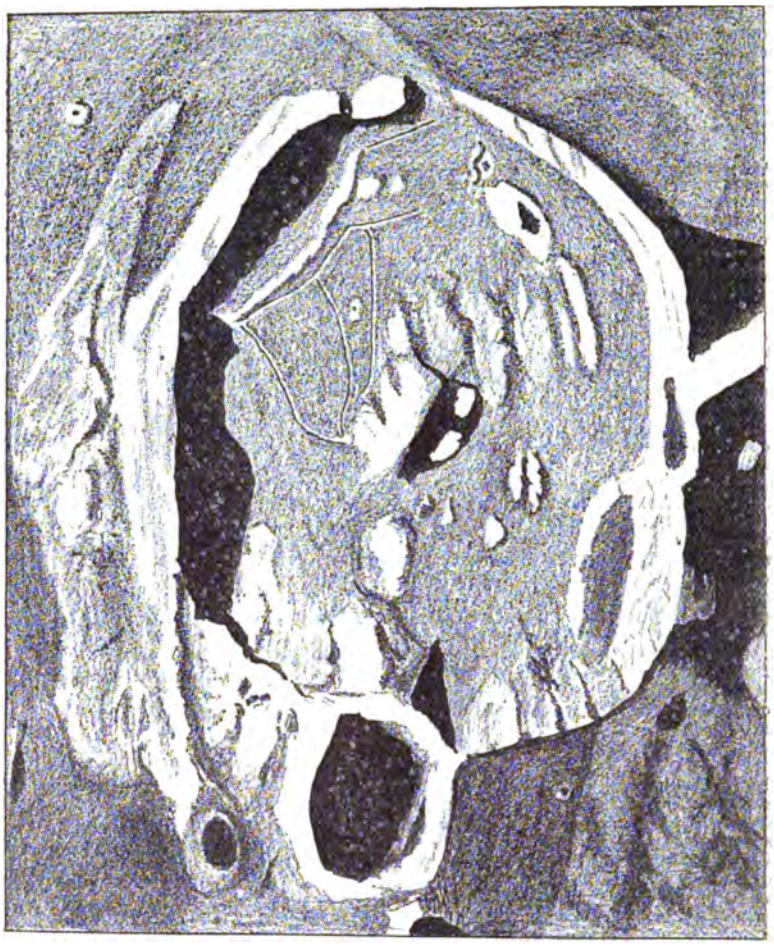
I trust that a single example will clear up the lifficulty under which "Ruric" labours (query 8944, p. 378) in connection with the determination f the Moon's position. Of what place, then, let s say, is the Moon in the zenith at 5h. 4m. p.m. n August 24th. At the instant specified, as will e seen by reference to page 137 of the *Nautical lmanac*, her Right Ascension is 8h. 53m. 28·56s., nd her Declination North 20° 5m. 49·33s. The idereal time at Greenwich mean noon, or R.A. of he Greenwich meridian at that hour on August 24th s 10h. 11m. 49·08s., and, of course, 5 hours and minutes later it is 15h. 15m. 49·08s. But we have een that the Moon's R.A. is only 8h. 53m. 28·56s., r, in other words, she is then 6h. 22m. 20·52s. est of Greenwich. Hence we see that she must e vertically over a point in the Gulf of Mexico mewhat to the north and west of the town of era Cruz.

"J. M." (query 68955, p. 378) must really forgive me for saying that he must either have made ery recent acquaintance with the ENGLISH MECHANIC, or his perusal of it must have been of most perfunctory character, inasmuch as a tudy of your back volumes would have supplied im with answers to every one of his questions. Why, even so recently as on p. 109 of the current olume, he might have found replies to two or three f them. However, as categorical answers to his umbered questions may serve hereafter to refer ther people to, I give them:—1st, then, the mount of magnifying power afforded by a Barlow ens depends upon its own focus and position in the ube of the telescope. If, for example, it is proposed to double the power of the telescope with any given eyepiece, then the Barlow lens must be placed t half its own (negative) focal length from the ocus of the object-glass—i.e., a Barlow lens of 8in. negative) focus must be placed 4in. from the focus f the objective, to obtain a power of 80 with an yepiece magnifying 40 without it. 2. If you double he magnifying power, of course you get one quarter f the light. 3. It by no means improves definition. . There is a distinct disadvantage in attempting to make a low-power eyepiece do the work of a higher ne by its aid. 5. Is practically answered above n 1. 6. The only work it is suitable for is the measurement of double stars, as it increases the magnifying powers on the stars without apparently thickening the spider-lines in the micrometer. 7. The "principle of optics" involved in its construction s this: it is virtually a concave lens, consisting of a ombination of a plano-convex flint lens with a oncave crown one, which renders the converging ays from the object-glass less convergent, and by o lengthening its focus increases the size of the rimary image. 8. Most decidedly it can *not* be sed in photographic work, which requires an bject-glass specially corrected so as to render the isual and actinic rays coincident, and by no means merely achromatic image. Finally, let me sum p by saying that, save for the one object of the measurement of double stars, a Barlow lens is a mere nuisance and incumbrance. Were it susceptible f being put to a quarter of the number of uses to which my querist appears to think it applicable, here would be but few telescopes of any size or mportance made without it; whereas it is one of he very rarest appliances to be found in an Observatory.

"Vooght" (query 68985, p, 379) is under a slight misapprehension as to what he has read in one of Proctor's books as to the number of the fixed stars isible to the naked eye, inasmuch as this does not each much beyond 6,000 in the entire celestial vault. We can rarely indeed see more than 3,000 stars at nce by unassisted vision, though an ordinary fieldlass brings out 16 or 17 times this number. Dr. Dallinger must have been referring to the stars isible in the great Lick telescope.

I would strongly advise "Solar Focus" (query 8840, p. 112), Mr. Linscott, who replies to him on . 354, "Ecnal," p. 375, and, in fact, all interested n the construction of the Newtonian form of eflector, to carefully study an excellent paper in he current number of the *Journal* of the Liverpool stronomical Society, by the Rev. John Bone, .R.A.S., "Upon a proper determination of the ze of the Plane Mirror in a Reflecting Telescope f the Newtonian form." From it they may gather e mathematical principles on which the size of the at must be determined, and learn (possibly to their rprise) what an enormous and disproportionate mount of light is lost by making the plane too nall. Let me add, with reference to what Mr. inscott says on p. 395, that not being an optician, was ignorant that a Newtonian plane is usually escribed as being of the length of its *minor* axis.

Mr. Ingall (letter 30092, p. 389) must kindly forgive me for saying that it was precisely because I m aware that "the trouble" (of seeing stars and lanets in sunlight for the two or three years folowing 1883 was) . . . "due not so much to an *paque* as to a *luminous* veil," that I wrote as I did. f the upper regions of the atmosphere had been illed with Krakatao dust, then would every particle f it above the horizon have been illuminated by he sun, alike in his neighbourhood and in that of he Pole. Mr. Ingall, with his great observing experience, knows well how clouds, even of the most tenuous character, when lit up by sunlight, absolutely blot out every vestige of a star; whereas, at night, the same star is easily visible through even an increased amount of unilluminated cloud. What your excellent correspondent says about heated air impeding daylight definition is undoubtedly correct.



In connection with the question mooted by Mr. Monck (in letter 30097) on p. 390, I would just remark that when we say that we see an object, what we mean to convey is, that we become conscious of its presence through the medium of one of our senses, that of vision. Now, everyone knows that the rays of light proceeding from any given object are converged by the crystalline lens and vitreous humour of the eye, and that, in a normal eye, they form an image of their original source on the retina. Just so; but *this is not seeing*. Behind the retina lies the expansion of the optic nerve, and it is not until the vibrations of the retina are conveyed to the brain, and, in turn, set its molecules in motion, that we *see*. Cut this optic nerve, and albeit the retinal picture retains all its pristine sharpness and brilliancy, the subject is blind—stone-blind. The question then of an inverted image seems to me to be an idle one to discuss. If I have to raise my head to see the top of an object, and depress it to see the bottom of that object, I call the part whose perception involves the raising of my head *higher* than that which I am obliged to bend my head downwards to see. There can be no such a thing as erection or inversion *in the mind* apart from some such reference to our own muscular sensation as this.

"Lyons" (letter 30109, p. 392) is so far right, that the distance of the visible horizon from an elevation of 900ft. would be 39·69 miles, very approximately indeed: or, if we take Proctor's estimate of the depression, at average atmospheric pressure of 6·4in. per mile, 41·08 miles.

Does "Dubliniensis" (reply 68942, p. 397) remember Sir George Airy's protest against the expression "centrifugal *force*." If I err in objecting to it, I do so in uncommonly good company.

"Heliostat's" calculation (given in query 68993, p. 400) is quite correct, on the assumption that the stone was projected vertically upwards with a velocity of 96ft. per second. The theory has of course been proved by experiment, and the stone will obviously pass any given point with identically the same velocity in rising as in falling.

A Fellow of the Royal Astronomical Society.

GASSENDI.

[30116.]—I HOPE I am not encroaching too much on your valuable space in sending yet another sketch of Gassendi, made on the 21st May, 1888, with an 8½in. reflector, under somewhat lower illumination than those already published.

M. Gaudibert will note that there is no vestige of the craterlet on the N.W. wall referred to in his very interesting letter on p. 369, though, as he shows several other craterlets omitted in my drawing, it is very possible that I might have missed it, even if it had existed at the time. Still, it is a matter of impossibility for all the numerous observers who have examined Gassendi to have overlooked a craterlet in this position, so conspicuous as M. Gaudibert states that this one now is, and if M. Gaudibert's observation is confirmed, this will undoubtedly form a well authenticated case of change.

In the mean time I look forward with eagerness to the next opportunity of seeing Gassendi.

Geo. P. B. Hallowes.

LUNAR SURFACING.

[30117.]—WE generally look upon a world like the moon as one that must have been once in a liquid state. Our earth and the various planets of the Solar system we suppose were one and all at one period of their life in this condition. To be liquid they must have been at a great heat, sufficiently so to make all solids flow like water. This I take as the time when the moon was active—in full vigour of youth—when the rising and falling of her tides was the rising and falling of molten matter. This great heat would slowly radiate away, and the once fluid surface would begin to set or harden. Just previous to this hardening of the surface, we can imagine a semi-fluid globe under the attraction of the sun and our earth. The tides would become sluggish, the waves of semi-molten matter would hardly be able to rise and fall, and, when the crust hardened, they would cease to be waves; but, at longer or shorter intervals, the molten matter beneath would force its way through the crust in jets; these would sometimes melt the crust on which the jet of matter fell, at others this matter would cool and solidify round the opening of the jet, whether the opening was large or small. Where the opening in the crust had been made 60 miles in diameter this might safely be called a mighty tidal wave. As it rose the crust would be broken into fragments, and, as the wave subsided, these fragments near the outer edges of the hole that had been made would be thrown upon the solid crust, as easily as the waves of the sea drive a vessel upon the shore; these adhere to the crust, and form a ring raised above the level of the now agitated matter in the (now) crater. The whole of the surface of the moon nearest the earth would probably be broken by such craters—some very large, others equally small. The semi-molten waves falling upon the outer ring form ridges and layers one upon the other. This solid crust, being lighter than the semi-molten and molten matter, floats upon the surface, as icebergs float in the sea. Every time a wave of this matter rolls on the "shore" of the crater the outer ring is lifted higher and higher. The inner portion of the ring will be made up of ridges and terraces, upon which pools of the molten matter form separate craters. On the outer edges of the ring immense jagged edges, caused by the breaking and cracking of the crust as the wall rose higher and higher. Sometimes probably a crater is lifted bodily by the wall, and the crater may be tilted at a great angle if it was previously solidified.

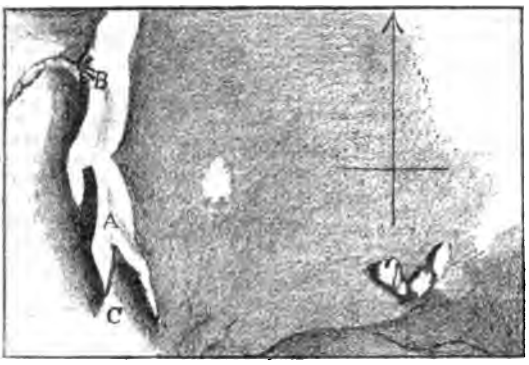
Another great tidal wave may break down a portion of the walls of one, two, or more craters, these all afterwards forming, as it were, one crater, but ever showing signs where the great catastrophe had taken place. Eventually the walls would sometimes attain great heights. As the whole crust becomes more solidified, the effects of these tidal waves would be less felt. The whole of the floor of a crater may be solidified, when a wave would break it up. As it again solidified, small craters, cracks, ridges, and innumerable smaller features would be left upon the floor. If the action of the molten matter beneath the crust was not sufficiently strong to break up the whole of the floor, we should naturally expect an upheaval in the weakest places, and large cracks or gaps would radiate from this weak spot. This weak place may or may not form a crater, with or without a wall, according to the strength of the upward rush of the matter below. And whether or not there was a crater cone would depend upon the short or prolonged action or agitation of the igneous matter. If the action was prolonged and gradually subsided, the matter would solidify nearest the crater edges, and slowly close up, and it would be the slow, dying energy that would produce the crater cone. Where crater cones are made up of several peaks, and the whole forming a portion of a circle, it is clear that this is a portion of the wall of a crater, the sole survivors of a great catastrophe.

When every crater was solidified, and every crater cone ceased to emit lava, and when the moon was being solidified near her centre, this solidifying matter below her surface would press upon the liquid lava beneath, with a tremendous pressure as it *expanded in cooling*. At the last this pressure becomes too great; the bowels of the moon begin to fight their great enemy—pressure. They find his weak parts; then there is a violent trembling of the whole surface of the moon, and she allows herself to be rent open in her weakest parts; hills, craters, plains, and valleys are separated by many chasms spread over the moon's surface from one centre of "radiation," and this centre would be, according to the previous reasoning, a crater—probably the last one formed; therefore, the weakest. There should be here one of the largest crater cones on the moon, composed of the latest material from the bowels of the moon. Coming from the "refiner's fire," it should be the purest, the least weather-beaten; and, along with the many chasms filled up with the pent-up lava from below, will present some of the most brilliant markings on our satellite.

July 2nd. **D. B L.**

SUNSET ON FRACASTORIUS — TELESCOPE STAND—OPTICS.

[30118.]—Mr. Elger, in contributing an elaborate drawing of Fracastorius in your 973rd number remarks that "representations of it under a setting sun are somewhat rare," and I trust this will be sufficient excuse for my submitting the accompanying sketch, taken about 3 a.m. on June 17, when I find (taking account of libration) that the terminator was about 9° more to the W. than at the time of Mr. Elger's observation. Using a power of about 200 on a 4in. refractor, and aided by exceptional definition, I noted the following marked differences of outline in the portion of the W. wall shown in Figure. The spur at C was much prolonged, and the base of the inner wall indented, as at A and B. On looking over a number of drawings in the R.A.S. Library, I only found one giving very approximately these peculiarities.



I should be glad to supplement the description you kindly allowed me to give of my (Mr. Vallance's) telescope by a few words about his stand, which consists of three very massive wooden legs, and which I have fixed thus: Each leg rests on solid masonry, and a pier of brickwork is built between them, on which rests a petroleum barrel filled with sand well rammed round a tree-trunk, which rises from the centre and helps to carry the weight above. The legs being then bolted to the barrel and also to the trunk, I have an absolutely rigid pedestal. I ought to mention, moreover, that in the sand is sunk a large socket-pipe, down which the clock-weight descends well out of harm's way. With your permission, I should like, in another letter, to detail how I have been able, with my own hands, to put up an excellent observatory, resembling one described in a back number, for *honestly* little over £2.

If "Sol" (query 68968, page 378) has any acquaintance with mathematics, he will, from a consideration of the familiar formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f},$$

easily perceive that in a concave lens a convergent pencil will emerge as a parallel beam when its point of convergence is at a distance equal to the focal length of the lens. Hence, by simple geometry, he will find the focal length required in the example given will be, theoretically, 7¾in.

Newbury. **J. M. Bacon.**

VULCAN.

[30119.]—In M. Lewis Swift's letter I read the following:—" . . . The evidence against such theory, though negative, is almost as strong as against the *hypothetical* satellite of Venus. . . . What *ridicule* would have attached to Prof. Hall had he announced beforehand his determination to find satellites to the planet Mars!" (The italics are mine.) For astronomers knowing no cosmogonic law it may be so; but anyone knowing that all astronomical phenomena have their causes, knowing that every sun that rotates is surrounded by planets, that every planet that rotates is surrounded by satellites, and that satellites do not rotate, both hypothesis and ridicule vanish. I extract the following lines from a work in three octavo volumes of 1,000 pages each, published in 1866-67-68:—"V. Mode de production des corps périphériques, et des mouvements rotatoires et orbiculaires des corps célestes, p. 20. A. Mode de production des mouvements rotatoires du corps central par la production des corps périphériques, p. 181. B. Mode de production du mouvement orbiculaire des corps périphériques par le mouvement rotatoire du corps central. Mode de production du mouvement rotatoire du corps central, p. 184. Origine unique des lois de Képler in formules mathématiques. Erreurs de ces lois, &c., &c." Prof. Hall's discovery was announced beforehand as follows:—"Mars se distingue des autres planètes par son satellite, qu'on n'a jamais aperçu *quoique cependant il existe*, car Mars a expúlsé des jets de masse brulante, comme cela résulte, 1° de son mouvement de rotation, et 2° des échancrures que l'on voit sous forme de taches mobiles. . . . V. 2, p. 293. Satellite de Mercure, observé par Schroeter, Harding, Roetaler, en 1799. C'est par oublé que ces astronomes ne seront par souvenus que le point lumineux était le satellite de Mercure, dont le mouvement est dans le même sens que la rotation de la planète, mais dont la vitesse diffère. Elle lui est inférieure, et se manifeste dans un plan très peu éloigné de celui de l'équateur de la planète. Ce plan *b*, *c*, *c*¹ fait un angle de 70° avec le plan de l'orbite de Mercure, p. 268. . . . . Les astronomes actuels ne peuvent se rendre compte, 1° de la disparition du satellite de Vénus, depuis un siécle; 2°, de la disparition de la lueur cendrée de la partie obscure du croissant, aperçue pour la dernière fois le 8 Juin 1825, par Gruithuisen à Munich. . . . Il ne s'agit que de la cause physique qui rendit invisible le satellite et la lueur cendrée sur la partie obscure du croissant. . . . Je donnerai dabord l'historique des observations, puis je montrerai la position du satellite de forme ovalaire circulant avec la planète dans l'espace annulaire dans lequel circulent les météores qui réfléchissent la lumière zodiacale. Je ferai vainque cette lumière arrive simultanément avec celle du satellite qui devient alors plus faible, et par suite invisible. La première observation du satellite fut faite par Cassini le 28 Août, 1686. Il vit le satellite le 25 Janvier, 1672, raréfié en proportion de l'accroissement de la lumière zodiacale. Schmidt, à Athénes, 28 Octobre, 1740. Short en Angleterre du 3 au 11 Mars, 1761. Montaigne le vit 4 fois du 3 au 4 Mars, 1761. Boedkier 10 et 11. Horrebow et pluiseus curieux, 15, 28, 29 Mars, 1764. Mont Carron à Auxerre, p. 281. Existence réelle d'un satellite de Vénus. Mouvement, orbite, révolution, grand arc. Rapport entre le plan équatorial de Vénus et le plan de l'orbite de son satellite, p. 757. Il-y-a un siécle, le satellite de Vénus était visible. . . . . Lambert a déterminé la position de son orbite, p. 849. Le seul satellite de Vénus est devenu invisible depuis un siècle. C'est le 4e. Il correspond à la lune. Les trois autres ont perdu depuis longtemps, leur mouvement orbiculaire dans leur rencontres avec les aérolithes, les nuées de poussière, et de météores. Le satellite actuel est devenu invisible à cause des nuées de pouissière qui lui font écran, ou se sont déposées à sa surface, et ont produit une diminution de la réflexion des rayons aussi bien voir la Terre qui vers Vénus. . . . Lorsque dans la suite des temps le satellite se deviendra visible, les astronomes ne manqueront pas de déterminer son équation séculaire pour comparer à celle de la lune. . . . L'existence du satellite est d'accord avec l'équation séculaire de la lune, ce qui fait voir qu'il devra s'écouler un très longtemps jusqu'à l'époque, où la lune perdra tout son mouvement orbiculaire, car elle se trouve dabord dans le même état où se trouve actuellement le satellite de Vénus, p. 850."

Morchain, Somme, France. **Ch. Rabache.**

JUPITER.

[30120.]—Le 6 Juillet, à 10h. 40m. (t. m. de Bruxelles) la tache rouge de Jupiter s'est trouvée au méridien central; elle se voyait très-bien avec le gross. 280 de mon équatorial de Grubb; sa teinte rose est encore sensible, et elle me paraît redevenue plus uniformément sombré; du moins, je n'ai pu encore réussi à lui voir son aspect d'anneau elliptique plus clair au centre. Je l'ai déjà observée plusieurs fois cette année, et les amateurs qui suppléeront par leur persévérance aux difficultés résultant du peu de hauteur de la planète seront amplement récompensés par les détails intéressants qu'ils remarqueront. *Le secret de Jupiter est encore à découvrir.*

Louvain, 8 Juillet. **F. Terby.**

METEOR OF MAY 29th.

[30121.]—I have read with interest letter [illegible] *re* Meteor seen at Leeds and Belfast.

Would Mr. Booth oblige by saying how the height (60 miles) is obtained, as well as the place over which it was vertical at that time?

The astronomical azimuth of the meteor as seen from Leeds, as per data given in letter, would be about 99·3°, and so would not be due W. from Leeds, neither would it give a point 22 miles W. by S. from the Calf of Man.

July 8. **Chas. Grant.**

THE VISIBILITY OF MERCURY BY DAYLIGHT.

[30122.]—Do not some of the correspondents who have written on this matter slightly overrate the difficulty of seeing this planet in the daytime—at least, so far as regards the optical power necessary? At all events, on one occasion (Aug. 6, 1888) I saw the planet at transit in my little instrument of only 1¾in. aperture. It is true that it was a glimpse only, it not being seen until it had passed the centre wire; but just after that it was apparent, showing its small white crescent upon an unusually blue sky with sufficient clearness, and was held until it passed out of the field. This observation would seem to show that the possibility of seeing difficult celestial objects by daylight is less a question of aperture than of favourable atmospheric conditions.

W. J. B.

A CORRECTION.

[30123.]—There is an error in my last letter (30092). You will, perhaps, kindly correct second paragraph, line 6. The word "observation" should be "obscuration," to make the meaning intelligible. **Herbert Ingall.**

WEIGHT OF METEORITES.

[30124.]—THE following is the weight of the five argest known meteorites in the world:—

Santa Catharina (Brazil)	25,000 kilos.
Tucuman (Arg. Repub.)	15,000 ,,
China...........................	10,000 ,,
Bendegó (Brazil)	5,360 ,,
Melbourne (Australia)	3,000 ,,

The meteorite of Santa Catharina was discovered n fragments, the largest of which weighed 2,250 ilos. The total weight is, however, estimated at 5,000 kilos, as it is statod in the Book of Receipts f Sao Francisco do Sul that this quantity of ikeliferous iron was exported. The weight of his colossal mass must have been even greater, as a arge number of the smaller fragments would aturally not be found.

The weight of the meteorites of Tucuman and hina both, *in situ*, are the result of vague calcuation.

The "Bendegó" is the largest existing meteorite n the world *that is deposited in a scientific establishent.*

G. W. N.

BRUCINE.

[30125.]—IF Mr. F. W. Mason (letter 30113) will ok into any work upon the chemistry of the lkaloids, he will find HNO_3 mentioned as a test r brucine, with which, as he states, it strikes a right red. If he looks further, he will see morphia lso strikes the same colour with HNO_3, but is not ffected by chloride of tin.

Mr. Mason, after saying brucine may be extracted rom nux vomica, states brucine is also found in false angostura bark." Now, "false angostura ark" is no other than "nux vomica bark," it aving received this name because it was used to dulterate "cusparia bark," which is the *true* ngostura bark, the chemical distinction being nux om. bark becomes red if a drop of HNO_3 be pplied, on account of the brucine it contains; whilst ith cusparia a slight darkening in colour only akes place, owing to the action of the HNO_3 upon he "angusturine" contained in the cusparia bark.

Such being the case, it is obvious if HNO_3 is a est for brucia, brucia is a test for HNO_3.

Frederick Davis.

[30126.]—IN commenting upon the question aised by Mr. F. W. Mason, F.S.S., as to whether rucine has been used before as a test for HNO_3, ay I say that when I was working at the Camridge University Chemical Laboratory some few ears ago, I was taught that the red colouration ccurring when brucine was added to strong HNO_3 as a useful test for brucine.

Harold G. Dixon.

[30127.]—I AM surprised that a *chemist* should be norant of the antiquity of this test for HNO_3. It more delicate than he imagines, as it will show he presence of one part of N, as nitrate, diluted ith 10,000,000 parts of water. If Mr. Mason will onsult Vol. VI. of the *Analyst*, he will find therein paper by J. West-Knight on the use of this test or quantitative estimations. As far as water is oncerned, I prefer myself the phenolsulphonic acid est.

Sm.

"A PIANO FOR EVERYBODY."

[30128.]—UNDER this heading Mr. Thomas asson, p. 392, implies that the American organ is eficient in "expression" as compared with the armonium.

As it is no use kicking a dead donkey (this matter as been thrashed out before), I will briefly ask im why "expression" is wanting in the American rgan? Perhaps he had better hear somebody who an play it before he replies; but for the benefit of hose who don't know, I may explain that in the armonium the wind is forced past the reed, in the . O. it is drawn past. "Starveling, mawkish, exressionless," &c., are not the words of wisdom or f knowledge.

Organon.

[30129.]—ALTHOUGH the letters on the above ubject have wandered from the main point, it may ot be out of place to refer your readers to the very njust criticism, made by Mr. Casson, with respect the American organ. I refer to the letter which ppears on p. 392 of the present volume of the ECHANIC.

I am surprised that such a talented gentleman as r. Casson should regard the American organ as n "American eunuch snob." Has Mr. Casson ver heard the capabilities of the American organ rought out by a good performer? If not (and uch is probably the case), then it is unfair to say hat the American organ is an "expressionless and oulless" instrument. I quite agree with Mr. asson in his opinion respecting the "dummy" tops which are so often found in American rgans; but he will perhaps bear in mind that unless n organ contains a good display of these useless tops, the instrument will not sell, or meet the approval of those who are ignorant of real musical taste. The majority of purchasers of American organs do not care for an organ unless it contains a good supply of stops, and I believe that goes a great way in inducing manufacturers to put more stops in their organs than they know to be absolutely necessary, in a musical point of view. These unnecessary stops must have a title, but it is only the ignorant that can possibly be deceived by the number of stops contained in an organ.

A small American organ is preferable to a harmonium, in a general way, because the harmonium is usually too noisy for ordinary dwellings. True expression is not regarded as of any particular importance except by those who have true musical taste. The majority of so-called harmonium players do not trouble, or care to trouble, about expression. Give them a tidy, well-finished organ case, and plenty of stops, and they are satisfied. They know not what is meant by a set or row of reeds, neither do they care to know. On the other hand, if we take a good American organ, and listen to it, under the hands of a good performer, it is then (and only then) that the capabilities of the American organ are brought out. Under these conditions the American organ is anything but a "soulless" and "expressionless" instrument. Fair play, Mr. Casson! We can put an expression stop to an American organ, and the harmonium can only then beat it in "volume" of tone. The harmonium (unless specially constructed by a mechanical artist) can never approach the American organ in pipe-like quality of tone. In a general way, a certain amount of expression can be obtained from the American organ by the use of the knee or automatic swell without the expression stop. If the American organ is "expressionless," "soulless," and "mawkish," it is not the fault of the instrument, but the fault of the player. As regards the "pipe top," that is merely an ornament, nothing more.

Swansea. **G. Fryer.**

ORNAMENTATION OF IRREGULAR AND OTHER SURFACES, &c.

[30130.]—IN reply to "A. F. D." (30068), I am half afraid that some of our amateur engine-turners may have thought my last letter somewhat cantankerous. I was smarting under what I considered an injustice (now happily removed), and did not, of course, intend to include all amateurs, and am now willing, and I hope able, to assist (through your columns) any gentleman concerning rose-engine turning and its difficulties.

Taking irregular forms as a whole, I think that the principle of the slide-rest as used with the rose-engine, is not as well known as it should be, as previous queries in the "E. M." will testify. It appears to me that the action of a fixed cutter in a slide (excuse the Hibernicism) is not generally known, nor do your many correspondents seem to have thought it worth their while to speak about this matter. This cutter will, so fitted, give and take with the inequalities of a given surface according to the skill of the operator. This slide-rest has the usual longitudinal traverse, and the transverse action by means of a cheeked slideway, and the tangent-screw quadrant. By these means we are enabled to cut any surface, whether plane, cylindrical, convex, concave, or globular. These conditions are the daily practice of a skilled rose engine-turner, and seldom do we have a perfectly flat or cylindrical surface to work upon. While on this subject I ought to say that there are also several methods of sharpening cutters for the purpose of cutting irregular surfaces, these, of course, could not be explained without a personal interview.

With regard to "A. F. D.'s" second query as to the merits of the spherical chuck and the spherical slide-rest, it is very hard to give a practical opinion. In this case I will content myself with giving my experience with apparatus which will give about the same results, with this difference, that the work executed was of a practical, and, therefore, paying character.

In this case the work I have done on a very heavily-made rose-engine, made by Mills, Clerkenwell, with a straight-line chuck which would take easily 36in. with some inches to spare. I had occasion to apply to my then employer for a special spherical chuck to carry out an ornamental idea for someone—I think it was one of our master's customers—to do a series of ornamental borders on the spherical surfaces of teapots, irrespective of form. This chuck was, of course, duly made, and fully paid for its cost in the shape of an immense run we had upon this particular kind of work. Anyone acquainted with the powers of a rose engine will see at once that this kind of work cannot be done on every lathe, as the fact of merely putting the straight-line chuck in position for work required the strength of two of our workmen, in addition to one to direct the fixing. With regard to machines for turning irregular forms (or surfaces?), if "A. F. D." is well up in the art, perhaps one of Messrs. Birch's medallion machines might suit him, as any one of them, either as a pastime or a source of income, is equally interesting. You have only to get your pattern or model made, fixed in the machine, and go on turning till further orders. Of course, the man must know his machine, also how to sharpen the cutters and attend to the centring and alignment, &c.

The horse's leg alluded to was probably turned in a lathe similar to the one used by gunmakers for the shaping of gun-stocks—a copying machine, similar lathes being used for shaping the shafts of hammers, axes, &c. I should be glad if correspondents would please ask specific questions, as this subject is so wide that one is likely to lose oneself in its labyrinths.

The geometrical engraving lathe is designed for cutting steel plates for transfer, for the purpose of ornamenting, and for protection against forgery, bank-notes, bills of exchange, and other paper representing money. I take this opportunity of replying to "C. C. E.," who, I am glad to hear, is one of our few accomplished rose-engine turners. *Re* his inquiry as to a machine for cutting or forming compound rosettes for the rose-engine, this lathe will cut simple rosettes to a limited extent, and compound rosettes to any extent; and not only that, but to the exact depth and contour to match any given design or figure. For this very reason, the owners of this unique lathe, which, by the bye, equals in cost one of Holtzapffel's best, would feel inclined to charge a prohibitive price for such work. With regard to compound rosettes for cylindrical work, I am not quite so sure, but I think the work required could be done, plus the requisite alterations to the lathe, &c. Briefly, the geometric engraving lathe has longitudinal, lateral, circular, eccentric, elliptic, and epicycloidal movements, each of which can be used one with another, or separately, or the whole combined. The different patterns—whose name is legion—are formed by the use of change wheels, and five eccentric levers, according to the taste and skill of the operator. A good technical knowledge of steel, &c., is also required.

N. Maclean.

117, Harwood-street, Sheffield.

EXAMINATION OF BLOOD-STAINS—BRUCINE—HARDENING AND TEMPERING OF STEEL—RENDERING CRUDE CARBOLIC ACID SOLUBLE.

[30131.]—THE interesting abstract by "F. R. M." (letter 30112, page 393) of the remarks of Dr. Copeman on the examination of blood-stains seems deficient in one or two particulars. Thus it would appear as if the characteristic absorption-spectrum of reduced alkaline hæmatin was peculiar to the blood of man and monkey. At least, so I read the description. This is incorrect, as anyone can prove for himself. I have from time to time seen and exhibited the absorption-spectra of the blood of many animals, including the ox, sheep, pig, rabbit, and fowl, but never had the slightest difficulty in obtaining the same band as is yielded by human blood. I never tried the effect of heating the liquid to 50° C. If this treatment caused the disappearance of the band from human blood and not from that of other animals (except the monkey), the fact is very interesting. In using the spectroscope it is best first to examine the aqueous extract of the blood-stain, for if the blood be tolerably recent the spectrum of oxidised hæmoglobin, characterised by two black bands, will probably be observed. On then adding citric acid the bands disappear, the spectrum of the acid hæmatin produced being far from characteristic. I have then been in the habit of adding a little Rochelle salt (as a precaution), then ammonio-ferrous sulphate and ammonia. This treatment brings out the spectrum of reduced alkaline hæmatin with great distinctness. But I should think sodium hyposulphite would be as good or preferable as a reducing agent to the ferrous salt. As to the value of the size of the corpuscles as an indication of the origin of blood, under favourable circumstances I have found it possible to affirm that the blood was *not* that of certain mammalia; and in one case to disprove the statement of a murderer that the stain on his trousers was caused by hen's blood (the corpuscles of which are elliptical). In Philadelphia I have seen the slides prepared by Dr. T. G. Wormley, and had no difficulty in distinguishing the corpuscles of human blood from those of the sheep, ox, &c., when they were viewed side by side. The description given by "F. R. M." of some of Dr. Copeman's observations I cannot quite follow, especially the mode of manipulation which enables him to distinguish human blood from that of all other mammals except that of the monkey. It seems to be based on the production of hæmin crystals—a method which is not novel, nor usually regarded as trustworthy. But there may be some improved method of operating which removes this objection, and I should like to know more of it.

"Brucine" (letter 30113, page 394) is not a "salt," and it is rather odd to find it so described by a correspondent who calls himself a "Consulting Chemist." I am afraid Mr. Mason is not in the habit of "consulting" works on chemical analysis, or he would have been aware that the red colouration with brucine has been given as a test for nitric acid for the past thirty years, and is mentioned by nearly every writer, from Fresenius downwards. It is now practically superseded by more delicate colour reactions.

"The Hardening and Tempering of Steel" (letter 30110, p. 392) is a subject in which I have long taken an active interest. As a practical chemist who has spent the greater part of his life in Sheffield, I thought I knew something of the subject; but I am disappointed to find myself unable to grasp the meaning of "I. Q."; unless he holds that the hardening is due to the carbon assuming the diamond form. Seeing that a somewhat similar effect is produced by cooling glass quickly, where the formation of diamonds is out of the question, it is evident that another explanation must be sought. Besides, bearing in mind the chemical inertness of the diamond, we should expect to find it left as a residue when the hardened steel was dissolved in an acid. It is highly probable—if it has not been actually proved—that carbon may crystallise in the adamantine form from its solution in certain metals; but, unfortunately, experience shows that from molten iron it is invariably deposited in the form of graphite.

"Rendering Crude Carbolic Acid Soluble" (query 68992, p. 400), is not easy. Carbolic acid can be dissolved in alkaline liquids, such as caustic soda; but the solution is less efficacious than the free acid. Much of the crude carbolic acid of commerce is largely adulterated with hydrocarbon oils of little direct value as antiseptics. These are insoluble in alkaline liquids alone, though they dissolve more or less in presence of carbolic acid or soap. Sheep dips are usually made with soft soap, caustic soda, rosin, or rosin-oil (or both), with more or less carbolic acid, creasote, and other fancy additions. When properly made, a clear brown liquid is obtained, which forms a milk-white emulsion when mixed with water. In making carbolic-soap, the carbolic acid should be added in the free state to the soap (after saponification) and not dissolved in the alkali.

Sheffield. **Alfred H. Allen.**

OCULIST'S FORMULA—DIOPTRES.

[30132.]—In my note on this subject (letter 30096) I see there is an error, for which, although obvious, I must apologise. In line 13, *one-twentieth* should of course be *one-fifth*. There should also have been the word *convex* before "lens of unknown strength," and, as stated in reply 68759, the flame or window should be distant enough to give parallel rays. **G. C. K.**

ELECTRO-PLATING.

[30133.]—In reply to "Thalassa" (letter 30114), it may interest him to know that the active ingredient in my new depolariser, which I find gives such a powerful and steady current, is precisely chlorate of potash.

I have also used and written about the use of permanganate of potash as a depolariser; but although it is extremely energetic, yet it labours under the disadvantage of clogging the zincs very much, if used in a single-fluid battery. It does very well along with chromic acid, in batteries of the double-fluid type. **S. Bottone.**

WHAT IS ALCOHOLIC EXHILARATION?

[30134.]—Dr. Allinson was describing to me at Littlehampton a few Sundays since, across Prof. André's hospitable dinner-table at Alpine House, with some gusto, his occasional "orange feasts," at which he consumes with relish and benefit a dozen oranges or so, and, as he remarked, with all the subsequent exhilaration which a bottle of wine would produce, and none of the disagreeable "after-claps" of headache and nausea. I remarked, "Then I suppose there is alcohol in oranges, doctor?" "No," said he, "but there is sugar." I thought that, as far as cause and effect went, that meant much the same thing, and I see I am supported by a writer on alcohol in the current issue of the *Tocsin*, a monthly magazine of general and medical philosophy, edited by Mr. F. A. Floyer, B.A., M.B. Camb., M.R.C.S., and with considerable ability, and published by H. Vickers. Says the writer:—

"Perhaps of all subjects which are tossed, torn, dissected, and raved about, that which is indicated above is the storniest in its controversial effect among those who know least about it. The efforts of some of these are quaintly summed up in the lines written by the author of 'Odd Echoes from Oxford,' whose name we forget and whose book we have lost, which run thus:—

'Now those who drink the smallest drop
Of liquor alcoholic,
Are doomed as sure as eggs is eggs
To tortures diabolic.'

A matter which is commonly overlooked in discussing the question of alcohol is that the presence of some of the group of substances known as alcohols is essential to life. Therefore, a total abstainer who prides himself upon his freedom from alcoholic beverage deceives himself in the same way that one who fasts thinks that he does without food. In the latter case, if food is withheld the body preys upon itself, and the ascetic who plumes himself upon his virtue is in reality a cannibal of low degree, in that he is an autophagist (self-eater). The requisition of the body for food and alcohol is absolutely bound up with existence. The demand is inexorable; sometimes credit is given, but if health is to be preserved, the debt must sooner or later be paid in full.

"A circumstance which has an important bearing on the supply of alcohols in the animal economy was pointed out by Draper in his book on physiology. He is an author not much read now; but we are inclined to think that he may be regarded as the last of the modern physiologists whose work bore any considerable relationship to the workings of the human body in health and disease. He points out that digestive or fermentative changes of milk, as well as of starchy or of saccharine substances, when carried on *at the temperature of the body*, result in the formation of alcohol, but not, at any rate as regards the former, at a temperature which presents much deviation from this. Nature has a reason for everything, and what we have referred to will account for the predilection of children for sweets and milk in order to conveniently supply the necessary quantity of alcohol. It might be rather a shock to the feelings of a mother to recognise that the gambols of her babe, due to high spirits and health, are literally due to alcoholic spirits. But it is a fact, nevertheless. As, therefore, some form of alcohol is a necessary ingredient of the body, it is of the greatest importance for every one to hold correct notions concerning its value.

"There can be no doubt that the ability to supply alcohol in a direct form is the greatest blessing which the wit of man and the bounty of nature has devised for the benefit and comfort of the human race. Unfortunately, the question of its administration, like all the important questions affecting mankind, is embraced by faddists who din their distorted views into the ears of a long-suffering public, with the result of exposing their ignorance of the subject. We cannot but hold to a conclusion which would certainly be admitted by the Galenic school of physiology—viz., that the man who hastens off after dinner to Exeter Hall, the House of Commons, or some such place, and passes an evening of excitement as a prelude to a restless night, uses up more alcohol—even though he touch not a drop—than the man who stays at home and consumes a bottle of port, or a portion thereof, as a precursor of a good night. Yet the former would probably call himself virtuous, and stigmatise the latter a sot. The abuse of alcohol will, we maintain, be found to go hand-in-hand with unnatural conditions of society, although, of course, other conditions may be productive thereof. The advocates of 'temperance' would do well to endeavour to rectify these, and also to abolish the adulteration of alcohol, as the best means of furthering their cause.

"Anybody can drink; most people can get drunk—many people do; but the art of using good wine as an adjunct to intellectual enjoyment and mental fruition is becoming lost." **Kappa.**

DISINFECTANTS.

[30135.]—Probably "An Eager Reader," answered in your issue of July 5, may have had the chloride of lead disinfectant in his mind when inquiring for one which could be produced at a cost of one penny a bucket, but whether Dr. Guthrie invented or first used it for the purpose, I cannot say. The cost of this compound is merely nominal. It is, however, a very powerful deodoriser, and perfectly inodorous, differing in this respect from many agents, regarding which we may be inclined to think the remedy is worse than the disease.

The preparation is made in the following manner: Take a tablespoonful of common salt, dissolve it in a bucket of water containing, say, two or three gallons; and in a jug dissolve, in boiling water, about as much nitrate of lead, cost about 3d. per oz., as will cover a sixpence (the exact weight prescribed I forget). Pour this into the salt solution, and throw down your foul-smelling drain, which will be at once deodorised. I may mention that permanganate of potash is an equally cheap and efficacious disinfectant and less trouble, as it is only necessary to dissolve a few grains in water and apply where required.

Leyton. **G. E. Cox.**

EDISON'S PYROMAGNETIC MOTOR.

[30136.]—In No. 1172, p. 25, you gave an account of Edison's pyromagnetic motor, a method of generating electricity direct from fuel. I notice that experimenters in England are alive to the importance of the subject, and are investigating the probabilities of success. I therefore send on a note which has been published here over the signature W. B. Cooper. That gentleman says: "Mr. Edison has claimed, in his United States patent for a pyromagnetic motor, a stationary coil designed to establish a polarity in the armature at a right angle to that produced by the field-magnet, and as I observe that he has retained this feature in his British patent, I am prompted to propound a query which long since presented itself to me—namely, whether, if the polarisation due to the coil operates in the manner claimed, the increase of efficiency due to it is not paid for in full at the dynamo. While I hesitated to believe that both Mr. Edison and the experts of the Patent Office could have adopted a theoretically inoperative device, yet I have been unable, after a careful study of the subject, to reach any other conclusion. If the power of the motor can be increased in this manner, then if an armature, rotating between the poles of a permanent magnet, is subjected to the influence of a stationary coil energised by a dynamo driven by the armature; or, even better, if another permanent magnet is used instead of the coil; then the armature should rotate perpetually, without the expenditure of energy.

"While admitting that the action of the coil upon the portions of the armature which are receding from the poles of the field-magnet is favourable, I maintain that it will have an adverse effect upon the portions which are approaching the poles. With all due deference to the parties interested, the authorities of the Patent Office have apparently inadvertently, and under the pressure of many duties, allowed a claim for a feature which is at variance with physical laws; and it should not be considered a reflection upon the Patent Office [illegible], but rather upon the legislators who fail to provide for increasing the force and accommodations of a department the conduct of which is a credit to the nation, and the records of which are destined to descend to posterity as a grand memorial of the scientific attainments of the present epoch."

I venture to think that these remarks by Mr. Cooper may be of interest to your electrical readers.

Phila., Pa. **E. T.**

THE EFFICACY OF LARGE APERTURES IN MICROSCOPY.

[30137.]—Let me point out a way in which Mr. Lewis Wright's experiment may be performed without silvering the front lens of an objective.

An inch objective with a Lieberkühn ought to resolve more than the same lens without a Lieberkühn with transmitted light, supposing the hypothesis to be correct. If the increase of aperture is only useful for illuminating the object by reflected light, and no rays pass through the increased portion to the eye, it is abundantly evident that the conditions are fulfilled by a Lieberkühn. The experiment can therefore be easily tried.

Edward M. Nelson.

THE EIFFEL TOWER.

[30138.]—The time has passed when any professional theories can hope to refute well-known and demonstrable facts. I am almost in daily intercourse with a gentleman who has visited the tower and ascended its platforms no less than five times. He admits that it is known all over Paris that the top of the tower can be seen for over 90 or 95 miles, and from the second stage only well-known objects can be seen at from 50 to 60 miles! So the pleaders for curvature must not venture to anticipate any confirmation of their theories from the Eiffel tower. This is nothing to be wondered at. There must be scores and hundreds of readers of the "E. M." who know that vessels can see each other at the water-level of the Mediterranean at 50 or [illegible] miles. Does "Lyons" venture to deny this? How absurd to talk of "mistakes," and to hope that such suggestions will stifle positive facts!

Croydon. **John Hampden.**

TINNING HARD STEEL OR CASE-HARDENED ARTICLES.

[30139.]—I replied to this question in the "E. M." many years ago, and do so again because there still appears to be some perplexity on the subject. In the first place, a bath of melted tin will not injure the temper or materially affect hardened steel surfaces, inasmuch as tin melts at 442°, and polished steel acquires straw colour at 460° Fahr. The iron or steel article must first be freed from scale (if any) either from the foundry or forge by means of a pickle of dilute sulphuric acid and the scratch-brush or sand. If the articles are of steel, and have been quenched or hardened in oil, every trace of this must be removed by immersion in a boiling soda lye; next, the surface must be made chemically clean—even the film of oxide due to a pale straw colour will prevent the adherence of the tin to the steel. Have a bath consisting of 1 part of hydrochloric acid to about [illegible] parts of water; hold the article with a pair of brazing tongs, and stir it for a few seconds in the bath; withdraw it, and while still wet immediately immerse it in a ladleful of melted tin, the surface of which should be kept from oxidation [illegible] of good clean tallow. In less than half a the article, when withdrawn, will be found completely tinned. Of course, precaution must be taken not to overheat the tin, but keep it down to the proper melting temperature. Over 30 years igo, when milling machines (which have now almost superseded the planing machine) were but little known, and had to be tenderly used for the want of the iow accompanying spacing emery rubber-grinder for sharpening the teeth or cutters, I had occasion o use the above process in order to get over this lifficulty. The cutter block was inclosed in a turned ind truly concentric ring, and the hard tinned utters set in place in duly-spaced notches in the ole plate, with their cutting edges in close contact vith the ring; melted tin was then poured in the innular space containing the cutters, combining hem as one piece with the block, which (when the noulding ring was drawn off) was then ready for ise. When the edges of the cutters required enewal they were melted out, sharpened individually, and cast in place again. This now would e considered an obsolete contrivance.

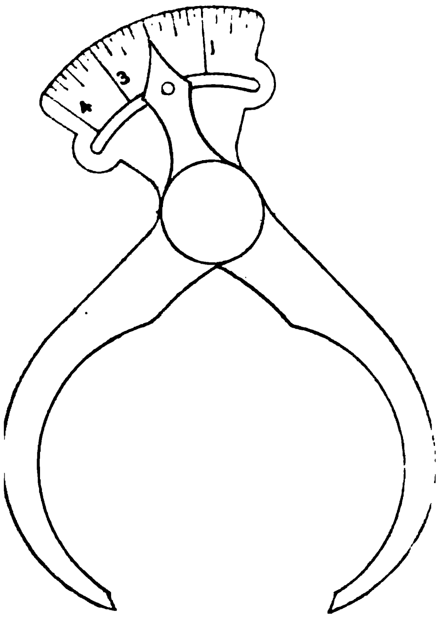
F. H. Wenham.

CALIPERS.

[30140.]—I AM afraid, for the patentee of the ndex calipers you described in a recent issue, that ie has been very much anticipated; the sketch inderneath being from calipers which have been in onstant use in these works for the last 17 years, nd which were presented to my father by my randfather more than 20 years ago. I am also nder the impression that many workmen in this istrict have had similar callipers for very many ears. The quadrant allows for a screw fastening.

Thos. Taylor, Jun.

Gladstone Engine and Machine Works, Gladstone-street, Leicester.



ROYAL INSTITUTE OF INVENTORS.

[30141.]—I HAVE recently felt the extreme necesty of a society which I will call the "Royal nstitute of Inventors."

It is notorious that in a great number of cases n inventor, after years of labour and thought, ucceeds thoroughly so far as the perfection of his nvention is concerned, and still reaps but a small roportion of the pecuniary benefit arising therefrom, sometimes even having to bear heavy losses, vithout, perhaps, the poor solace of the honour ttaching to his invention.

Again, a man may work laboriously in the direcion of an invention which is in itself impossible or iseless.

Again, for lack of aid, an invention of real value nay be pirated uselessly, or be hopelessly lost.

A co-operative combination of inventors would e an inestimable boon to hundreds of skilled nechanics, the benefits of whose genius are now bsorbed by the shrewder master capitalist.

Inventors as a class work hopefully and ardently vith a keen affection for their work, having generally but a poor idea how to watch their own nterests—perhaps even a species of contempt for he profit and loss question in invention.

I am fully aware of the difficulties attending the ormation of a cohesive society from the scattered ind varied members of the unnumbered fraternity of inventors; but I am sure that such difficulties are not insurmountable.

A free expression of opinion in "Ours," a consultation by a few, with, perhaps, your good help—let the "practicability," "necessity," "utility," be estimated by a handful of thoughtful men. This would be a beginning.

The beginning might be but small, and it may take years to prove it; but I firmly believe that the most useful society of modern times would be the

R.I.I.

[We do not think any such society in the least likely to succeed, but we give space to the above letter.—ED.]

REPLIES TO QUERIES.

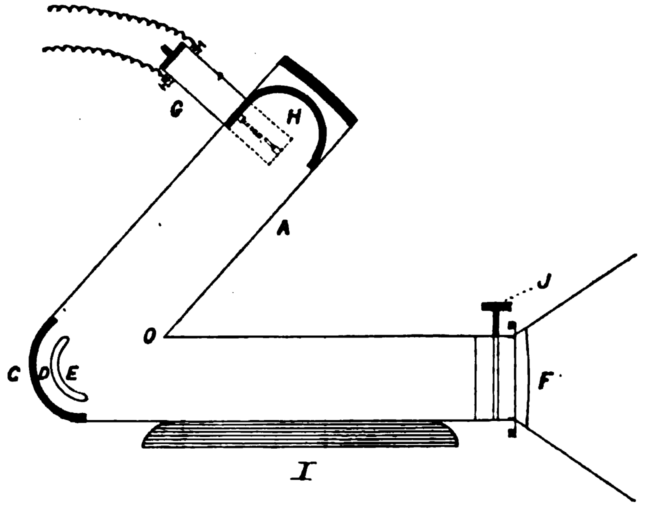
**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[68531.]—**Brighton Railway Engines.**—Since answering the above, I find 359, Hayling Island, has not been scrapped, but has had her number altered. I must try and explain "W. E. C. B.'s" mystification about 484, Solent and Glynde. Originally Solent was 266 and Glynde 194. Then, in May, 1882, 266 Charlwood was built, and Solent altered to 484. Then, in July, 1888, 194 Bickersteth was built, and Glynde altered to 484, and as I have not seen anything of Solent for some years I presume she must have been scrapped previous to the alteration of Glynde. This, I believe, to be the correct statement of the case.

C. F. DENDY MARSHALL.

[68339.]—**The Megascope.**—The megascope that I have constructed for myself, after a good deal of pains, trouble, and expense, consists as the following sketch:—A and B joined at the angle θ, of which D is a silvered reflector, E is the slit in the side for the insertion of articles or photos (mine is made for carte de visite), C is a brass back-piece that by a suitable arrangement joins the two brass tubes together at a proper angle, F is the lens (mine are taken from an ordinary 5ft. dissolving-view apparatus), G is the source of light (which in my case is a small arc lamp); upon this light depends whether or not you get a good effect, as in all cases it must be extremely powerful. H is another silvered reflector, I is a base to hold and support the arrangement (in my case it is of lead), J is the screw of the lens. With brass tubes A and B of 15in. by 6in. diam. I am able to obtain a 4ft. picture, and I was not able to obtain this till I used the arc lamp. I warn E. C. Owen that unless he is prepared to adhere strictly to that old proverb, "If at first you don't succeed, try, try, try again," he will never succeed; it was only after a vast deal of time, labour, and expense that I succeeded. Any further information E. C. Owen may require, shall be pleased to give.

F. W. MASON.



[68750.]—**Pearl Brooches.**—Surely the perforations in so-called mother-o'-pearl can be done with drills and rose bits. If very large, a fret-saw might be brought into requisition.

T. P.

[68751.]—**Spiral Spring.**—The rules generally adopted for calculating spiral springs can be found in the textbooks, and in back volumes; but not for tons of dead weight, I think. Fifteen to twenty tons is no joke, and I am afraid the querist will have to make his own calculations.

S.

[68725.]—**Sound.**—This question was given at the recent May examination. The velocity of a lateral pulse in a string is given by the expression—

$$v = \sqrt{\frac{t}{m}}.$$

Where v = velocity of propagation, t = tension of the string in dynamical units, m = mass of unit length of the string. Again, as one vibration of the string is made in the time taken to travel over twice the length of the string, we have, if l is length of string and n the number of vibrations made per second—

$$n = \frac{1}{2l}\sqrt{\frac{t}{m}}$$

from which, if we take as units the foot-pound and second, we have $l = 2$, $t = 81 \times 32$, $m = \frac{1}{84}$.

Hence $n = \frac{1}{2 \times 2}\sqrt{\frac{81 \times 32}{\frac{1}{84}}} = 72 \times \sqrt{2} = 101{\cdot}8$ approximately.

C. J. WOODWARD.

[68756.]—**Gas-engine.**—I have been waiting to see whether anyone could by any possibility answer this query. Briefly, I would advise "One in a Fix" to copy a gas-engine that will work, instead of attempting to invent something, and then expecting others to help him out of difficulties. Let him alter his engine to a pattern that has been tested in actual work.

J. M. T.

[68762.]—**Ivory Comb.**—"X. Y. Z." will find nothing better than isinglass dissolved in acetic acid, which is melted by standing the containing vessel in hot water.

T. L. P.

[68767.]—**Walking Sticks.**—Straighten the sticks by steaming them and fastening until dry; then rub in a mixture of clean grease and plaster of paris, coloured if necessary; then coat with best copal varnish or French polish. It is not quite clear what the querist means.

X.

[68759.]—**Oculist's Formula.**—Spectacles being numbered on two different systems, it sometimes proves confusing when one's stock is numbered on one system and the glasses are ordered on the other. Oculists generally order in dioptres, but as a rule the lenses are numbered in Paris inches. According to the inch scale the refractive unit is a strong lens of 1in. focus, and all other lenses are weaker than the unit. The dioptre scale takes for its unit a weak lens of 1 mètre (39·37079in.) focal length, and is called one dioptre (written 1 D). Stronger lenses are written as whole numbers; thus, a lens having a focus of 1 mètre is called 1 D, another having a focus of ½ mètre is 2 D, and you will see from this that the higher the number on the inch scale the weaker the lens; but on the dioptric system, the higher the number the stronger the lens. The question was asked what + ·5 meant. You will now see that it is a lens having a focus of 72 Paris inches, or 2 mètres long. If it is desired to convert a metrical lens into Paris inches, divide its value in dioptres by 36, thus:—

$$+ 3{\cdot}5\ \text{D} = \frac{3\frac{1}{2}}{36} = \frac{1}{10} \text{ nearly, send } + 10 \text{ lens.}$$

To convert inches to the dioptric scale, multiply its inch value by 36 thus: 14in. $= \frac{1}{14} \times 36 = 2{\cdot}5$ D. To find focus of glasses from which number has been removed, take a strip of black paper (such as needles are folded in), and cut out a hole the size of a threepenny piece; stick this upon the lens to be tested, and fix it in a hole in a piece of wood, which should stand upright and form a screen to a candle placed behind. If you now place a piece of white paper opposite the lens, you will find a point where you get an image of the candle represented upside down; and by moving first the candle from the lens, and then the paper screen from the lens, a point will be reached when the image will be of the same size as the flame of the candle; of course the image must be quite sharp. Now take a piece of paper 39in. long, and mark it off into 36 equal parts, each space will represent 1 Paris inch, and by measuring the distance between the lens and the paper screen, you will know the focus of your glass in Paris inches. These operations should be conducted in a dark room, the only light being the candle mentioned. To save trouble in calculating, I give a few of the most important numbers:—

Paris Inches.	Dioptres.
4	9·
5½	7·
6	6·
7	5·
8	4·5
9	4·
10	3·5
12	3·
14	2·5
18	2·
26	1·5
30	1·25
36	1·
40	·9
50	·75
72	·5

If these few remarks prove of use to "L. C." and others, I shall feel amply repaid for the little trouble I have taken to render them explicit. Derfla.

[68773.]—**Purification of Zinc.**—Does not "O'M." know that there is no cheap method of purifying zinc? C. T. L.

[68779.]—**Facile Bicycle.**—Surely the querist could easily find out by experiment which size bicycle suits him best. At any rate, the makers will tell him if he sends the length of his leg.

Q. P.

[68780.]—**Easter Day.**—This subject has been discussed in the "E. M." in 1882, Nos. 933, 935, 943, 946, by the late Rev. Jas. Pearson and myself, under the head "Perpetual Almanack." The late rev. gentleman had a method which he considered as simple and correct, but it was neither. In No. 1264, p. 333, June 14th, M. Marienberg mentions Dr. Gauss's (of Göttingen) *simple rule*, which, to me, seems very complicated as compared with the method I advocate, which is found in the "Calendrier perpétuel de tous les temps, passés et futurs," published in 1868. This is as follows:—Page 20 shows that 1827 began on a Monday. Page 8 shows that the 1st of March was a Thursday. To the millésime 1827 add 1, and divide 1828 by 19, the rest is 4, which is the golden number. The lunar cycle, page 22, shows that on the 1st of March, 1827, the moon was four days old, and that therefore the first Sunday after the full moon following the 22nd of March was April 15th. So, to look at three pages and make a division is all the trouble. But this method extends to many other things of great interest. For instance, Newton died on a Thursday in March, 1727. In England it was the 9th, whereas in France it was the 20th. Almost every Englishman knows the year and day of the month the Queen was born; but I daresay only few know the day of the week, and what was then the age of the moon. A will is dated Friday, January 24th, 1807. Can it be invalidated? Yes, because the 24th was on Saturday—therefore the date is false. A public Act is dated Monday, 16th January, 184 ., the last figure is wanting; which was the year? A monument bears an inscription dated Friday, January 24th, 1 . 45, the second figure is off; which was the century? What day of the week will be the 1st of January, 2099? A total eclipse of the moon occurred in March, 1848; what was the day? What day in the week was the 1st January, 1868, in France and Russia? Which will be the new-moon days in 1892? All this is found in no time.

Ch. Rabache.

[68783.] — **Harmonium.**—Scales for making harmonium pans have been given in back numbers; but as the querist seems to have been promised some information, and applies to an individual by name, I will merely point out that all the information needed has been given many times before.

Organon.

[68785.]—**The Nail-less Horseshoe.**—If this horse-shoe was "recently discussed at the Society of Arts," particulars will no doubt be found in the *Journal* of the Society. T. M.

[68788.]—**Water Beds.**—Perhaps if "W. H. S." would say what his water beds are made of, he might get some useful information. If they are made of rubber cloth, they are perhaps best kept under water.

R.

[68813.]—**Dog-cart Brake.**—To use a brake on a two-wheeled vehicle, and not throw weight on the horse's back is mechanically impossible. The weight thrown is, however, small, and much less likely to throw the horse down than the pressure and discomfort of the vehicle on his hind quarters. On the Continent, where enormous loads are carried on two wheels, a brake is invariably used—the cart would not be safe without it. C. M.

[68813.]—**Dog-Cart Brake.**—In answer to your inquiry, "Diarmed," for a brake on two-wheeled trap, which will not throw weight on the horse, I fancy that weight must be sustained by a stud on each shaft, having a wheel on the bottom of it, and by a spring caused to incline backwards and off the ground, until pulled into position by a small wire rope attached to the handle of the brake. The sort of brake I should recommend is one having a slide to drag on the ground near each wheel, moved by a bent lever hinged to the axle, and then coming up to the right side of the driver as in a waggonette. The small wire rope to be fixed to the strut just above the wheel and through a hole in the shaft, well forward, to keep the strut upright when the brake is put in action.

Phillip Vallance.

[68796.]—**Mensuration.**—There having been as yet no satisfactory answer to this simple mensuration problem, permit me to remind the querist that parallelograms upon the same base and between the same parallels are equal to one another, or shall we say "parallelograms having the same vertical height are to each other as their bases"? R. N.

[68796.]—**Mensuration Problem.**—This can easily be solved by common algebra. Take a and b for AB and BC, and w for the width of road. (See "W. E. H.'s" figure on p. 374.) The right-angled triangles AEF and CDF are similar; hence

$$CF = \frac{ax}{w} \text{ where } x = AF. \quad \text{By Euc. II. 12.}$$

$$AC^2 = AF^2 + CF^2 + 2 AF\,FD.$$

$$\therefore \quad a^2 + b^2 = x^2 + \frac{a^2 x^2}{w^2} + 2x(b - x)$$

$$x^2\left(\frac{a^2}{w^2} - 1\right) + 2bx = a^2 + b^2.$$

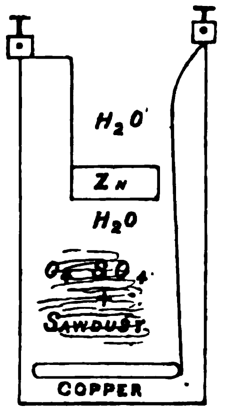
From this quadratic, x must be found. In the case before us, if we make w = 10ft., we find—

$$x = \frac{\pm 100\sqrt{15} - 20.}{33}$$

The area of road is ax, or $\frac{2{,}000}{33}(5\sqrt{15} - 1)$ which is about 1,113sq.ft.

Portsmouth. A. M.

[68819.]—**Magnet.**—Use bobbins made of ebonite: these are, in my estimation, much the best; but if these are unattainable, use any well-dried wood, well soaked in paraffin wax. Use round cores, which should be of soft iron. Size of bobbins should be 3in. long, by ⅜in. diam. inside, and 1¼in. or 1½in. diam. when wound with wire. If you want the instrument in continuous work for one hour, I think you had better use a modified Daniell, as the Leclanché might get polarised if used continuously for that time. A good cell of the modified Daniell type, and I should think one that would meet your purpose, is the Minotti, used in the G.P.O. It consists of, as the following sketch:



an external cell of earthenware or glass contains a copper plate lying at the hottom of the cell; on this, and above it, is a thickness of sawdust, saturated with a strong solution of copper sulphate, to which a little H_2SO_4 has been added; the cell above this is filled with water, and a well amalgamated zinc plate hung in it; this consists of a very good arrangement for such work as "Locomotive" requires. The strength of a Leclanché compared with a Daniell is—

Leclanché.	Daniell.
$\frac{1·6}{1·12} = 1·42$ amp.	$\frac{1·079}{2·5} = ·43$ amp.

Any further information "Locomotive" may rerequre, shall be pleased to give.

F. W. Mason.

[68836.] — **Boot-Making.** — Have shifted my quarters, and been very unsettled, hence you not being answered by me: but I see one E. Barroll has answered. He speaks feelingly, I guess, or, as some folks have it, is in the habit of measuring others' corn by his own bushel. I have had letters from parties who could not get suited at shops, or fitted bespoke, who in less than a month have made shoes to fit themselves, and wearing them with satisfaction, thanking me for the information given. I will see to you next week. In the mean time, I should like to know what boots—i.e., spring-side, Bluchers, half-Wellingtons, Clarence, or Wellingtons. Jack of All Trades.

[68853.]—**Neatsfoot Oil.**—I have never been able to get neatsfoot oil in the market. The abomination sold as such is nothing like it. When I get it from the neat's foot I get it as limpid as water.

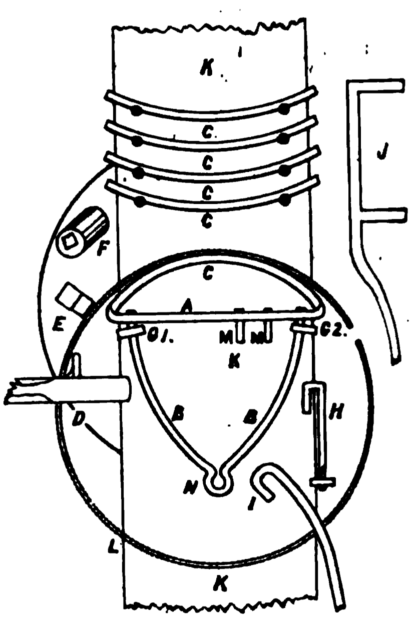
Jack of All Trades.

[68881.]—**Link Motion.**—I think "C. L. R." has made a slight mistake, which, although small, is of great importance—viz., the valve is shown as only closing one part with lever in mid-gear, thereby admitting steam to cylinder with lever in that position (which should not be). But, in my humble opinion, all steam-engines should be rotary ones of a type suitable for each class of work.

Locomotive.

[68884.]—**Enamel.**—There have been several recipes for enamels given in former numbers that will last as long as the metal itself. There is no work published on enamelling. The best work on enamelling is to "work" a few years at an enamelling works, and so learn the trade thoroughly. Books would be no good. Potter.

[68902.]—**Tire Bending.**—In smiths', wheelwrights', coachmakers', and tiresmiths' shops the apparatus for bending the tires was anything but scientific; take them generally, they were all a bungle. In 1845 I took a job at a coach-wheelwright's in Great Queen-street, Holborn, and it was very poorly provided for bending the tires. I made certain improvements in the existing one, and made a new one for the smaller work that would bend from 15in. up to 5ft., and do the work beautifully, and both quick and easy; the width of iron ranging from 1in. by ¼in. up to 2in. by ½in. It was made out of 1½in. by ⅝in. iron, and as per sketch:—A is 9in. long between corkings; this is riveted on to BB—the corkings lean out, which prevents the dust from getting in the ends of the bent pieces; CCCCC are pieces curved, ranging from 1ft. to 3ft. 6in. curves, each piece going between the corkings; D is a side view of a horn which goes through the post K; E, an end view of same; F, a socket—goes easy on the horn and varies in thickness; G¹, G² are bolts made like H; I, twisting wrench; J, one of some scroll wrenches—two or three are handy; L, dotted line, shows the tire when finished; MM are studs riveted in A to keep wrench from slipping; N, hole for ½in. bolt. A block was put on side of post K to fix D at E, and the extra curve pieces were laid on nails driven in the post. I used to bend the front tires half-way first, and then turn ends; but the others were continued bending the whole length. The bolt G² will be better an inch lower than shown in sketch, as it will be more convenient when using the wrench to finish bending the end.



Woodgreen. G. B.

[68915.]—**Auxiliary Screw.**—I am obliged to F. Baker and W. Hosken for their replies. Referring to W. H.'s sketch, if the handle were placed where the screw is, and vice versâ, as far as the mechanism is concerned, my arrangement is the same, with the exception that I have made the now screw-shaft flexible, and thereby got the screw into its right place. I have caused more friction by so doing, but have compensated for it by the greater convenience gained. 1. The geared wheels are not under water, and therefore offer less resistance to the speed of the boat. 2. The difficulty of turning a handle on top of the rudder would be great, and it would be wkward. If the boat had a mizzen mast (many f the class have), there would be no room for the andle to turn. The united efforts of two can be rought to bear on the handle, if placed as in my ketch. With regard to the spiral not being strong nough, how is it that, from a dentist's tool to large ize drills, spirals are used? All my mechanism elow water can be inclosed between two boards. hope W. H. will favour me further.

Tredagh.

[68943.] — **Staining Terracotta.**—Have you ried three of red ochre and one of red lead?

Jack of All Trades.

[68943.] — **Staining Terracotta.** — "Dum piro" had better explain what he wants a little ore fully. Are the articles he wishes to enamel aw clay, or have they been burnt? If clay, and toving is only meant, lampblack, or any dry black olour, will do, being used strong enough to give he desired tint. But if the articles are to be burnt lack, mix 10lb. of chromate of iron and 15lb. oxide f manganese with each 100lb. of clay; mix the hole thoroughly in water, pass through a fine ieve, and evaporate the surplus water. If neither f these suit, say more fully what is wanted.

Potter.

[68949.] —**Wood Pulp.** — This you will find ather an expensive job, owing to the resin in the aterial. Try some of it boiled in caustic soda.

Jack of All Trades.

[68952.]—**Tinning Case-Hardened Articles.** -If case-hardened properly, nothing short of a right red heat will soften it. Dip the articles in ome sulphuric acid, and wash in clean water. cour them with fine sand, bath-brick, or fine sandtone grit, and wash clean; now take a piece of ane and wet one end in hot water, and hammer to ake a brush; make the other end hot, and seal up ith beeswax. Use this to brush your work over ith killed spirits of salts with zinc, to which a ery small portion of salammoniac is added, and ip your articles into a bath of tin, or two parts tin nd one of lead, the top of which is covered with bout ⅛in. clean tallow. Do not get too hot, when our tallow begins to smoke, it is getting too hot. his is best done over gas—two or three Bunsen urners.

Jack of All Trades.

[68953.] — **Differential Equations.** — This roblem is certainly one of the most interesting I ave ever come across, and I intend examining it ore fully. Perhaps, with the kind permission of e Editor, we may have others of the same sort om "M.I.C.E." If $a\,c$ (Fig. 1) is the velocity of he boat, part of this velocity, $a\,b$, is destroyed by he tide, and the actual rate, $b\,c$, of the boat in rossing the river is $a\,c\cos.\theta$ miles per hour, and ince $\sin.\ \theta = x\frac{\sqrt{2}}{D}$, the actual rate of the boat is $= b\sqrt{1-\frac{2x^2}{D^2}}$. Now, the distance passed ver in any time t by a constantly accelerated body $= \int r\,d\,t$, where r is the rate ∴ the distance run y the boat in any time $t = \int b\sqrt{1-\frac{2x^2}{D^2}}\,d\,t$ hich $= x$ ∴ $d\,x = b\,d\,t\sqrt{1-\frac{2\,x^2}{D^2}}$ $\frac{d\,x}{\sqrt{1-\frac{2x^2}{D^2}}} = b\,d\,t$, the integral of which is $\frac{D}{\sqrt{2}}\sin.^{-1}x\frac{\sqrt{2}}{D} = b\,t + C$. t vanishes at the ame time as x, and ∴ $C = 0$. The equation conecting the distance with the time is ∴ $\frac{D}{\sqrt{2}}\sin.^{-1}\frac{\sqrt{2}}{D} = b\,t$. Put $x = \frac{D}{2}$, when we have $\frac{D}{\sqrt{2}}\cdot\frac{\pi}{4} = b\,t$, where t is the time required to reach the iddle of the river $= \frac{T}{2}$. Making the substituion $T = \frac{D\sqrt{2}}{b}\cdot\frac{\pi}{4}$, which is identical with that lready found by "M.I.C.E." In the second case, he water not being in motion, let the boat move the curve B B′ B″ (Fig. 2), the co-ordinates of any point of which are $A\,D = y$, $D\,B' = x$. The parts B E, E B″ being equal but opposite, we need only discuss the first half. The angle $D\,B'\,C = \theta$, and ∴ the angle $D\,C\,B' = \frac{\pi}{2} - \theta$. But the tan. $\left(\frac{\pi}{2}-\theta\right) = \cot.\ \theta = \sqrt{\frac{1}{\sin.^2\theta} - 1} =$ (since $\sin.\ \theta = x\frac{\sqrt{2}}{D}$), $\sqrt{\frac{D^2}{2x^2} - 1}$, and $\frac{d\,x}{d\,y} = \tan.\left(\frac{\pi}{2}-\theta\right)$ ∴ $\frac{d\,x}{d\,y} = \sqrt{\frac{D^2}{2x^2}-1}$, $\frac{x\,d\,x}{\sqrt{\frac{D^2}{2}-x^2}} = d\,y$, the integral of which is $\sqrt{\frac{D^2}{2}-x^2} = y + c$, and ∴ $\frac{D^2}{2} = x^2 + (y+c)^2$, which is the equation of a circle whose centre is on one bank C A of the river, and whose radius is $\frac{D}{\sqrt{2}}$. The constant c determines the position of the origin, A of the co-ordinates with respect to the centre of the circle. The sine of θ at the middle being $\frac{1}{\sqrt{2}}$ shows that the arc B E is $\frac{\pi}{4}$, and ∴ the first half of the course of the boat is a half-quadrant, the second half, E B″, being the same as the first, but in an opposite direction.

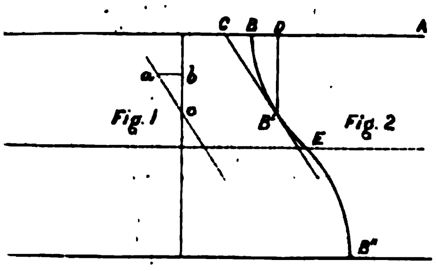


Fig. 1 Fig. 2

Camberwell. A. H. G.

[68953.]—**Differential Equations.**—Thanks to "J. R. C." and "A. M." for their replies, both very neat, and the printing equal to that of the University Press. I ought, strictly speaking, to have given the speed of the current to vary directly as the time instead of the distance from the shore, as I had no means of measuring distances, whereas I could always note the time that had elapsed from the start. The printing, however, would have been more difficult in this case. I will give my results:

$$D = \frac{b\,T}{2\sqrt{2}}\left(1 + \frac{\pi}{2}\right)$$

and the equation to the curve is—

$$x = \sqrt{p\,y - y^2} + p\sin.^{-1}\sqrt{\frac{y}{p}}.\ \text{where } p = \frac{b\,T}{2\sqrt{2}}$$

which is the equation to the cycloid, the origin being at the apex. The last term of this equation is usually written $\frac{p}{2}\cos.^{-1}\frac{p-2y}{p}$; but both have the same dif. coef., so one may be put for the other. But the most curious result I ever obtained from the calculus I will give here, as a curiosity. Calling the sine of the angle in the middle c, so as to be more general, sin. θ is supposed to vary according to the ordinates of a parabola (a very likely case to occur), being $= o$ at the start and c in the middle; then $\sin.\ \theta = \sqrt{\frac{2c^2}{T}}\,.\,t$. I find that the curve made by the boat through the water (supposed not moving) is $y^{\frac{2}{3}} + x^{\frac{2}{3}} = p^{\frac{2}{3}}$, where p is a constant, and $= \frac{b\,T}{3\,c^2}$. In this equation the origin has been changed to a point measured along the straight line from shore to shore, the distance being p, as above, and x is measured backwards from the origin. The above is the equation to the hypocycloid (see Tod. "Dif. Cal." p. 389). The course made by the boat will be two portions of this curve, as in the case of the circle. Thus there appears to be a relationship between the cycloid family and the conic sections.

Bath. M.I.C.E.

[68958.]—**Pumps.**—I made a stupid mistake in my reply last week, and put 1005·3 cubic *feet* instead of cubic *inches*. Please correct. Sm.

[68963.]—**Filter for Waste Oil.**—Make a tube of zinc, put a perforated diaphragm one-third of its length from the bottom, on the top of this put a layer of cotton wadding, on this 2in. of fine charcoal and another covering of cotton, and a perforated plate on the top. Now fill up with oil, and stand your tube in a receiver. But just under the bottom diaphragm make a hole to let the air out.

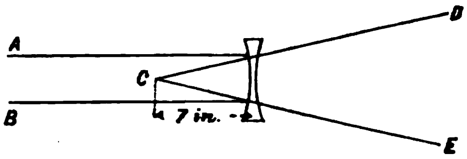
Jack of All Trades.

[68970.] — **Springs.** — Use some hard rolled phosphor bronze. Jack of All Trades.

[68979.]—**Cement.**—In a quart of boiling-water dissolve a good teaspoonful of ground alum. Now get some pine-sawdust and boil in this; take out and dry in the oven. When dry, put into an old iron saucepan, ladle, or frying-pan, and fire until all is charred. Mix equal parts of this with good, fine plaster of paris dry; now take some sugar-paper and boil, and whip up to a pulp thin, and when hot add about half-glue to the quart. When cold, mix your compo with the latter and mould to your liking. This will stand heating up to between 300° and 400°. If mixed with pipeclay-slip instead of plaster, you may subject to a white heat.

Jack of All Trades.

[68968.]—**Optics.**—The following should suit "Sol":—Let A B be a parallel beam of light falling on concave lens of, say, 7in. focus. The rays in passing through the lens will diverge as shown; the angle of divergence being such, that if continued backwards, it would converge at C, 7in. from the lens. On the other hand, it will be seen that D C E would be rendered parallel in passing through the lens. Therefore, lens 21in. focus (21in. to avoid fractions, "Sol" can work out 22in. for himself), 3in. diameter, ray required, 1in. diameter—3 : 21 : : 1 : 7. That is, 7in. from apex or 14in. from lens, the ray will be 1in. in diameter. As per example, the rays will converge at 7in. from this point; and, therefore, a 7in. concave lens 14in. from convex lens will give parallel beam. Bon-Accord.



[68989.]—**Cooling Apparatus for Room.**—A rotary fan to blow in cool air would, perhaps, answer your purpose. Sm.

[68991.] — **Tempering.**—If "W. F." has "already tried several years," I am afraid that his want of success is not the fault of the recipes. There are plenty of those in back volumes, some of them rather fanciful; but let "W. F." try again with this. To temper mill-bills, or any edge tool required to chip stone, iron, &c., heat to a blood-red (in the dark), and hammer until nearly cold; then heat again to a bright red (in the dark) and quench at once in water. Reheat by drawing over the fire, and when so hot that a drop of water flashes off, put aside to cool. The great thing in hardening and tempering is not to get the steel too hot; hence it should be red (in the dark). Nun. Dor.

[68992.]—**Carbolic Acid.**—If you dissolve it in glycerine, you can afterwards dilute with water to a considerable extent. Sm.

[68994.]—**Magneto-Bell.**—In the next three articles on "Electric-Bell Construction" the construction of a magneto-generator and bell will be described. If, however, "Talibu-l'-ilm" requires immediate information on the magneto-bell and generator, he will no doubt find all he wants in my book, "Practical Electric-Bell Fitting," published by Messrs. E. and F. N. Spon, 125, Strand, in which there is a chapter on the magneto-bell.

F. C. Allsop.

[68995.].—**Electro-Motor for Small Boat.**—Field magnets and Pacinotti ring armature of the type described and figured in my articles, § 26 to 34. Diameter of F.M. core, 3in., height 7in.; diameter of armature, 6in.; depth, 4in.; wire on armature, 4lb. or 5lb. No. 16; wire on fields, 20lb. No. 10, connected up in series. This will require 24 storage cells of the T type to work it properly. A similar machine, but with field magnet wound with 20lb. No. 22, connected in shunt, would do for charging the accumulators. You cannot depend on the accumulators retaining full charge for over a day or two. The entire weight of the dynamo would be about 100lb., of the accumulators about 768lb.

S. Bottone.

[68996.]—**Battery for 5-candle Light.**—You can't do better than use the Leclanché cell, either the biggest size agglomerate block or some special form of the cell, such as the "Victoria," which are specially designed for this purpose. See answers in back numbers to similar queries.

F. C. Allsop.

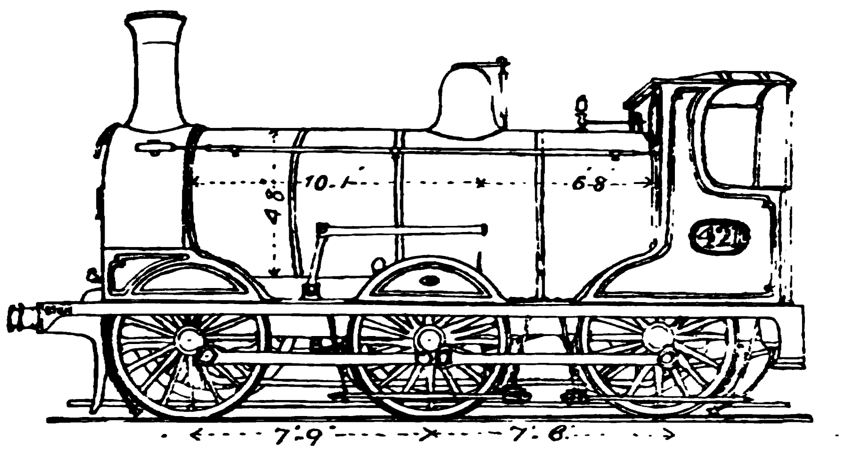
[68996.]—**Battery for 5-candle Light.**—As you only require your lamp to be lighted for a few minutes at intervals, you could use the Leclanché cell, and would require 6 volts E.M.F. This would necessitate the use of 6 cells; use the No. 1, they are much to be preferred to Nos. 2 and 3.

F. W. Mason.

[68996.]—**Battery for 5c.p. Light.**—For such short intervals as you mention, nothing is better than a battery of four cells of the low-resistance Leclanché type, connected in series. These will run a 6-volt lamp well, provided the light be not required for more than a minute at a time. I have made and sold many such, and they have always given satisfaction. S. Bottone.

[68996.]—**Battery for 5-candle Light.**—The best battery for a 5c.p. lamp, which is only required for a minute at a time, is the Leclanché. You would require six large-size Leclanché cells for a 6 volt. 5c.p. lamp, but why do you want a 5c.p. lamp to see the time by? I should think a 4-volt. 3c.p. lamp would be quite sufficient; for this you would require four cells. The batteries would last about a year.

Meran. A. R. B.



[68988.]—**Brighton Railway Goods Engines.**—The total length, including tender, is 49ft. 8in. The diameter of wheels, 5ft.; of cylinders, 18¼in., with a stroke of 26in. Nos. 401 to 432.

C. F. Dendy Marshall.

[69000.]—**Secondary Batteries.**—Begin by trying your hand at making a two-celled one first. Each cell of a well-made accumulator will give about two volts; hence 50 volts will require 25 cells. Each square foot of positive surface of lead will give six ampère-hours. Of course, if the 25 cells are coupled in series, as they must be to give the 50 volts, the foot of positive plates in each cell will still only give six ampère-hours. Of course, the actual number of ampères you can draw off in a given time depends entirely on the resistance you put in circuit. To get a current of eight ampères, your external resistance must not exceed six ohms. From plates 1ft. square, with 25 cells and a current of eight ampères, you would get about three-quarters of an hour's run. I have experienced no difficulty in making accumulators. My mode of procedure is to take ordinary sheet-lead, about $\frac{1}{16}$in. thick, score it all over with crossed diagonal lines, cover it with a paste made of a mixture of oil of vitriol and red-lead, made to the consistency of mortar. This is spread over pretty thickly with a wooden spatula. The plates are then allowed to dry. They can then be put in their places in the cells. Remember, the charging current must have an E.M.F. of at least 2·5 volts per cell to be charged. You will find a chapter dedicated to accumulator-making in my "Electrical Instruments for Amateurs."

S. Bottone.

[69001.]—**Problem.**—In order to weigh any number of pounds, from 1 to 40 inclusive, with four weights, the weights must be 1, 3, 9, 27. The analysis of this problem is best shown by taking the general case—that is, where there are n weights wherewith to weigh every value of w, from $w = 1$ to $w = N$, no two combinations of the weights being of equal numerical value. Denote the scale-pans by A and B, w being placed in the latter. Let a, b, c, d be the weights, of which a is the smallest, the others being written in order of magnitude. Then, weights in A being reckoned positive, those (if any) in B must be reckoned negative. Now $a = 1$, evidently, and in order that no combination of a and b shall also make $w = 1$, we must have the numerically least arrangement of a and b equal to 2. Therefore, $b - 1 = 2$, which gives us $b = 3$. With these two weights we can weigh the consecutive values 1, 2, 3, 4 of w, and no others. To weigh $w = 5$ we require c, and to render but one arrangement for weighing 5 (and any number below 5) possible the least of the combinations of a, b, and c must equal 5. Hence $c - 4 = 5$, which gives us $c = 9$. With the weights 1, 3, 9, used singly and in combinations, it will be found that we can weigh all numbers, from 1 to 13. Again, reasoning as before, $d - 13 = 14$, so that $d = 27$. Now, so far as we have gone, the numbers of the weights follow the law of a geometrical series, the common ratio being 3. In the case of four weights, therefore, $N = \frac{3^4 - 1}{2} = 40$. Let us assume that the same law holds good for n weights. Then the greatest of the weights will be expressed by 3^{n-1}, and we shall have $N = \frac{3^n - 1}{2}$. To weigh $N + 1$, and higher values of w, we shall require a new weight, p, such that—

$$p - \frac{3^n - 1}{2} = \frac{3^n - 1}{2} + 1.$$

$$\therefore p = 3^n.$$

It follows, therefore, that if the rule be true for one value of n, it is true for $n + 1$. But it has been shown to be true for $n = 2$ and $n = 3$. Hence it is true for all values of n, and the weights in all cases are represented by $1, 3, 3^2, 3^3 \ldots\ldots\ldots 3^{n-1}$, their sum—that is, the greatest number they will weigh—being $\frac{3^n - 1}{2}$. With fourteen of these weights, any number, from 1 to 2,391,484, might be weighed.

Charing, Kent. J. R. C.

[69001.]—**Problem.**—The weights are 1lb., 3lb., 9lb., and 27lb., forming a geometric series, the ratio being 3. "X." will find a treatment of this problem in Todhunter's "Algebra," third edition, art. 442, page 242. It is evident that the weights must be allowed to be used in either scale.

Calculus.

[69004.]—**Fluorine.**—If you leave the porcelain crucible with the wheat ash and H_2SO_4 and waxed glass plate, in a warm place, and for about sixteen hours, if any fluorine is present you will be able to detect it by usual signs.

F. W. Mason.

[69004.]—**Fluorine.**—Small quantities may be detected by blowpipe reaction. Insert a slip of platinum foil in end of open glass tube, and on it fuse a mixture of the fluoride with microcosmic salt. HF is evolved, which dims the interior of the tube, and turns yellow Brazil-wood paper.

Sm.

[69007.]—**Faulty Medical Coil.**—Primary excessive; two layers would have been ample. Have you looked well to your connections at the secondary terminals? Use another cell, and note effect, and also wire should be s.c. Any further information I shall be pleased to give. Read my article on Coils in No. 1245, and then note where your coil differs.

F. W. Mason.

[69007.]—**Faulty Medical Coil.**—Several things are possible. 1. The primary wire is rather small for a 7in. coil. 2. The secondary wire, being cotton-covered, leaks. 3. The winding of the diffrent sections of the secondary, instead of being continuously in one direction, has been reversed in one or other of the coils. With 1lb. of No. 30 wire, properly laid on, and especially properly insulated, you should get sufficient power to make the strongest man cry for mercy. I should advise you to rewind the secondary. Soak your wire in paraffin wax (melted). Let the wire be all in one length; separate each layer from the subjacent one by a sheet of paraffined paper. When you arrive at the end of one section do not cut the wire: simply leave out a long loop for attachment to terminal, and be specially careful to insulate these projecting loops of wires from the neighbouring coils of wire by means of paraffined paper. When the wire has all been laid on you can bare the ends of the loops of their covering to enable you to solder them to their respective terminals. S. Bottone.

[69009.]—**Blowpipe.**—It is scarcely worth while making one, considering the price at which they are sold. Write to Mr. Fletcher, of Warrington.

Sm.

[69011.]—**Battery.**—To S. Bottone.—The reason is self-evident. Your failure is owing to the fact that the resistance of the porous cells is so great that not sufficient current passes through the lamp to light it properly. The Edison-Swan lamps, and especially the low-voltage ones, take a lot of current. In this respect they are far behind the German-made small lamps. Some of the Edison-Swan 6 volt lamps that I have take as much as 2·5 ampères to light them properly; so you will be obliged to use one or two more cells to get a full 5c.p. out of your lamp. S. Bottone.

[69012.]—**Glazing Tiles.**—There are a number of different glazes used in glazing tiles. For printed, painted, or self-coloured tiles the following glazes are suitable:—The frett: 100 Cornwall stone, 70 flint, 88 borax, 40 soda, 40 whiting, and 30 china clay. Pass the above through a ¼in. riddle, well mix, and calcine. To each 90lb. of frett add 80lb. stone, 30lb. flint, 130lb. white lead, and grind. [illegible] common glaze is made of 240lb. lead, 120lb. [illegible] 40lb. flint, ground together. A high heat is [illegible] to fuse these glazes.

[illegible]

[69013.]—**Evaporation of Acid in Daniell Cell.**—Use layer of wax on top of solution.

F. W. Mas[illegible]

[69014.]—**Dividing Oval on Lathe.**—A [illegible] method of dividing the oval with tolerable [illegible] I have done as follows:—Mount on the oval [illegible] truly a zinc plate, using the ornamental [illegible] taking care that it is most truly centred, when [illegible] tool is in position for work, and also see that [illegible] rest is quite level on the lathe bed, and [illegible] Cut a single line ellipse of any given size, [illegible] eccentricity of the guide-ring of the chuck. [illegible] set the dividing plate for the required number [illegible] divisions, and divide the ellipse into four [illegible] parts, taking particular care in counting the [illegible]sions, and mark the lines required with [illegible] using the winch-handle of the slide-rest [illegible] right hand while pressing the cutter-slide with [illegible] left. In the same manner mark a division [illegible] major and minor axes of the ellipse, which [illegible] will be quite unequal. Now supply yourself [illegible] pair of fine-pointed spring dividers, and [illegible] reduce the eccentricity of the guide-ring until [illegible] divisions are equal at both axes.

Norman M[illegible]

[69016.]—**Railway Gradients.**—The [illegible] incline upon the Birmingham and Bristol [illegible] the Midland Railway is 2 miles 3 chains [illegible] length, the total rise in feet being [illegible] gradient 1 in 37. All trains, both passenger [illegible] goods, are assisted in the rear by bank [illegible] when running up from Bromsgrove to Black[illegible] The *vis viva* of a train moving at any given [illegible] is equivalent to the raising of the train [illegible] height, by falling through which it would [illegible] that velocity, and this is true whether the [illegible] raised vertically, if it were possible, or by run[illegible] it up an incline; therefore, it follows that [illegible] train runs up an incline the engine has not [illegible] overcome the resistance on the level, but [illegible] raise the train to a certain height. To ascert[illegible] work thus done by the engine in foot-tons, [illegible] the height in feet by the weight of the train. [illegible] vertical rise in feet per mile is found by [illegible] 5,280 by the gradient to 1. The resistance [illegible] engine caused by an ascending gradient is f[illegible] dividing 2,240 by the gradient, thus the L[illegible] incline offers a resistance of 60·5lb. per [illegible] trains weight—thus, $\frac{2,240}{37} = 60{\cdot}5$. Your [illegible]spondent, "W. E. C. B.," will see from [illegible] figures that severe gradients are a very [illegible] objection; unfortunately, several important [illegible] of line in this country have been made with [illegible] gradients in order to reduce the cost of const[illegible] but they are a constant source of expense in [illegible]ing, to say nothing of the delay caused [illegible] slowly ascending inclines, which becomes [illegible] great importance when there is severe [illegible] between companies as to the time occupied [illegible] journey. Clement E. Stretton.

Consulting Engineer Asso. Soc. of Eng[illegible]
Leicester, July 6. and Firemen.

[69018.]—**Ferric-Chloride Battery.**—I [illegible] not allude to the single-cell arrangement [illegible] but the double cell—in fact, a modified [illegible] was the type I then alluded to, where the [illegible] acid was replaced with the ferric chloride [illegible] which was acidified with HCl. But regarding [illegible] single-cell pattern that you name, I have [illegible] much practical experience with it, having never [illegible] such a cell more than once or twice to my [illegible]ledge or note-books; but still, in my opinion [illegible] arrangement you quote is a very good [illegible] would answer all right in such a case as [illegible] Regarding using this cell for the miners' la[illegible] would, in my opinion, answer, though, as I [illegible] before, I have not practically tested it. [illegible] E.M.F. of the cell is, I fancy, about [illegible] 0·5 ohm resistance. You do not state what [illegible] lamps you use, or candle-power, &c.; but, [illegible]posing you used 5 c.p. lamps of 6 volts, you [illegible] require four cells. A box 6 by 4½ by 4 [illegible] these four cells admirably, and would light [illegible] for about two hours. You are also right [illegible] joing up in series; but "Coal" had [illegible]vertise his address for further particulars [illegible] cell. F. W. Ma[illegible]

[69020.]—**Rat-Trap Bicycle Pedals.**—[illegible] acquaintance of mine who was troubled in a [illegible] manner got over the difficulty by cement[illegible] of corrugated indiarubber soles on to the [illegible] his bicycling shoes. He tells me that [illegible] perfectly. He has made use of the old [illegible] lawn-tennis shoes. S. B[illegible]

[69023.]—**Electric Launches.**—[illegible]chanical knowledge will avail "Punch" [illegible] in the construction of an electric launch [illegible] has also a fair electrical knowledge. [illegible] motor is certainly less trouble and [illegible] n an engine and boiler of a corresponding ver; but "Punch" has also his storage batteries nake, which he will find rather a tedious pro- i. He can, of course, purchase these, and make motor himself. Messrs. Immisch are the owners the charging stations and electric launches on Thames. Their head station is on an eyot off waterworks at Hampton, while they have eral floating stations, which can be moored at desired place. In their launches, which are l built and splendidly finished off, the batteries placed under the seats on each side of the boat, lids of the seats being hinged at the back, so as e easily lifted up for inspecting the batteries, motor, which is of the Immisch type, runs at a h speed, and some difficulty was at first ex- ienced in getting a suitable form of propeller t would give anything like a respectable effi- icy at this speed. In their large launch, the *ountess Bury*, which is 60ft. long, twin pro- lers are used, each being driven by its own tor. This gives the boat the capacity of turning very small compass. The motor is controlled a special switch, designed for the purpose by ssrs. Immisch, which in exterior form, is not un- a beer-engine. This switch is placed either in bows, just in front of the steering-wheel, or on top of the saloon, which thus gives the steers- n a good view all round him. The controlling itch has usually three handles, which are capable a motion backwards and forwards, like a beer- . The first handle reverses the motor, which is ne electrically, and not mechanically—i.e., by ersing the connections of the armature with the d magnets, and not by shifting the brushes. The ond handle places the two sets of batteries either parallel or series, thus giving either half or full ed, while the third inserts varying resistances o the circuit to still further reduce the speed. e launches are very roomy, while the absence of ated air from the boiler and the smell of oily gines, places the electric launch beyond com- rison with the steam one. As in the steam unch, however, there is a good deal of vibration, ich is particularly noticeable when the boats are rting or going up stream. F. C. ALLSOP.

[69025.]—**Chemical.**—Add KNO_3 or $CaCl_2$ to ur water until the boiling-point rises to 110° C. ery, should not the heading have been "Physi- "? SM.

[69025.]—**Chemical.** — Use two vessels, one thin the other, with water in outer vessel. Main- n this at a suitable heat, so as to keep inner ssel at 110° C. with a small rose Bunsen. This n be easily managed. F. W. MASON.

[69028.]—**To Mr. Mason.**— I should think ur armature is too far off from the poles of the agnet, or else there is a bad connection in the cuit somewhere. Take the bell down and test it nnected up directly to the battery; then, if it orks properly, you will know the fault is some- here in the wires or clock connections. If the ll does not ring well, try screwing up the contact- rew a little more. F. C. ALLSOP.

[69028.]—**To Mr. Mason.**—It is hard to state hat is the matter with your bell, since you say it orks all right when the hammer is touched, and at you have a weak spring. Have you adjusted e platinum-tipped screw, and, also, is your bell nging in a suitable position. Take spring off ll casting, and file bright the end of it, and also d of casting. Join up again, see that all con- ctions are quite safe, and then join the cell direct to it. If no good, please advertise address, hen will see what can be done. F. W. MASON.

[69030.]—**Ironmongery.**—Replying to this, I ould respectfully advise "G. J." to let it alone, less his ambition is a sixpenny bazaar. The nall ironmonger, &c., isn't likely to be a success, nless he knows something of the trade, which I ould submit is a most difficult one to acquire on count of the multiplicity of articles in its cata- gue—an acquaintance with which is only obtained y actual contact and experience. This experience G. J." evidently hasn't had, or he had never ked our worthy Editor to invite any reader who nows to expose to public gaze what is a strictly ade matter—viz., discounts and profits of this or ny other commercial enterprise. The "E. M." is r the circulation of knowledge, mechanical and ientific, I take it, and not a sort of rack to extort mparatively private matters. "G. J." must take to consideration his position, his customers, and is own self, and act accordingly. His utter ignor- nce of the business comes out in his amusing xample 33⅓ per cent.: no firm ever did, and I rust never will, do business on such terms, though 3⅓ per cent., just one-third of a century, is a very onvenient discount, and surely not beyond "G. J.'s" rithmetical capabilities. Get a good discount table rom the bookseller at a cost of, say, a shilling, and ou might get a system of book-keeping there for bout another, though I never knew a man of usiness keep his books on the plans contained herein; most modify and alter to suit their own vhims and requirements. IRONMONGER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

68476.	Marine Boiler, p. 204.
68494.	Boot Repairing, 205.
68504.	Piston Rings, 205.
68514.	Albatross Breast, 205.
68525.	Movable Stereoscopic Pictures, 206.
68529.	Glass Gauge, 206.
68546.	Microscope Exhibition, 206.
68551.	Ventilation, 206.
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68748.	Anemometers, p. 290.
68749.	Underground Surveying, 290.
68753.	Silicic Acid and Alumina, 290.
68758.	Prime Cost, 290.
68761.	Camping Out, 290.
68765.	Spectacles, 290.
68772.	Ventilation, 290.
68775.	Piebald Snails, 290.
68777.	Frigoline or Frigiline, 290.
68781.	Cupola, 290.
68784.	Spirit Compasses, 290.
68789.	Raising Water, 290.
68790.	Cycling, 290.

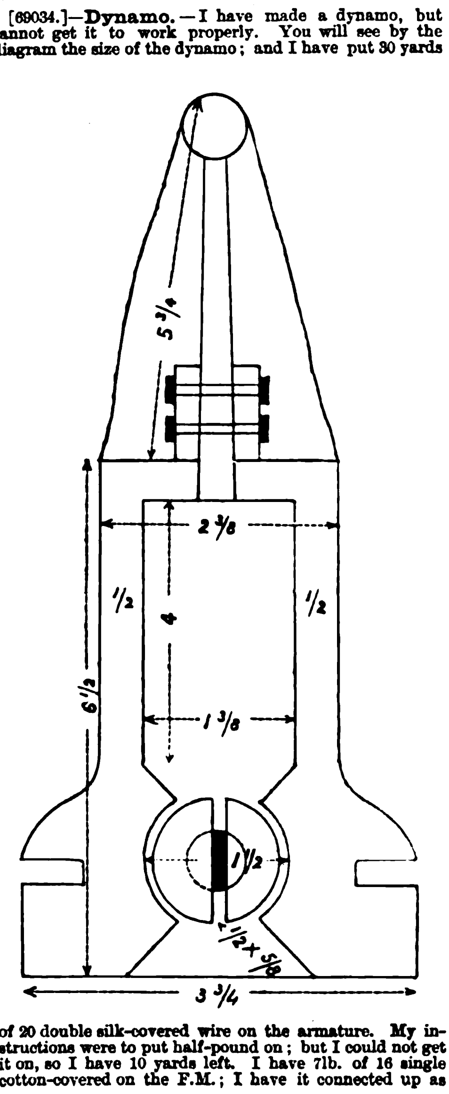
QUERIES.

[69031.] — **Anemometer.** — To "FELLOW MET. SOCIETY."—I am making an anemometer; and, referring to Vol. XLVIII. page 225, of "E.M.," I see you recommend cups 9in. in diameter, and arms 24in. from centre of revolving axis to cups. Will you please say the number of revolutions it will make by the passing of one mile of wind, in order that I may calculate train of wheels properly; also, would not conical cups do, being easier to make, and offer less resistance to wind?—HALLET.

[69032.]—**Colouring Plans on Skins.**—Can any one inform me the best method of colouring plans on skins? The use of chalk and ordinary water-colours mixed with ox-gall is rarely satisfactory.—MAPPER.

[69033.]—**Engine for Sewing-Machine.**—Would some reader of the "E.M." kindly give me dimensions for a horizontal slide-valve steam-engine capable of driving a sewing-machine or small lathe; also best size for boiler to suit same.—NOVICE.

[69034.]—**Dynamo.**—I have made a dynamo, but cannot get it to work properly. You will see by the diagram the size of the dynamo; and I have put 30 yards of 20 double silk-covered wire on the armature. My instructions were to put half-pound on; but I could not get it on, so I have 10 yards left. I have 7lb. of 16 single cotton-covered on the F.M.; I have it connected up as series wound. If I insert a piece of platinum wire it will heat it; but if I place a lamp in the circle, no current. I have tried it with a resistance of iron wire; but no good effect.—G. W. B.



[69035.]—**Spring.**—What would be the power of a spring 2in. broad, No. 16 Birmingham wire gauge thick, in a box 9in. diam.?—E. P.

[69036.] — **Platinum Contacts becoming Oxidised.**—Would Mr. Bottone, or any one else who has had experience in the matter, help me in the following? I have had an electric clock going for a little over six months, during which time the platinum contacts have been a constant source of worry. The point and part of plate where point touches to make contact become covered with something black, which I put down to be oxide, which gives a lot of trouble through being a non-conductor, for, although the point touches plate, and presses fairly hard against it, no current will pass; but immediately on the contacts being cleaned by brush, file, or even a card passed between them, the current again passes; but, lo! not for long, for in about a week it will be in the same state again. The current used proceeds from three medium-sized Leclanché cells in series; the circuit consists of about 20 yards of line wire, an electro-magnet, which actuates clock, a little larger than magnet of ordinary bell; surface of contacts being same as ordinary bell contacts, and circuit is completed by them every half-minute for the space of one third of a second. I may remark, by the way, that the cells have larger porous pots than usual (2½ diameter), and they stand the strain put on them very well. In experimenting to overcome the difficulty, I have changed the platinum for 22ct. gold, but with no better results. Thinking the platinum to be of poor quality, I have taken and used platinum from an induction coil which had done duty for years without giving trouble; but results were the same. I have been using a relay, thinking a relay would hammer the connections together with sufficient force to knock or rub away anything that may form on the points; but no, that obnoxious black stuff makes its appearance, and stops the current in defiance. I have also used condensers, having a dozen sheets 2 by 4½in. to both contact and relay; but with no better results, the black deposit appears just the same, quite ignoring my endeavours to get rid of it; and now, after going as far as my short brains will allow me, I appeal to the "E.M." that some kind person with a larger head may assist me. I may add that frequency of contact seems to be the difficulty, as I have had a German-silver contact completing another circuit once per hour without failing.—A. E. B.

[69037.]—**Navigation and Seamanship.**—Will any reader who has a thorough knowledge of the Board of Trade Regulations for the examination of masters and mates in the mercantile marine, mention the textbooks and course of study necessary to take certificates as mate, as master, and as extra-master. There is a book published by Lockwood and Co. (by Greenwood and Rosser, price 7s.) Is it used as a textbook?—ALPHA.

[69038.]—**Poor-Rates and other Municipal Taxes.**—Must these taxes be paid on or before 20th June or 20th July in Scotland in order to qualify for a vote in a borough, and does the rental in any way affect the qualification?—ALPHA.

[69039.]—**B.C. Battery.**—Will some of our electrical correspondents kindly help me? I have a bichromate battery, the carbon plates of which have become detached from the plate or cover of cell. They seem to have been soldered on. How can I refix them?—E. J. W.

[69040.]—**Declination Circle.**—Would some reader be good enough to tell me how to read the "vernier" of a declination circle?—the circle is divided off to 30. The vernier has thirty divisions on it, which is equal to fifteen divisions on the declination circle;—or tell me of some book that treats upon the verniers?—ORION.

[69041.]—**Engine Slides.**—I got a pair of slides for a one-horse vertical engine cast, and when they were planed up they were found to be very much blown. The founders will cast me a fresh pair for nothing; but I cannot afford to throw away the cost of planing. Will some kind reader tell me by what means I may fill up the holes? I have tried block-tin, but can only fill up some of the larger holes.—H. C.

[69042.]—**Electric Bells.**—Two years ago I fitted a house up with bells. On three different occasions since I have found the wires broken, and where broken they are covered with a green dust, seemingly verdigris, and they look as if they had been eaten away. Will anyone kindly tell me the cause?—T. P. L.

[69043.]—**Alarm Gun.**—Can any reader suggest a simple way of making the above, suitable for fixing in orchards and gardens?—GUNPOWDER.

[69044.]—**Dynamo.**—To MR. BOTTONE.—A friend gave me the castings of a small dynamo ready for winding. Size: armature 3⅝in. by 1¼in., field magnets 5½ high, 3¼ wide, 3½ long. I wound it according to the instructions given in your book, except that I had to use less wire, on account of this machine being smaller than the one you describe in your book. By putting the wires in the mouth you could feel a few sharp shocks, but it would not ring a bell. The same friend was kind enough to lend me a 20c.p. dynamo. I found this was wound with about 4½lb. of No. 22, on the field armature wound with No. 18, both cotton-covered, wire well varnished. Again I started on my own, this time putting one pound of double cotton-covered wire, No. 22, on each leg, well varnishing each layer. Tested it, and found it all right. Armature, 1¾oz. of No. 18 (all it would hold) silk-covered wire well varnished, and tested up to commutators connected up or shunt wound. Result: by attaching one wire to the tang of a file and running the other wire down the file I get a series of sparks; but it don't show anything on a 2c.p. lamp. I again wound the armature with No. 30 c.c. wire; no good again. No. 16 c.c. wire; no good again; with No. 23 s.c. wire, same as No. 18. After this I did a war dance round the machine and slung it on the scrap heap. To-day I have come across it again, and, as I don't like to be beaten, I thought I would ask you for assistance. I have tried it with slow speed and fast, and have reversed the driving; and to saturate the F.M's. I have used a bichromate battery, also a dynamo.—TINA.

[69045.]—**Wanted, Position of H.M.S. "Cormorant."**—Can any of our readers inform me how to ascertain the present position, and probable time of arrival, of H.M.S. "Cormorant," lately cruising in the Pacific, and now homeward bound. The information asked for is much needed, and will be greatly appreciated by a mother who wishes to communicate with a son on the ship "Cormorant."—J. H.

[69046.]—**Photo Enlargement.**—Will some kind friend help me? I can enlarge on paper, but I want to enlarge direct on a prepared canvas as sold by artists' colormen for painting in oil.—Poor Charlie.

[69047.]—**Efficiency.**—Would Mr. Bottone or others kindly say if carbons for chromic-acid battery should be steeped in paraffin wax, and how this should be done? I understand that this prevents the acid from creeping up and spoiling the connections. Has this to be done with all carbons, some carbons being closer in the grain than others? Does solder used in the connections in any way lessen the E.M.F. of a battery? I and many other readers of the "E.M." would, I am sure, be very glad to see a few columns on the manufacture of an electro-motor, such as could be run with a few chromic-acid cells.—Electric.

[69048.]—**Locomotive.**—Can any readers of the "E.M." tell me how to find what power must be put on the crank-pin of the shaft to move a train? Has the stroke to be compared with the axle of shaft, or with the diam. of the driving-wheel? I should be much obliged if someone would enlighten me by working out an example.—Misty.

[69049.]—**Zinc Casting.**—Requiring to cast some zinc cylinders 6in. high, ¼in. thick, for Bunsen cells, I shall be very grateful if Mr. Bottone or any other electrical friend will inform me of the entire process and requirements. I desire to get a stock of Bunsen cells, but zinc cylinders being so expensive per pound is the cause which prevents me from so doing. Does Mr. Bottone's depolarising fluid surpass chromic acid?—E. A. Avery.

[69050.]—**Gas Engine.**—To "Yarg."—Many thanks for reply. I am uncertain about proper method of making pattern and core-box, if any, for cylinder with jacket cast on. Will you kindly send me your address? Have advertised mine in Address Column.—D. G. I.

[69051.]—**Observatory.**—I am thinking of building a small room to use as an observatory, at the top of a London house, but doubt if a wooden structure like a Romsey observatory would be suitable in so exposed a position. Though I understand that for a reflector the open air is better than an inclosed space, it is so gusty and smoky on the roof that some kind of shelter is necessary. I shall, therefore, feel much obliged if any reader of the "English Mechanic" who may possess town experience, will kindly give me his opinion whether brick or corrugated iron should be employed in the construction, with any other suggestions, bearing in mind that I wish to keep the telescope in the place. The space I propose utilising is 13ft. by 8ft. 10in.; this being over a room at the back of the house is clear of the chimneys towards the south and west, though I have a flat roof, say, 50ft. by 22ft. available; but then it is between two rows of chimneys.—G. G. B.

[69052.]—**Saddle Boiler for Greenhouse.**—Will any of our readers kindly inform me the proper way to set ordinary saddle boiler to heat conservatory hot water pipes; also whether there is any reliable work published relating particularly to hot water fitting?—Mechanic.

[69053.]—**Incandescent Lighting with Leclanches.**—I have several 6-volt lamps, and often want a bright light in a particular spot for a few minutes, so connect seven No. 2 Leclanchés in series, and join them on to one of these 6-volt lamps; by adding another three cells to the seven I get a most brilliant light; but I am afraid I get it at the cost of the lamp. What I mean is this: with the ten cells connected I am afraid of injuring the filament. How can I tell the right number of cells to use to get best results from lamp and cells. Does six volts (marked on the lamp), mean batteries of that voltage should be used with it? Any help will oblige.—M.M.I.Sc.S.

[69054.]—**Compressed Air.**—Can any of our correspondents tell me how much a given volume of air would be reduced at, say, 100, 500, and 1,000lb. pressure per square inch?—G. C. T.

[69055.]—**Blue Salt.**—Will any of our chemical readers kindly tell me what metals form blue solutions with the alkalies and alkaline carbonates (KHo, NaHo, AmHo)?—True Blue.

[69056.]—**Black Needles.**—What metal or metals precipitate as black or red needles or hairs?—True Blue.

[69057.]—**Lavender Beads.**—What metal forms a lavender bead with borax?—True Blue.

[69058.]—**Moths in Mattress.**—Last summer I found a few moth grubs on a wool mattress. During this June they have appeared again. I should be glad of information as to the exact time of year when the mischief occurs. What are the best means to take by way of prevention? Also whether careful watching and destruction of every grub as it appears will eventually get rid of the nuisance; or, if not, whether there is any cure short of taking the mattress to pieces and baking.—L. A. L.

[illegible]—**Gas and Hot-Air Engines.**—Will feel obliged to any one who will inform me if there is published a good practical book on the principles of hot air and gas engines, and if I could obtain a set of castings any size up to [illegible] H.P.?—R. H.

[illegible]—**Oil Furnace.**—I am wanting a furnace to [illegible] pieces of steel about ¼in. thick, by about a foot long. Would any reader kindly inform me if they know of any small furnace heated with oil suitable for the purpose? I have not any gas in the district. Regularity is most important. Any information will much oblige.—Fire Box.

[illegible]—**To Mr. Bottone.**—I have constructed a small dynamo of the Siemens type: estimated candle power two four-candle power lamps arranged in parallel. [illegible] I now wish to magnetise the field magnets, which are about ¼in. thick, 4in. broad, and 6in. long, wound with [illegible] silk-covered copper wire, No. 16. What size [illegible] will be required to give magnetism sufficient to [illegible] what should the magnets be able to sustain [illegible] the battery is connected?—Primary.

[illegible]—**Pyrometer.**—Is there any method of finding [illegible] of the interior of a kiln mostly used for [illegible] coal is the fuel used. Ordinary thermometers would, of course, be no use, the heat being so great. Is there any substitute?—E. M.

[69063.]—**Flies.**—I have the misfortune to live in rooms near a large stable, and am therefore swarming with flies. Fly-papers don't seem to abate the nuisance much. Do any of our readers know of any chemical that can be burnt in the room that will clear them out or kill them? I am sure that this is a subject that will interest many of our readers.—Blue Bottle.

[69064.]—**Varicose Veins.**—I am a man 53 years old, with varicose veins just showing in my right leg. Will any intelligent reader of the English Mechanic kindly inform me through its pages what is the best means of curing them?—Most Anxious.

[69065.]—**Preserving Mixture—"Jargoons."**—Would any readers give me the recipe for a cheap and reliable preserving mixture for botanical and zoological specimens? I should prefer it in the form of a powder, in order that it could be carried about, and used when required by simply adding water. Also, would any reader inform me what "jargoons" are, and their use?—F. H. Harvey.

[69066.]—**Heating Swimming Bath.**—I am building a new swimming bath, 40ft. by 17ft. by 6ft. one end, and 4ft. 6in. at the other end; and would like to know what would be the best and cheapest way of heating it; only wanting it warm for winter use.—George.

[69067.]—**Hour Angle of the Moon.**—In the *Selenographical Journal*, No. 34, December 1880, it states that the moon's hour angle is found by subtracting the sidereal time from the moon's right ascension. In the same journal, No. 36, Jan. 30, '81, in an example *re* Libration of the Moon, it states that the moon's hour angle is 1° 52′ W. = − 28°. Will "F.R.A.S." oblige by saying if the above statements are correct? Should not the first statement read—subtract the moon's R.A. from the sidereal time: and in the second ought not the sign to be + before 28°?—Chas. Grant.

[69068.]—**Injection Water, and Loss by Vacuum.**—Will any one kindly show how to ascertain quantity of injection water required in inches or gallons per hour for a compound engine, cylinders 26 and 40in. diam., 5in. stroke, 46 revolutions per minute, 70lb. boiler pressure, steam cut-off in h.p. at about ½-stroke = 24lb. average pressure, and in l.p. at about 2-5th stroke = 10lb. average pressure; terminal pressure in L.P. cylinder at point of exhaust = 7½lb. below atmosphere line. This engine works with a vacuum of 13lb. in winter, and in summer 12lb. Please show how to calculate the loss of coal, supposing 1lb. of coal evaporates 6lb. of water in our boilers.—Georgetown.

[69069.]—**Zinc Casting.**—Will some reader kindly tell me what to mix with zinc to stop it from drawing when making thin castings?—A. A.

[69070.]—**Clock Gun.**—Can any reader give me a good description of a clock gun used for driving away birds? I have heard of one where you put in twelve cartridges, and one went off every hour.—Experimenter.

[69071.]—**Instantaneous Photos.**—What is the maximum exposure which can be allowed for waves and other seaside subjects without perceptible blurring? My shutter is set to, say, one-twentieth of a second. What stop should I use $\left(\text{standard number, or } \frac{F}{x}\right)$ with "Ilford Ordinary" for fishing smacks, &c., on a bright summer day?—Hx.

[69072.]—**Celluloid Cuffs.**—Will a reader give me the name of a preparation for restoring tarnished celluloid collars and cuffs to their original whiteness?—Bachelor.

[69073.]—**Tar Water.**—Will the readers of the "English Mechanic" who know anything about the virtues of this, say what their experience and opinion of it is? I think we have here a valuable preventive of disease, as well as remedial agent, that is greatly overlooked. What is its known action upon the liver and kidneys? I have heard it has a tendency to create gravel; but think that is wrong. I know it is an excellent stomachic and appetiser, and I think rejuvenator as well.—Pater.

[69074.]—**Children's Teeth.**—I have a daughter, age fourteen, disposition slightly nervous, whose teeth are in a deplorable state: she has hardly had a day free from toothache for three years. Jaw teeth all gone, and even the upper front ones decaying, at so young an age, although always in very good health, and never having had a single one of the ailments incidental to childhood. I do not know how to account for it, unless it is that, for years whenever her mother used to think the child had a cold coming, or any other (always imaginary) thing, she used to give her magnesia. Can any friendly reader suggest an alleviation or remedy?—Pater.

[69075.—**Plastic Metal Bearings.**—Can any of "ours" give me the composition of the alloy for lining bearings called Richard's Plastic Metal. I have looked through the last 20 volumes; but I can see nothing of it. —Brass Caster.

[69076.]—**ζ Bootis.**—I shall be glad if any correspondent has recent measures of the above star. It used to be comparatively easy to me even when under 0″·5; but it is extremely difficult now. In a fine view I got just before sunset on the 5th July, I fancied it was extremely close about 100° P ∠ ±. Power used, about 600 on the 10in.—Herbert Ingall.

[69077.]—**Pocket Battery.**—To Mr. Bottone.—I have been trying to make a sulphate of mercury one from your instructions given in No. 1,260 [query 68490], but could hardly get any current from it. I then made a paste by mixing the sulphate with water, and spread this on the carbon plates, wrapping a piece of thin rag round them, and immersed the whole with unamalgamated zinc in the dilute sulphuric acid; but it was a failure. On charging this little battery with bichromate solution it works a coil well; but of course it does not last long. The substance I have been supplied with for sulphate of mercury is a black insoluble powder, resembling black lead, which, on being heated, burns with a blue flame like sulphur. Is this right, or is it sulphide of mercury? —L'Allegro.

[69078.]—**Paper Making.**—I should like to start making coarse paper for bags, wrapping paper, and straw boards. I have a small stream of water, with fall about 4ft., carrying about as much water as will run throu a 14in. pipe in summer. I should be much obliged if of your kind readers could inform me how to commen and what the probable cost would be on the small scale? I can get flax waste on the spot at about 3s. p 120lb. Any information would greatly oblige.—Soc Somerset.

[69079.]—**Accumulators.**—I have a shunt-wou dynamo giving 55 volts, 7 amps, and wish to charge f storage cells (S. type, five plate) to run a Griscom mo What quantity and size G.S. wire must I put in as re ance?—Grategosh.

[69080.]—**Worsdell's Two-cylinder Co pounds.**—Will one of our readers send sketch of low-pressure cylinder, piston-rods, and crank, mar with and showing actual pressure in cylinder and recei when engine is running smoothly, and power, includ maximum, exerted by its piston (at and from mom of steam admission) at various points during a comp revolution of its crank? High-pressure cylinder work about boiler pressure (160 or 180lb.) during its en stroke, I believe. They effect a saving of 18·8 per ce I understand. If I use two of these large cylind each about double the capacity of high-pressure cylin what would be the saving then? Please state size a shape of inlet and exhaust ports in both cylinde travel of valves, and size of valve boxes; and incl sections (to scale), of valves and ports in sketch. think pre-admission is 3-16in., and pre-release 5-16 What effect has capacity of receiver, in this case t low-pressure valve box, upon economy? The tempe ture (Fahrenheit) of both high-pressure and low-press cylinder at points to be shown on sketch would be ve useful; and also temperature and pressure when t low-pressure and one high-pressure cylinder are used, suggested above.—Steam Power.

[69081.]—**Permanganate of Potash Cells.**—Would Mr. Mason kindly give me his opinion of M Gardiner's cell? Permanganate of potash being a pow ful oxidant, would it not attack the zinc on open circu I have made a cell according to directions; but fancy has the above defect. Also, what is the action of t bromide in the cell described by you on page 350? Is t cell a double-fluid one; and is there any waste on op circuit? My reason for inquiring is this: I have made shocking coil, and have fixed it in a box so that it mig be worked automatically by the dropping in of a penny. Three Leclanchés, with zinc in porous pot surrounded by manganese and carbon, work the coil well; but I am afraid they will not do for anything like continuous work. Occasionally the coil would be left for hours without work. Your kind advice would greatly oblige.—Wari.

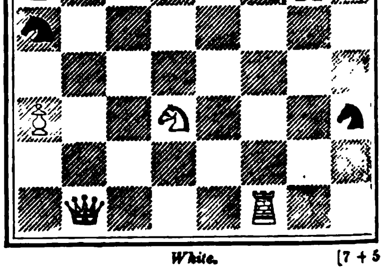
CHESS.

◆

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLVII.—By F. C. Cook.

Black.



White. [7 + 5

White to play and mate in three moves.

Solution to 1,155.

White.	*Black.*
1. Q-Q B 5.	1. Kt-Kt 3 (a).
2. Kt-Kt 5 (dis ch)	2. R-B 4
3. P takes Q (Kt) (ch)	3. Kt takes Kt (mate)
	(a) 1. Q takes P
2. Kt-Q 4. (ch)	2. Q-K 3
3. Q-K 7 (ch)	3. R takes Q mate.

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,155 by T. A. Pringle (very neat), F. C. Cook (obvious, but very clever, ingenious, and interesting), Muzio, W. Jay, J. Bryden (rather commonplace and obvious), W. Gleave, W. L. Martin. To 1,154 by J. C. Bremner (dual and triple), W. Jay (triple), A. Dean and Muzio; to 1,153, by A. Dean.

T. Ough.—You will have seen by last week's published solution, that 1,154 is quite solvable, and a very fine problem.

J. Rayner.—Thanks for corrected version.

Holloway's Pills.—This excellent medicine acts as a nervine and bodily tonic by aiding nutrition, and banishes a thousand annoying forms of nervous complaints. An occasional resort to Holloway's remedy will prove highly salutary to all persons whose digestion is slow or imperfect, a condition usually evidenced by weariness, languor, and despondency.

NSWERS TO CORRESPONDENTS.

. *All communications should be addressed to the* EDITOR *the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings illustrations on separate pieces of paper. 2. Put titles queries, and when answering queries put the numbers well as the titles of the queries to which the replies er. 3. No charge is made for inserting letters, queries, replies. 4. Letters or queries asking for addresses of nufacturers or correspondents, or where tools or other icles can be purchased, or replies giving such informan, cannot be inserted except as advertisements. 5. No estion asking for educational or scientific information answered through the post. 6. Letters sent to corremdents, under cover to the Editor, are not forwarded, the names of correspondents are not given to inirers.

. Attention is especially drawn to Hint No. 4. The ce devoted to letters, queries, and replies is meant for general good, and it is not fair to occupy it with quesns such as are indicated above, which are only of inditual interest, and which, if not advertisements in themves, lead to replies which are. The "Sixpenny Sale umn" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

e following are the initials, &c., of letters to hand up o Wednesday evening, July 10, and unacknowledged lsewhere:—

v. C. DAVIES.—W. Lipscombe.—G. Dixon. —W. X.—Dismal Jimmy.—Ignorant.—R. H. H.—W. F. P.—lamoht.—Rev. J. M. Bacon.—Langdon.—Wootton Rivers.—P. H. N.—J. W. Wilkins.—Experimenter. —E. M. Nelson.—F. Russell.—W. Hosken.—Hall, Birmingham.—Col. Ross.—S. R. Bottone.—Gilbert W. Lückhoff.

FFER. (The powder used for polishing nickel is generally nown as Sheffield lime, which is applied in the usual way to the bobs with the addition of a little oil. To "finish," dry lime is used on a "dolly," and that lime s afterwards used on the "bobs," where becoming nixed with a little oil and the particles of metal it forms the greyish powder to which you refer, and which is used for putting on the first polish. Rouge and crocus are also used by some. You can procure all r any in Clerkenwell; but for addresses we must, ccording to rule (see Hints No. 4) refer you to the Directory.)—A NEW SUBSCRIBER. (The best work on lectricity for "one who knows nothing of the subject" s Sprague's "Electricity: its Theory, Sources, and Applications," E. and F. N. Spon; but that is out of print. It would be as well if correspondents would give some idea of the kind of work they want. Perhaps Prof. S. P. Thompson's "Elementary Lessons in Electricity and Magnetism," Macmillan, will suit, or the late Prof. Guthrie's "Magnetism and Electricity," Collins. All books of the kind can be seen at the Patent Office Library, and readers can there discover which work will suit them best.)—E. SHACKLETON. (The numbers containing Mr. Lewis Wright's articles on the magic-lantern, &c., are out of print; but they are published in book form by Messrs. Macmillan under the title of "Light." That work contains more than the articles, and is not by any means confined to the magic-lantern.)—DRUID. (We do not know. Perhaps they will be advertised shortly. 2. There are several works on the manufacture of spirituous liquors. Perhaps that by Duplais and Mackenzie, "The Distillation of Alcoholic Liquors," price £2 2s., published by Sampson Low and Co., will suit you; or Byrn's "Complete Practical Distiller," Trübner, price 7s. 6d.)—A TAILOR. The word "tailor" is no doubt derived from the French *tailler*, to cut.)—4685. (You mean "galvanise," or to cover the metal with zinc. The iron must be scoured with sand to get the scale off, pickled in an acid solution, and immersed in molten zinc, the surface of which is covered with sal-ammoniac. The process has been described many times; but the work cannot be carried on without suitable plant.)—RONALD. (It depends on the student. The trade is carried on at Birmingham, Sheffield, Clerkenwell, Coventry, and other places.)—AMATEUR. (It must be brazed in the ordinary way with borax as flux and the usual spelter over a clear fire; but in such a matter better let an expert do it, as it is not altogether easy work. You will, however, find full instructions in back volumes. For instance, see No. 1248, Feb. 22, 1889, p. 525. There are full details in that number.)—ZINC. (Ice-safes are usually made of zinc—two cases, one within the other, the space between being filled with ice, and the whole surrounded with a thick wood case, the space between the wood and the zinc being filled in with charcoal powder, sawdust, or some other non-conductor. There must be free drainage. See indices. 2. The flypapers are coated with linseed oil, in which a little yellow resin has been boiled.)

Rupture Sufferers should call at the MEDICAL BATTERY COMPANY'S INSTITUTE, 52, OXFORD-STREET, LONDON, W. (corner of Rathbone-place), and personally inspect Mr. C. B. Harness' valuable Hernia Appliances, which have been so strongly recommended by the medical profession. An experienced and skilful surgeon attends daily, and examines patients free of charge. Pamphlets gratis and post free.

IT appears that the meteoric stone found in Scania, and acquired by Baron Nordenskiöld for the National Museum at Stockholm, fell on April 6, and that its fall was accompanied by a red flash like lightning and a thunder-like detonation. It weighs 11 kilogrammes, and had made a hole 30 centimètres in depth; but, having recoiled, it lay on the level ground at the edge of the hole. The colour is greyish-black, and the fracture greyish-white. From a hasty analysis made by Herr A. Wingärd, of Helsingborg, the chief mass appears to consist of manganese, in which are yellow and grey particles of metal. The meteorite seems to have been in a red-hot state, being covered with a glazed coating of fused metal half a millimètre in thickness.

USEFUL AND SCIENTIFIC NOTES.

Beri-Beri.—In a paper upon Beri-beri, Surgeon W. F. Thomas (*Indian Medical Gazette*, April, 1889) states that the affection is known to be endemic in Ceylon, in certain parts of India, in Burmah, the Malayan Peninsula, Siam, Japan, Islands of the Indian Archipelago, West Coast of Africa, and in South America. Among 177 cases, no less than 126 were under thirty-five years of age, and 152 were males. Debility following ague, renal disease, and scorbutic cachexia favour its occurrence. It is influenced by changes of temperature, and in jungle districts it prevails after the rains. It is most common among natives, but Europeans suffer when dwelling in endemic districts. It is not contagious. The proximate cause in a very large number of his cases was due to the presence of anchylostomum duodenale; and Mr. Thomas remarks that the only appropriate treatment consists in "the expulsion of the parasites from the intestines by small doses of calomel frequently till free purging has set in, or by the administration of thymol, proper dietetic rules, and removal from the beri-beri area. Until the parasites are expelled other treatment is of no avail."

A MILL has been established at Ottawa, Ontario, which makes paper pulp out of sawdust. The paper made wholly from sawdust is said to form an admirable sheathing that is fit for building after being tarred and dried.

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Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

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The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

Yes, the Ruptured will still find Dr. SHERMAN at his London Office, 64, Chancery-lane, where his wonderful success draws the afflicted from all parts of England, and where you and all others should go who entertain the hope of ever being cured. Send for his books, English and American, post free, 6d., and inform yourselves.—[ADVT.]

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Photographic, Microscopic, and all kinds of Scientific Apparatus exchanged.—R. WHITE, 55, Albert-road, Croydon. See Sixpenny Sale Column.

War Ships, unique models, magnificent speciality, no toys. Exchange Jewellery, Diamonds, microscope or such, and half cash.—Particulars, 19, Plymouth-street, Broughton, Manchester.

Lathe (foot), 4½ centres, planed bed, 2ft. 6in., heavy driving wheel, 2ft. 2in., quantity tools. What offers?—PAYNE, 103, Upper Charnwood-street, Leicester.

Wanted in exchange for **100c.p. Dynamo**, good half-plate Camera Lens.—PROCTOR, 65, Abbey-street, Nuneaton.

Gunmetal model of **Mortar Mill**, mahogany base, not finished, suitable for shows. Offers to value £5, cost £10.—H. 164, Euston-road.

Important.—All kinds of **Scientific Properties**, Apparatus, Instruments received for others or cash by A. CAPLATZI Chenies-street, Tottenham Court-road.

The Matchless 52in. **Bicycle** for sale or exchange, worth £12.—For particulars, apply to A. LIVESEY, Carr-lane, Slaithwaite, near Huddersfield.

200c.p. **Dynamo**, by Jones, Lambeth, compound wound, flanged pulley. Exchange direct-reading Ammeter and cash to £7 10s.—BRAUN, 1, Kilburn-square, N.W.

200c.p. **Sunbeam**, holder and shade. Offers wanted. —As above.

Single View Lens, by Ross, new condition. Offers invited.—As above.

Printers' Leads.—Mould for casting, adjustable, in good condition. Exchange Lathe Heads, Booth's Miterer, or Carpenter's Tools.—C., 8, Wellington-street, Chatham.

½-plate **Camera**, lens, double dark slide, tripod, focussing cloth, chemicals, instruction book, &c., suit beginner, 12s. 6d. Exchange to 15s.—GANNON, Springfield, Chelmsford.

Will exchange a 6in. centre **Lathe**, all iron, cone 3 speeds, T rest, nearly new, for a Safety Bicycle, or offers.—BONE, Elembank-street, Newton-on-Ayr.

Stocks, Dies, and Taps.—Splendid set for inch, ½, and ⅜ Whitworth thread, nearly new. Exchange.—PEARCE, 57, Crystal Palace-road, Dulwich.

Engine, well made, 2½in. bore, 4½in. stroke, iron bed plate and turned flywheel. Exchange.—PEARCE, as above.

Straight Edge, 24in., best make, divided, ⅛, 1-10, 1-16, 1-32, 1-64, 1-100. Splendid tool. Exchange. Useful offers.—PEARCE, as above.

Stocks, Dies, and Taps for brass threads, ⅛, ¼, ⅜, six taps, good tool. Useful offers.—PEARCE, as above.

"**Electrical Review**," unbound, for 1887; Bottone's book "The Dynamo"; "Bookkeeping," by W. Inglis. What offers?—W. DAVIS, 48, Sunny Bank, William-street, Sheffield.

A large quantity of "**Pharmaceutical Journals**," "Chemist and Druggists," and "British and Colonial Druggists," good condition. Exchange.—WALES, Hemsworth, Pontefract.

Wanted, ½in. **Slide-Valve Cylinder**, pump, 3-16in. plunger, ¾ stroke, 3½in. three-bladed propeller. Exchange Tools.—F. C., 51, King-street, Southsea.

What offers for a 3 and a 6H.P. **Steam Engine**, 60-light Dynamo, and a quantity of Cable?—HUDDLESTON, 97, High-street, Woolwich.

Two **Morse Inkers**, two Embossers, 20 double relays, 60 S.N. and Morse keys. Exchange Wearing Apparel or anything useful.—HUDDLESTON, High-street, Woolwich.

162 **Incandescent Lamps**, 5,000 porous plates and carbons, three galvanometers, and six bright fire alarms. Exchange for anything useful.—HUDDLESTON, High-street, Woolwich.

Saloon Rifle, 3-16 bore octagon barrel, 50 bullets, 50 small shot. Exchange for Marine Opera Glass to value 30s.—WILLIAMS, 28, Allanmouth-road, Hackney Wick.

Horizontal Engine, copper boiler 9in. by 4in., with fittings, on stand. Exchange for Leyden Battery, four jars.—PHILLIPSON, Louth.

52in. **Bicycle**, Singer's Royal Challenge, a perfect machine. Will take part exchange, good Field Glasses, or set of first-class Fishing Tackle, or anything useful for half value of £4.—Apply, No. 4, Cross-street, Mexbro.

48in. **Humber Bicycle**, new, nickel-plated. Wanted, Tricycle or anything useful.—HARRINGTON, 62, Delancey-street, Camden, N.W.

Double Driving Gear for side-gear tricycle, chain and lower wheel new. Offers invited.—HARRINGTON, 62, Delancey-street, Camden, N.W.

Splendid Model **Beam Engine**, bright, 1⅛in. bore, 4½in. stroke, metallic piston, full motion, fitted with brasses, gibs, and collars, gun-metal bearings, bright flywheel, all complete, with bright loco. type copper riveted boiler, with fire-box, and smoke-box and fittings, ⅛in. thick copper, work at 100lb. Exchange to value £8 10s. —279, St. Philip's-road, Sheffield.

Will give a high-class large-size 18-carat gold English Lever WATCH, with gold dial, full jewelled, the best watch money can buy, cost £16, warranted, in exchange for model Beam Engine, 2¼in. bore cylinder, with full motion, governors, and pumps. For shop window show.—279, St. Philip's-road, Sheffield.

Hand-Dynamo Castings, and Bottone's Book, "The Dynamo," new.—FUSSEY, Hull.

Set of **Change Wheels**, 5-16 pitch, new.—WM. FUSSEY, Hull.

Turned **Flywheel**, 24in. diameter, bored 1½in.—W. FUSSEY.

Wood-turning **Lathe**, 7½in. centre, wood bed, double crank, flywheel, &c.—WM. FUSSEY.

21s. **Ammoniaphone**. Exchange any of above, together or separately.—WM. FUSSEY, Anlaby-road, Hull.

6ft. 9in. iron **Lathe Bed**, planed, with saddle and slide-rest to fit. What offers? Wanted, good Field Glass. Stamp.—SEDGLEY, Witton-lane, West Bromwich.

Twelve Vols. "**English Mechanic**," down to present date. Exchange for anything useful in photo. studio, such as curtain, table cloth, background, pedestal, posing chair, glazier's diamond in good order, or telescope that will show astronomical objects fairly.—HORTON, Photo., Caroline-street, Cardiff.

To be exchanged, a Joiner's **Tool Chest**, 3ft. by 2ft. wide, 2ft. deep, 12 draws, three tills, splendid marked mahogany, solid, beautifully polished, suit gentleman, made by a good workman in his spare time.—G. ROBINSON, 3, Franklin-road, New Brompton, Chatham.

Grand **Locomotive Model Engine**, with tender, made for exhibition, and made to 1½in. scale; the grandest piece of workmanship ever made by man; has Prince Albert medal and certificate; very powerful and all bright; cost £400 to make it. Will take valuable exchange.—279, St. Philip's-road, Sheffield.

Beam Engine, one-man-power, capital condition, worth 45s. Exchange Drilling Machine and Screwing Tackle from ¼ upwards.—H. ELLIOTT, 8, Price-street, Newport, Mon.

Powerful **Medical Coil**, with regulator, handles, and battery complete; also Electro Motor. Offers requested. Anything useful to value £2 10s.—HARRIS, 17, York-street, Nottingham.

Wanted, model **Hot-Air Engine**, with pump attached, in exchange for good Silver Watch in good order.—T. CROOTE, 65, Church-street, Preston.

Portable Workshop, going at low exchange to value of £4, cost £10, glass all round, roof, body, floor separate, size 7ft. by 4ft., 6ft. 7in. high.—WATSON, 36a, Eden-grove, N.

Two new **Dynamos**, 6cwt. each, taken for debt. Small Engine or anything useful.—H., 21, Westbourne Park-crescent, W.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

New Illustrated Price List of **Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Billiards or **Bagatelle**, or **Requisites** for ditto, or Billiard Work.—HENNIG BROS., High-street, London W.C.

Manchester Electrical Stores.—Medical Coils, Magnetos, Bells, Cells, Wires, Fittings, Chemicals. Best terms.—J. BENTLEY, 7, Newton-street.

Electric Depot, 14, Deansgate, Manchester.—Handiest shop in the trade. Largest stock. Greatest variety. Lowest price.

Microscopy.—Instructive list of really high-class botanical preparations, with sample, 2d.—WALTER WHITE, Litcham, Swaffham.

Cyclists.—Use "Graphine" on your chains; no grease, will not hold dust, 9 stamps, free.—WOLFF and SON, Falcon Pencil Works, Battersea, S.W.

Diamond Drills, from 1s. Spring Drill Stock and postage, 1s. 3d.; Upright, do., 4s. 1½d.—Below.

Diamond Points for all kinds of engraving, writing, and ruling, from 2s. 6d.—Below.

Diamond Turning Tools, for truing Emery wheels and turning hard steel, from 5s.—Below.

Glaziers' **Diamonds,** from 6s. 6d.; Circular and Tube Cutting Diamonds, Diamonds for Lapidaries.—Below.

Diamond Sparks, for China riveters, from 6d.—WOODS and TOUSSAINT, 54, Spencer-street, Clerkenwell, London.

"**The Amateur.**" A paper for Fretworkers, Carvers, Inlayers, Painters. Sixpence monthly. Lists of latest designs free on application.—HENRY ZILLES and Co., 24 and 26, Wilson-street, Finsbury, London, E.C.

Catapults, 7d., 9d., 10d., 1s. free. Elastic, 2d., 3d., 4d., 6d. yard.—BELLEVILLE, St. Mark's, Cheltenham.

Safety Bicycles, superior make, warranted all ball bearings, from £10. Catalogue free.—HARGER BROTHERS, Settle.

Lard Oil, 3s. per gallon.—69, Commercial-street, E.

G.M. Fittings, cheapest house in London.—69, Commercial-street, E.

Cyclists.—Anti-vibration Safeties, Tandem Safeties and Tricycles. Send for list.—BRADFORD CYCLE Co., Ltd., Bradford, Yorkshire.

Bellows for Cameras, all kinds. Price list, 1d.—J. THOMSON, Camera Maker, Portgordon.

Write for **King, Mendham and Co.'s** (Bristol) new ILLUSTRATED CATALOGUE, 4½d. Acknowledged to be invaluable to amateurs.

Electric Bells, 2½in., 3s. 6d.; 3in., 4s. Presses, from 6d. All materials required by fitters in stock.

Complete **Sets,** consisting of bell, battery, wire, press, &c., packed in box, 7s. Larger size, 8s.

Cheapest House in the Trade. Send four stamps for our illustrated catalogue.—J. SUNDERLAND and Co., Electrical Engineers, Halifax.

6d. prepays three insertions of a 20-word advertisement in *Morning News*, Belfast. Established 1855. Specimen free.

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he English Mechanic
D WORLD OF SCIENCE AND ART.
FRIDAY, JULY 19, 1889.

SOME OBJECTIONS TO THE DIOPTRIC THEORY.

ECENTLY a dioptric theory of microscopic vision has been put forward opposition to the Abbe diffraction theory. e great objection to the dioptric theory that it is unsupported by experi- nt. The single experiment put forward y be said to touch the subject only in an irect manner. I allude to the reflex from objective front, to which I shall refer er.

1. The point with regard to the images of condenser diaphragm at the back of the jective has nothing to do with the ques- n.

Let us take a simple case—viz., an oil ⅛ large angle focussed on a P. angulatum, uminated by edge of flame, centred and ussed by stopped-down condenser on ject in usual manner. Now, if we ex- ine the back of the objective we shall the usual picture of the dioptric beam d the six spectra round it. The size of dioptric beam—i.e., the disc of light at back lens of the objective—will depend the size of diaphragm and angle of con- nser. The size of the spectra will equal the e of the dioptric beam. If the object be w taken away, we shall lose the spectra, t not the dioptric beam. Now, no one agines for a moment that this image of diaphragm is projected to a focus at the jective conjugate; what is projected there an erect image of the edge of the flame. the object is replaced, there will be an verted image of it, in the erect image of the me, independently of any spectra.

Now with regard to the spectra. I well nember that the first experiment I per- med when the diffraction theory was w was to receive the images on a ce of oiled tissue-paper at the objective ck. If my memory serves me right, you n trace an image of P. angulatum about lf an inch from the objective back. The ages will necessarily be much out of focus, it, nevertheless, they can be made out. ere were black outlines on a light ground the dioptric beam, and a green image in ch of the six spectra. Remove the greased per screen further back from the back ns, and the six spectral images were seen coalesce with the central dioptric image. he point to be learned from an examination the back of the objective is the size of the ne, or cones, which form the image at the jective conjugate.

Thus, the dioptric image of a point in the ject is formed by a cone, the base being e bright disc at the objective back. A ectral image is formed by a cone, the ectral disc being its base, and so on. I am opinion that Prof. Abbe has established perimentally and theoretically, that the lineation of this microscopic image of the ne structure of P. angulatum depends on e fusion of these green spectral images ith the dioptric beam and with one another.

2. The next point is the extinction of the ectra by the dioptric beam, or, more cor- ectly, the effect of the spectra is so feeble comparison to that of the dioptric beam, hat their power to influence the image is ractically nil.

The answer to this is, that just as much as ou increase the diameter of the dioptric eam, so do you increase that of the spectra —a fact which may be experimentally verified n two minutes. Thus, expand the illumina- ing cone until it nearly touches the expanded pectra, now stop out the dioptric beam, and ook at the brightness of the spectral image. Then, without moving the stop, reduce the illuminating cone, and watch the diminution in the brightness of the spectral image.

Of course, it is impossible to carry on the experiment when the dioptric beam overlaps the spectra, as it is impossible to cut out the dioptric beam without cutting out the spectra as well. But it is for the "dioptricians" to show why the brightness of the spectral image should cease to increase at the point when the dioptric beam overlaps the spectra. The brightness of the spectral image most certainly increases as you increase the dioptric beam as far as you can carry on the experiment, and I can see no possible reason why it should not go on increasing until you reach your maximum cone.*

Fig. 1

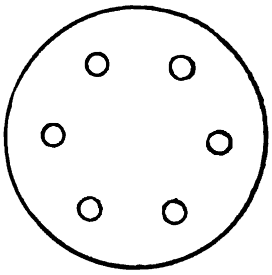
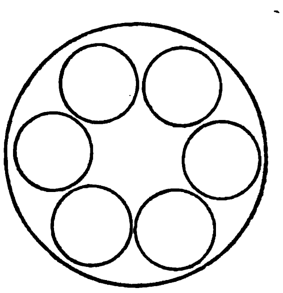


Fig. 2



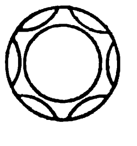


Fig. 3

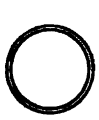


Fig. 4.

EXPLANATION OF FIGS.

Fig. 1.—Shows back of objective, with spectra of first order, of P. angulatum, the dioptic beam of small angle being stopped out. The diatom will be resolved on a dark ground, and will be fairly bright.

Fig. 2.—The same, with a dioptric beam of larger angle. The diatom will be resolved and intensely lighted on a dark ground.

Fig. 3.—The same, with a smaller aperture, so as to admit only the edges of the expanded spectra. The dioptric beam is now present, and the diatom is resolved on a light ground.

Fig. 4.—The same, aperture of lens reduced, so as to cut out the edges of the spectra; dioptric beam same as in Fig. 3. The diatom is not resolved.

3. The following experiment, although not proving the matter, points very strongly in favour of the diffraction and against the dioptric theory. Examine a P. angulatum with a lens which, when illuminated by a narrow pencil, will not grasp the six first-order spectra, and enlarge the cone until the dioptric beam occupies, say, ¾ of the back. Now, if a lens of suitable angle has been chosen, the expanded spectra will just cut into the peripheral zone of the objective. If the eyepiece is replaced, delineation will be seen; but if a stop be placed over that peripheral zone, although the large dioptric beam remains the same, the delineation will have vanished. If the image is a dioptric one, why, in the presence of such a large dioptric beam, are those little edges of spectra in the peripheral zone so supremely important?

4. You cannot have an irregular picture from a spectral image. A short time ago I also held this view, and I used to assign the irregularities in the microscopic image to a function of the dioptric beam; but special experiments, made with a view to determine this point, have altered my opinion. In a purely spectral image I have seen irregularities in the microscopic image, such as a missing dot, &c. These differences are not clearly seen, but yet they are seen. I do not for one moment say that the dioptric beam has no influence on the image—it has a very great influence; in fact, a greater influence than perhaps any spectrum taken by itself; but that is quite another matter altogether to saying that the microscopic image is a purely dioptric one.

5. The reflex from the front lens. This is the only part of the dioptric theory which has been supported by experiment. It is very well known that an object, such as a diatom illuminated by a central axial cone, appears brighter than the field.

The "dioptricians" explain this fact by saying it is caused by light reflected from the front lens of the objective, and this statement is supported by the experimental examinations of opaque objects mounted in balsam.

I have very grave doubts as to the opacity of some of these objects which shine so brilliantly; therefore, let us pass on to one object upon which there can be no doubt—viz., the mercury globule.

On examination, a mercury globule exhibits a feeble illumination from the reflected light. A great deal depends, however, on the curvature of the front lens, which, of course, differs in lenses of different constructions. It was found on trial that a certain dry ¼ gave brighter illumination than another dry ¼, also both ¼'s gave more brilliant results than a certain oil-immersion ⅛. It was also found that the effect was heightened by racking up the condenser much within its focus.

It is not difficult to calculate to what focus light, radiating from the principal focus of the lens, will be brought by reflexion from its posterior surface.

Let us examine a particular case, say a hemispherical lens of 1-10in. radius, of crown glass, ref. index 1·5. Then by ordinary formula—

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{r} + \frac{1}{s}\right)$$

$$f = \frac{1}{5}$$

Now we have to find the apparent curvature of the concave surface as seen through the plane.

By formula— $R = \frac{Ff}{F - f}$.*

where R is radius of curvature, F principal focus, and *f* the apparent radius of reflecting surface seen through the plane—

$$\frac{1}{10} = \frac{\frac{1}{5}f}{\frac{1}{5} - f}$$

$$f = \frac{1}{15}.$$

The next point we have to determine is the focus of a concave mirror of 1-15 radius for rays coming from a radiant 1-5in. in front of it. By formula for a concave mirror—

$$\frac{1}{p} + \frac{1}{p^1} = \frac{2}{r}$$

$$\frac{1}{p} + \frac{1}{\frac{1}{5}} = \frac{2}{\frac{1}{15}}$$

$$p = \frac{1}{25}.$$

Therefore we see the reason why the illumination by reflection from the posterior surface of the lens should be feeble; because it is brought to a focus within the lens, and by the time the rays come to the object they are greatly dispersed.

---

* Unless the experiment has been tried, one would hardly believe the great brilliance of the spectral image when the dioptric beam has been stopped out.

* Formula by C. V. Boys, F.R.S., in "Measurement of Curvature and Refractive Index," *Philosophical Magazine*, July, 1882.

When the condenser is racked up, the radiant is placed nearer the concave surface, and its conjugate focus brought nearer to the object, and consequently the illumination of it is strengthened. Therefore we can see that the single experiment put forward in support of the dioptric theory fails.

6th and last point. It is an established fact that the most critical of all images are those on a dark ground. Here an objective is put on its mettle, and its revolving power strained to the utmost. It is a great pity that certain technical difficulties come in the way of this kind of illumination with wide-angled lenses. Here we have no dioptric beam, nothing but spectra, and we get a "true" image—i.e., one that behaves like a daisy under a 4in. on focal alteration. Such a case is quite inexplicable by a dioptric theory; but is quite consistent with the views put forward in my last paper. When the back of the objective is examined, it will be seen entirely covered with spectra, so no zonal differences can exist, and consequently focal alterations will not produce different images. The above seem to me to be the chief objections to the dioptric theory.

In conclusion, let me say that the author of the dioptric theory has done excellent work, although according to my own view he has failed to establish his case. First, he has given the most concise and lucid explanation of interference phenomena that is extant in our language. Secondly, he has given testimony to the fickleness of images derived from a small cone of illumination.

Edward M. Nelson.

THE LUMINOUS FOUNTAINS ON THE CHAMPS DE MARS.

Of all the marvels at the Paris Exposition the luminous fountains on the Champs de Mars are not the least. Indeed, the Parisians are in ecstasies with them. They look upon the great Eiffel tower with pride, of course, as being the highest erection in the world; but their pride is mingled with a certain amount of distrust. Anything unpleasant that happens to mar the enjoyment of these pleasure-loving people—whether it be a thunderstorm or what not—is usually attributed to the influence of this extraordinary building.

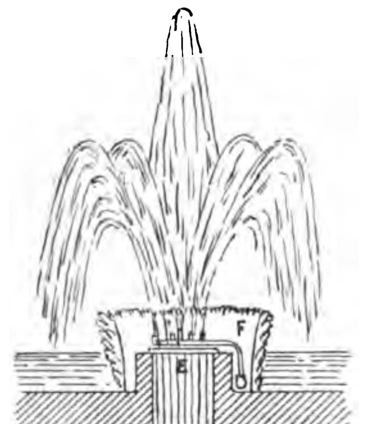


Fig. 1

The fountains, however, appeal to the right side of the Parisians: the people talk in the most extravagant manner, and say that were it only the 17th instead of the prosaic 19th century, poets would strike the lyre and sing in celebration of the union of Vulcan with the Naïades.

The luminous fountains of the Champs de Mars are of two kinds—those having a vertical jet, and those which have a parabolic jet. A short description of the latter arrangement appeared in this paper a few weeks ago. We are now in a position to illustrate the mechanism of this new fine art, for such it may be considered.

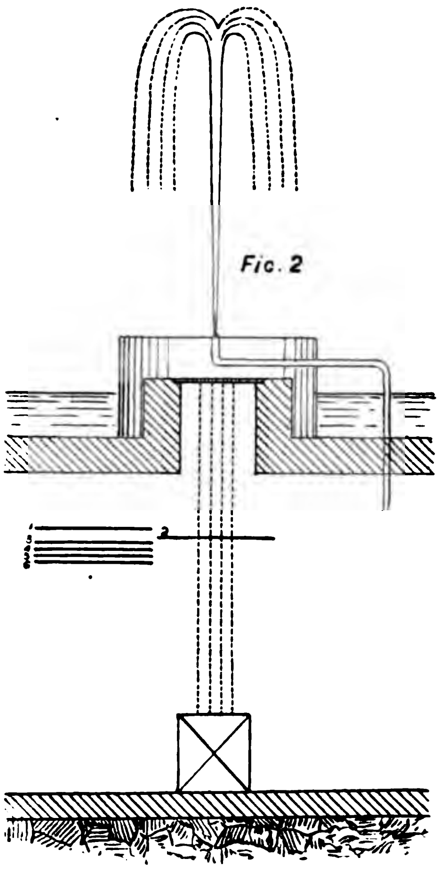


Fig. 2

Fig. 1 shows the system of illuminating vertical jets. A is an electric lamp with a regulator for the vertical rays; B is a silver reflector; C, a mirror placed at an angle of 45°, for the purpose of directing the reflected rays upwards; D, a series of sliding coloured glasses; E, slab of glass; F, pipe for feeding the jets.

Fig. 2 shows another view, with the details somewhat modified.

Figs. 3 and 4 are concerned with the illumination of parabolic jets. In Fig. 3, A regulates the horizontal rays; B is a reflector; C, the sliding coloured glasses; D, a mirror which receives the luminous rays, and projects them into interior of the tubule E.

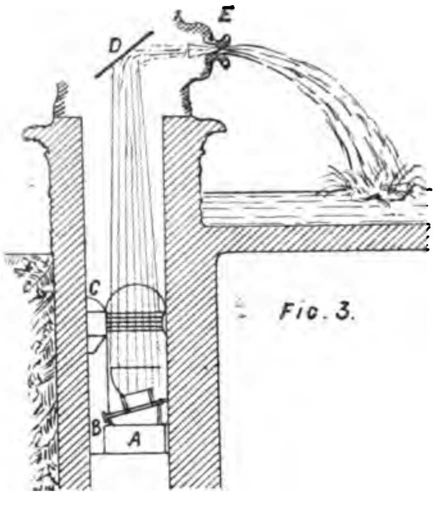


Fig. 3.

Fig. 4 shows the arrangement for producing the hollow parabolic jet of water, which was specially referred to in the previous description.

The ordinary tubule is here replaced by a funnel, A A, with double walls or cone-in-cone arrangement.

The water is laid on within the double walls of the funnel, and forced out between them, as shown by the direction of the arrows, escaping at the annular orifice B, forming a hollow jet

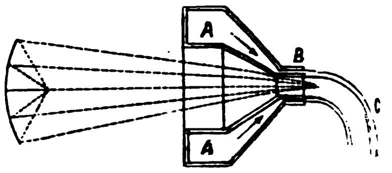


Fig. 4.

C, no thicker than a decimètre; D is a reflector which projects the bundle of luminous rays into the interior of the hollow jet of water, the walls of which reflect the light, and so cause the jet to be illuminated for a length of several mètres.

A MODEL LOCOMOTIVE.—XIII.

Piston and Connecting-Rods.

The piston and connecting-rod fittings shown in the accompanying illustrations have not quite as much elaboration of detail as is found in actual work; but in essentials they are similar. There are no liners on the faces of the cross-head, nor oil-cups with lids, nor are there so many distinct pieces about the big and little ends of the connecting-rod. I show single guides also, though double ones are most common; but the single ones will be easier to fit up.

Commencing with the piston (Fig. 70A), this is made of cast iron from a pattern whose form is like the casting, excepting that it has no grooves for the rings and no hole for the rod—these being turned and bored from the solid—and there is also allowance made for turning on the diameter. Note the curvatures of one side of the piston, which is made to correspond with the curvatures of the front cover, the object being to diminish the clearance space for the steam as much as possible. The piston is turned to make a close yet free fit with the cylinder bore, and the boss is bored taper for the rod. The two piston rings may be made of wrought iron, steel, or gun-metal; being so small, steel will be preferable. As solid rings they will be turned to about $\frac{1}{16}$in. larger than the piston body. About $\frac{3}{16}$in. will then be filed out for the purpose of splitting the rings; after which, they will be sprung into place, the divided portions being put on opposite sides, so as to break joint with one another.

Make the piston-rod of steel. Wrought iron would be too weak to stand the cutting out of the cottar way. The diameter of the rod all along its length should be checked while running in the lathe with a female gauge slid along, and any tight sections should be eased with a fine file. The gauge is more sensitive than calipers, and may be made by drilling and lapping out a true hole in a block of iron or steel. One end of the rod is turned taper to fit within the piston, and the nut which holds it in place is secured with a split pin. The opposite end is also tapered to fit within the boss of the cross-head, and is secured with a cottar. Sometimes that end of the piston-rod which enters the cross head is made larger in diameter than the body of the rod, in order to compensate for the cutting out of the cottar way. But as this involves a special stuffing-box, the practice is not usual.

In considering double and single sets of guides in this case our choice must be settled by a balancing of difficulties. If we adopt double guides the work about the cross-head is simplified in this sense that we have more scope for the strong fitting of the parts, and can get a sufficiency of metal without much difficulty, which, in such small work, ought to be imparted in excess of that deduced from a strictly correct scale. But if we use double guides, this involves much extra work in fitting and setting them accurately in line, and parallel in each direction, and, moreover, we also cramp the space available between the guides and the frame-plate for the fitting of the pump, which I intend to use on the model. On the other hand, using single guides we have to crowd a good deal of work about the cross-head and the little end of the connecting-

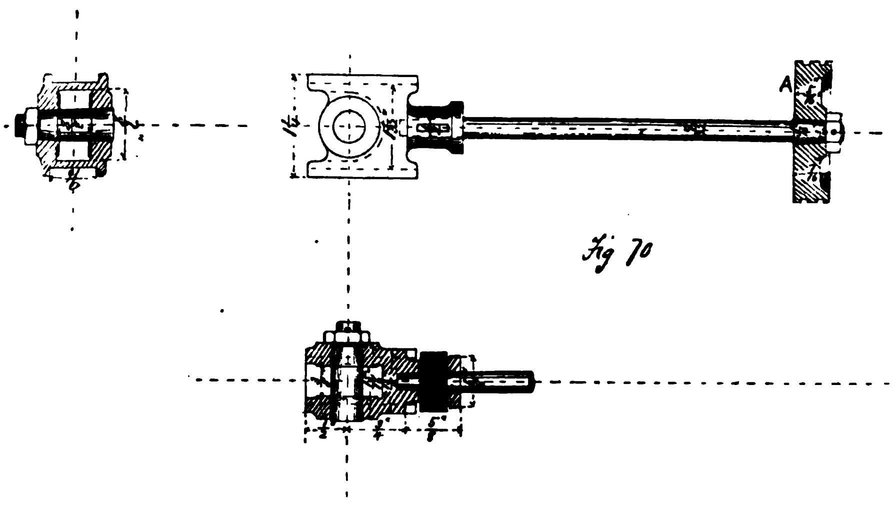


Fig 70

od. In fact, it is scarcely possible to make the rosshead and little end proportional and exact o any recognised type, and I shall not attempt t, but simply give a good workable design and limensions. The cross-head itself is necessarily ery thin in places. It is so in practice, much ore so here. Often it is forged in one with the iston-rod, and case-hardened. But stamping ch a forging is not practicable for us, and utting out the interior to a decent shape from e solid would be a laborious task. Cast iron, gain, would not stand the driving in of the ottar, and would be very liable to fracture indeendently of that. The best material for us to use, therefore, will be gun-metal, as being both tough and easily cast to shape. The interior will be cored out, the pattern being shown at Fig. 71. In Fig. 71, A is the print, the pattern moulding sideways, and the print being broad to prevent the core from tipping in the mould. The taper hole and the cottar way, and also the hole for the crosshead pin, will not be cored; but these will all be cut in the solid casting. The sliding faces of the cross-head are usually lined with gun-metal, or with white metal; but this would give us trouble. These faces must be filed as parallel as possible, the boss faces square therewith, and the holes for the cross-head pins parallel with the sliding faces, but in the transverse direction, and exactly central between them. Also the taper hole for the piston-rod must be truly bored while the cross-head is chucked on the face-plate. Note the double taper of the pin, Figs. 70 and 72, imparted as a ready and efficient method of tightening it fast in the cross-head, so that it shall not slip round. The pin is held with a nut, and this again is secured with a split pin. On the right hand of the engine this pin is lengthened, Fig. 72, to work the pump ram.

Connecting-rods are usually made of best Yorkshire iron, no welds being permitted. Probably a bit of steel will be better for a model. Our rod, complete with its fittings, is shown in Fig. 73. The section, save for the rounding of the narrow edges, is rectangular, and the big end is necessarily deeper than the little end. The big end is fitted with one form of strap arrangement; the little end is of the solid form, often used on small stationary engines, but not on locomotives. Usually with this form of cross-head the brasses fit into the slotted portion of the solid end, and are tightened with a wedge block, having set screws on top and bottom, or a through bolt with nuts and lock-nuts. But we cannot introduce so much work here.

In Fig. 73, when the wear of the brasses is taken up, assuming that the wear is equal at both ends, the length of the rod will remain unaltered, because with the tightening of the cottars the centres will both go in one direction—that is, towards the little end.

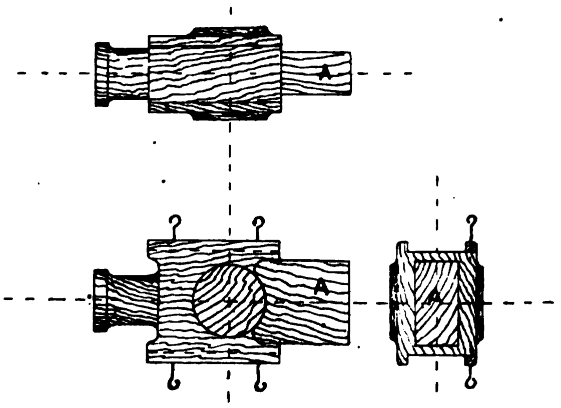


FIG. 71.

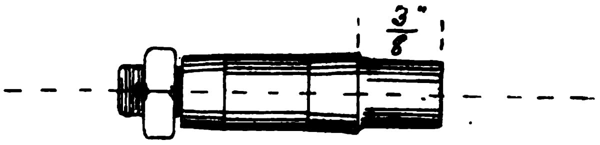


Fig 72

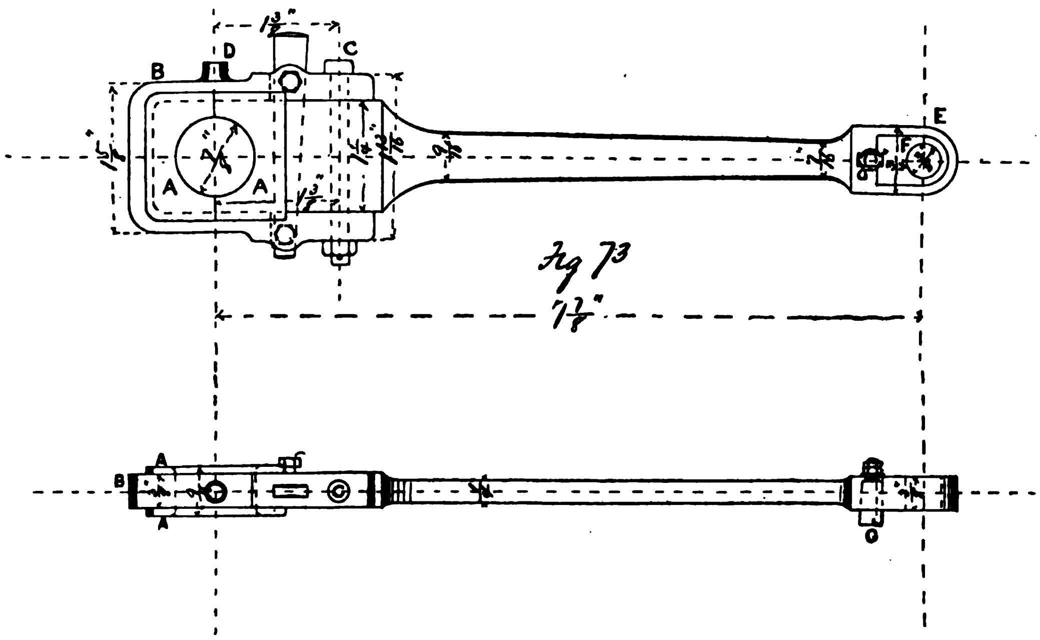


Fig 73

In making this portion of the work, first the rod itself, as a rough forging, will be blocked-up and lined-out with scribing block by methods essentially similar to that described in connection with the crank-axle —that is, by obtaining longitudinal centre lines at right angles with each other, and from these scribing the widths of the various parts, squaring up vertical lines from the marking-off table for centres and end dimensions. Every portion will then be finished bright, the sides filed, and the rounding edges either turned in the lathe, or filed. There is not much metal around the solid end, because the space in the cross-head is limited; but there is strength enough if the dimensions are adhered to.

Taking the fitting of the big end, the brasses A A will be made from patterns in no way differing from their casting, excepting for the extra allowances given for finishing, say $\frac{1}{32}$in. everywhere. These castings will be fitted first into the strap B, which is preferably made of steel, and filed to outlines. The centres of the bolt C and cottar are then marked, the strap slipped over the end of the rod, and while clamped there securely the holes are drilled through strap and rod end at once, and as much of the cottar way filed as can be done—that is, all except the necessary clearance spaces provided for tightening up.

Being but a small job, the faces of the brasses will now be filed parallel with the faces of the rod and strap. The rough hole in the brasses will be bridged with a bit of wood or metal, the rod be blocked up on the marking-off table, and the centre lines scribed and squared over the faces of the bridge pieces, and the circles of the hole marked off. The brasses will be now removed, and the hole will be tried on a face chuck, the brasses being clipped with bolts and straps, and properly centred. The outer edges of the flanges of the brasses will be afterwards finished off with a file. A plain oil-hole, D, well countersunk, will serve for lubrication, though, in practice, a reservoir and cotton wick for siphoning are used.

A trifle of clearance or side-play is usually allowed between the faces of the brasses and the crank webs, to allow of expansion due to heat, and so prevent cutting out of the brass. In the model this will be just a free fit, and no more. The edges of the brasses are rounded to an ⅛in. radius to match the crank pin.

In practice, a couple of bolts would be used for the strap-end; but one will be sufficient here.

For the little end of the rod the solid box form, Fig. 73, E, will serve very well for the model. Since the brasses F cannot work out sideways, being confined by the cross-head, they are not provided with either flanges or studs, but simply fit within the box-end. The square brass is grooved slightly to keep the wedge-block in place sideways. This wedge-block G, when first fitted, stands well out to one side, as shown, and the length of its screw within the face is the allowance for taking up of wear of the brasses. When this amount of wear is exceeded, then liners can be inserted behind the wedge-block.

Great precaution is taken on locomotives to prevent the working loose of the cottars and bolts of these fittings. The cottars are not only driven tight and frequently examined, but their security is assisted by the employment of set screws. Nuts are either provided with lock-nuts, or are secured with split pins, or the lock-nuts themselves are rendered doubly secure with split pins. In short, all that human foresight can effect is done to prevent the disastrous working out of cottars and nuts.

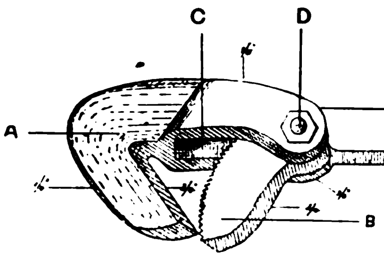
A plain solid end, bored and bushed with brass or steel, like the coupling-rod ends, and without any means for adjustment, would lessen the trouble of fitting. However, the form shown in Fig. 73 is that which we incorporate with our design.

The lubrication of cross-heads and little ends of this type is done through an oilcup screwed to the outside, whence a bit of tube and wick passes to the interior. We simply oil from the open end of the cross-head.

J. H.

FRAYN AND GOODYEAR'S PIPE WRENCH.

AMONGST the archives of the Patent Office there are few simple tools for which more patents have been taken out than for wrenches. The following description of a pipe wrench, recently patented by Messrs. Frayn and Goodyear, of Plymouth, may be of interest to mechanics. The wrench is made of steel, and is in two parts. The handle, or lever, is 1ft. 10in. in length altogether, and slightly curved at the upper part, in which teeth are formed to grip the pipe. The other part of the wrench is about 7½in. in length, with cheeks at the bottom ⅜in. in thickness, forming a socket for lever to work in, the two parts being connected with a centre-pin, nut, and screw. The top part is hook-shaped, which, with the lever, grips the pipe. The chief features of this wrench are that it will do for all sizes of pipes from ½in. to 2in. internal diameter without disconnecting or shifting, as is the case with those now in use, causing waste of time; also that it grips the pipe on three points, which prevents the pipe being pressed out of shape. In the Fig. A represents the hook, B the lever and grip, C the socket in which the lever works, D the centre-pin, with nut and screw on which the lever moves, and E the handle. The patentees claim that the invention will obviate the necessity of having so many wrenches for the work required to be performed; that it does not require to be disconnected or in any way shifted; and that the pipe when gripped is pressed on three equidistant points, which keeps the pipe from being bruised out of its original form.



ELECTRO-MOTORS: HOW MADE AND HOW USED.—VIII.*

By S. R. Bottone.

§ 31. THE armature being thus wound and fitted, the winding of the field-magnet next demands attention. The winding in this is extremely simple, as the core is cylindrical, and presents no difficulty in winding evenly. The core, whether as recommended at § 26, cast in one piece with the pole-pieces, or whether a separate cylinder of wrought iron, may be mounted between two centres (conveniently made by inserting two stout bed-screws in two wooden uprights), depressions having been previously made at each end of the centre of the core to retain the points of the centres, as shown at Fig. 27, where the field-magnet and pole-pieces are supposed to have been cast in one piece. The cylindrical core, as well as those portions of the pole-pieces where the wires will abut when wound on, must be carefully "dressed" with silk or brown paper, as previously described at § 10, and when this "dressing" is dry the wire of the requisite size and due amount must be carefully and evenly laid on, by causing the casting to turn on its "centres" by hand. It will be found to conduce greatly to the efficiency of the motor, and also to its power of withstanding the injurious effects of a damp atmosphere, if the wire laid on be previously run through melted paraffin wax. In order that the last layers of wire may not uncoil when liberated, it will be found advisable to serve the last inch of coiling with a coating of good hot carpenters' glue, and to pass the finishing extremity of the wire *under* the last coil. Sufficient wire must be left free, both at the commencement and at the end of coiling, for attachment to brushes or terminals. About 1ft. will be found enough in this case.

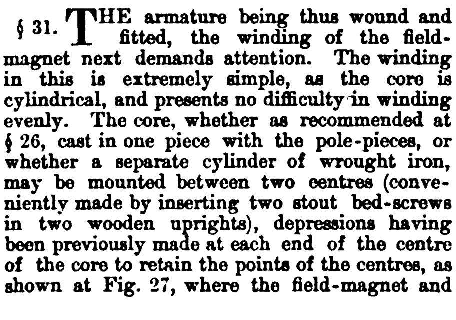


FIG. 27.

§ 32. The field-magnets having been wound, there only remains to give the wire coils on it and on the armature a coating of good shellac varnish (which may be tinted of any desired colour), and fit the parts together. The bearings, brushes, and brush-holders may be of the pattern shown at §§ 20 and 21, and the machine may be connected up, with reference to its armature and field-magnet wires, either in shunt, as recommended at § 21, or in series, as shown at [illegible]. The mode of coupling up to be adopted will depend upon the relative amounts and size of wire put upon the armature and field-magnet respectively. In order that the student may form an intelligent idea of what is meant by the terms "series" and "shunt," which are so frequently employed with reference to dynamo and motor winding, the annexed cuts (Fig. 28 and 29) are inserted. From these it will be seen that in the mode of connecting, known as "series winding," the whole current passes in *series* through the entire length of the wire constituting both the field-magnet and the armature coils, as shown by the arrows in Fig. 28, while in the *shunt* mode of coupling up the current, arriving at the brushes, has two paths open to it: one of lesser resistance, around the armature coils, another around the F.M. coils. If we consider the main portion of the current to be that circulating round the armature coils, we see that the lesser portion (that traversing the F.M. coils) may be viewed as being "shunted" off from the main circuit, hence the origin of the English term. The French and Italians call this mode of coupling "in derivation," since the current that energises the F.M.'s is "derived" from that feeding the armature.

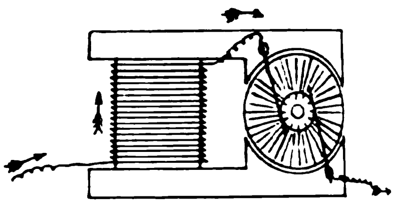


Fig. 28.

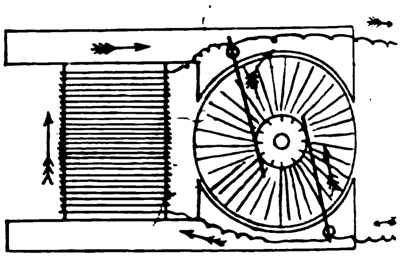


Fig. 29

The only difference which must be observed in fitting up this motor, as compared to the one described at § 21, is that the brushes must press on the commutator at points at right angles with an imaginary line drawn through the centre of both pole-pieces. This is shown in both Fig. 28 and 29.

§ 33. It will be evident from a consideration of the preceeding sections, that almost any form may be given to the field-magnets and armature which the necessities of the case may dictate, provided the following fundamental laws be not broken:—1st. The mass of iron and magnetic field of the F.M.'s must be very much greater than that of the armature. (In practice, A = 1 : F.M.'s = 7 will be joined a very good ratio. 2ndly. The armature must lie as much as possible in the strongest portions of the magnetic field, and come as close as possible to the pole-pieces themselves, without actually touching. For this reason, armatures with arms, or spokes or oscillating piston-like extremities, are of little or no use in the construction of efficient motors or dynamos. Ring, drum, or shuttle-shaped armatures are alone admissible.) In point of fact, any efficient dynamo will, if supplied with ufficient current at the proper potential, act as an efficient motor. It must be borne in mind, however, that the direction of motion set up by he dynamo when used as a motor will differ, according to whether the dynamo (or motor) be *eries, shunt*, or *compound* wound. If *series* wound, he armature will, when the machine is fed with current, start rotating in the opposite direction o which it must be driven, to act as a generator; f *shunt*-wound, the direction of rotation will be he same in either case; and lastly, if compound-wound, if the series coils are the stronger, the motion will be contrary, and if the shunt coils are the stronger, the motion will be the same as when driven as a generator.

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§ 34. Hitherto no account has been taken of he size and amount of wire to be used in winding he motor. It will be quite evident that there must be a "best proportion," but it will also be evident that this best proportion must and will vary with the E.M.F. and current at disposition to feed the motor with. As a rough-and-ready rule, it may be remembered that the electrical resistance of the motor as a whole should be about the same as that of the generator whether accumulator, battery, or dynamo) furnishing the current. And, further, it may be tated that the greatest efficiency will be obtained when the motor is so wound, that if driven to produce current (worked as a dynamo) it shall give, at the speed required from it as a motor an E.M.F. and current equal to that of the generator which feeds it. To render the meaning of the above statements clear, two examples are here given, fully worked out, from which the tudent can calculate any problems which may present themselves.

Let us suppose we desire to obtain the best result possible from a chromic-acid cell having an E.M.F. of 2 volts with an internal resistance of ·08 of an ohm. This would be equal to a current of 25 ampères on the short circuit. From his we see that, allowing one yard of wire on he armature for each volt, if run as a dynamo at an angular velocity of 1,250ft. per minute, we may put two yards of wire on the armature of such a gauge, that with the necessary amount to properly magnetise the F.M.'s the resistance shall not greatly exceed ·08 of an ohm. Now, in a series-wound machine, it is found that the best results are obtained when the resistance of he field-magnet coils do not exceed those of the rmature; but since the mass of the armature is ne-seventh that of the F.M. cores, it follows hat a finer gauge of wire must be used for the armature if we are to get nearly the same resistance on each. The resistance we can allow will be in this case ·04 of an ohm. On reference to a copper-wire table we find that No. 18 runs about 5 yards to the pound, and that 1lb. has a resistance of about ·663 of an ohm; hence, two yards equal to about ·03 of an ohm. Hence, if we use a trifle over two yards on the armature, we hall be pretty nearly correct as to E.M.F. nd resistance. As to the field-magnet coils, we find that No. 16 runs 24 yards to the pound, and has a resistance of about 0·2 of an ohm. Hence, ne-fifth of a pound, or, say, 5 yards, of this No. 16 wire would just about fulfil the requirements as to resistance and amount required to wind, with a sufficient number of ampère turns, he iron of the F.M.'s. From this we also get, ndirectly, the size to be given to the armature and field-magnets, since the armature, whatever ts shape, need not be larger than is required to contain conveniently the amount of wire specified; while the mass of the E.M. cores need not exceed, but should not fall short of, seven times that of the armature. There is one point that must be taken into consideration in choosing the gauge of wire to be used, and that is, the heating of the wire during the passage of the current. It will be seen, on reference to a "properties of copper wire table," that the "safe current" for No. 18 wire is only three ampères, while that of No. 16 is six ampères. Hence, if the whole 25 ampères were really to pass through the above motor, the heating would be excessive. But, in the first place, since the resistance of the wire on the motor is at least ·08, and that of the battery is also ·08, it follows that, even when standing still, the motor will only receive 12·5 ampères, and when it begins to work it sets up a counter-electromotive force which brings down the actual current passing through its coils to within the "safe" limit.

Let us now suppose we have to construct a motor to run in an electric-light circuit of, say, 50 volts, with a current of one ampère. This means that, if run as a dynamo, the motor should be able to give a current of one ampère at 50 volts pressure. To obtain this voltage, about 50 yards of wire must be employed on the armature, and it will be found, on reference to the wire table, that about ½lb. of No. 24 will most nearly answer the requirements as regards voltage and carrying power. As the resistance of the wire on the armature is somewhat lower than it should theoretically be, in order not to draw off too much current from the circuit, we must increase somewhat the resistance of the F.M. wire; so it will be well to wind the F.M.'s, in this case, with about 5lb. of the same No. 24 wire. Since the resistance of No. 24 is about nine ohms to the pound, and we have, on the fields and armature together, about 5½lb., it follows that the total resistance is about 49·5 ohms, with a possible E.M.F. of 50 volts. This fulfils the requirements, as nearly as it is possible, with the ordinary gauges of commercial copper wire, and is the proportion actually adopted by one of the leading electro-motor makers, in motors designed to run an electric-light circuit of a potential of 50 volts to take a current of one ampère.

In the next section will be given illustrations of the best forms of electromotors as now manufactured for practical use, with remarks as to the means employed for reversing the direction of rotation, &c.

WATER SOFTENING.

By George E. Davis.

MANY steam users have at last commenced to discern that the steam boiler is not the proper place in which to deposit the mud and filth from the feed water employed in generating steam. To those of our readers who have discovered this fact for themselves no words or exhortations will be necessary, still there are many of the old school still existent, and who have yet to be won over to the new *régime*. The softening of water on the large scale presents itself to us as two problems—one mechanical, the other chemical—and it is only by a proper combination of the two that success can be insured. A water temporarily hard by reason of its containing carbonate of lime held in solution by carbonic acid requires a treatment differing from that of water permanently hard by sulphate of lime, to say nothing of other constituents present in the various waters employed in producing steam.

From "temporary" hard water the addition of lime water will cause the separation of the whole of the carbonate of lime held in solution by the carbonic acid, plus the carbonate of lime also formed by the union of this carbonic acid with the added lime. From permanently hard water, the addition of lime extracts nothing save the carbonic acid which all waters contain, and perhaps magnesia, if these salts are present; but the use of lime in every case requires the greatest care in manipulation, as it is easy to make the water worse than it was originally.

Many processes have been devised from time to time in order to make hard waters suitable for boiler feeding. Some of them have been a nine days' wonder, and on the 10th day the glory of their fame has vanished. Many are the nostrums now in use for "fetching off scale," the users not having yet learned the lesson that it is better to keep the scale-forming substances out of the boiler in the first instance. Steam users should, however, know that without the active agents are used in definite proportion, easily ascertained by a chemical analysis of the water, the use of anti-incrustating agents is nearly useless. Of all the substances used as preventives of scale, the tribasic phosphate of soda is, no doubt, the best; but it is dear, comparatively speaking, and its combining weight is high. Next to this comes caustic soda, which forms the basis of most "boiler compositions," and it would be well if steam users bought and used the pure and undiluted article themselves, as all the other added materials are of but little moment. We have already mentioned that the anti-incrustating agent must be applied to the feed water in due proportion, and this quantity is far beyond what most steam users imagine. A few pints of a weak solution daily is of no more use than an expectoration. There is a certain minimum which must be applied. On the other hand, there must not be too much caustic alkali in excess, as in such a case the tendency to priming will be increased; and further, the caustic alkali will act upon and destroy the brass fittings upon the boiler in a very short space of time. Carbonate of soda, either in the shape of soda ash or as soda crystals, has often been recommended to prevent incrustations in steam boilers, but it is not nearly so efficacious as caustic soda or tribasic phosphate of soda, as a simple experiment will prove.

The softening of a water that has occupied my attention lately may well serve as an illustration of the foregoing remarks. I was asked to soften five millions of gallons per week of 144 hours. The water gave the following results upon analysis:—

Grains per Gallon.	
Total solids	63·50
Loss on ignition	13·00
Chlorine	3·23
Hardness	36·00
Parts per Million.	
Ammonia	0·10
Albuminoid ammonia	0·06

A further investigation showed me that the hardening constituents existed in the following proportions in grains per gallon:—

Carbonate of lime (held in solution by carbonic acid)	5·20
Sulphate of lime	24·30
„ „ magnesia	0·15
Magnesium chloride	4·27
„ nitrate	17·27

The foregoing quantities show to the trained mind the magnitude of the operations which have to be performed. Five million gallons of water contain not less than *six tons* of magnesium nitrate, or three hundred tons per annum. We will, however, look at it from another standpoint. The carbonic acid holding the carbonate of lime in solution does not merely exist in the proportion of $CO_2 : CaCO_3$, it is much in excess of this; in some well waters twice or thrice CO_2 to $CaCO_3$—in such cases the carbonate of lime does not commence to precipitate until all the free carbonic acid in the water has been neutralised by a caustic alkali or alkaline earth. With some waters lime is a very useful purifying agent; but in this instance there would be no advantage in its employment. A very interesting series of experiments can be made with the foregoing water. Take three separate portions of one gallon each. To the first (*a*) add 36 grains of pure carbonate of soda, previously dissolved in a little of the water; to the second (*b*) add 27 grains of high strength caustic soda[*] (Allhusen brand); and to the third (*c*) add 100 grains of tribasic phosphate of soda. If these additions be made in the cold, the different action of each will be remarkable; *a* may possibly become opalescent to a slight degree; but no appreciable deposit will occur even after twenty-four hours' settling. The portion *b* behaves very differently: first it turns opalescent, and then there slowly deposits a bulky precipitate, consisting of carbonate of lime, magnesia, and other impurities. The portion *c*, however, commences to precipitate the moment the phosphate is added, and in a very short time the deposit has settled to the bottom of the vessel in which it is contained, leaving, even with dirty water, the solution in the clearest possible condition.

We may now alter the physical conditions and observe the change. Place each vessel over a large Bunsen burner and heat to 70° C.; *a* throws down a small quantity of a sandy precipitate, *b* deposits a large quantity of a similar character, while *c* does not differ much from *b*. If we continue to heat the water, as the carbonic acid is expelled from *a* so we get a larger precipitate, but with *b* excessive boiling is not by any means necessary. We have thus arrived at several important conclusions: (1) Softening with carbonate of soda (soda ash) requires to be done at the boiling temperature, and, therefore, must be effected in the boiler. (2) Softening completely with caustic soda only requires the water undergoing treatment to be heated to 80° C.; this can be done in the boiler, and the insoluble matters easily filtered off in an apparatus such as that of the Pulsometer Engineering Co.

The water such as I have already given the analysis of would cost most probably about one halfpenny per thousand gallons for pumping. The softening would cost more. The quantity of high strength caustic required would be in grains per gallon:—

To decompose the sulphate of lime	14·4
„ „ „ magnesia	0·1
„ „ magnesium chloride	3·6
„ „ „ nitrate	9·4
	27·5

But some may say sulphate of lime is not decomposed by caustic soda—this is quite true—but the moiety of the caustic soda immediately becomes carbonate by combination with the excess of carbonic acid in the water, so that caustic soda may be said to be doubly effective—first it absorbs the carbonic acid, allowing the actual carbonate of lime to fall; and secondly, the carbonate of soda so formed acts upon the sulphate of lime, producing carbonate of lime and sulphate of soda.

Caustic soda added to a boiler feed-water will eliminate the lime salts, but I have not found it so easy to throw down the magnesia. Where a water contains much magnesia, I prefer a suitable mixture

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[*] The Newcastle Chemical Works Co. are now grinding this caustic and packing it in hermetically sealed tins of moderate size.

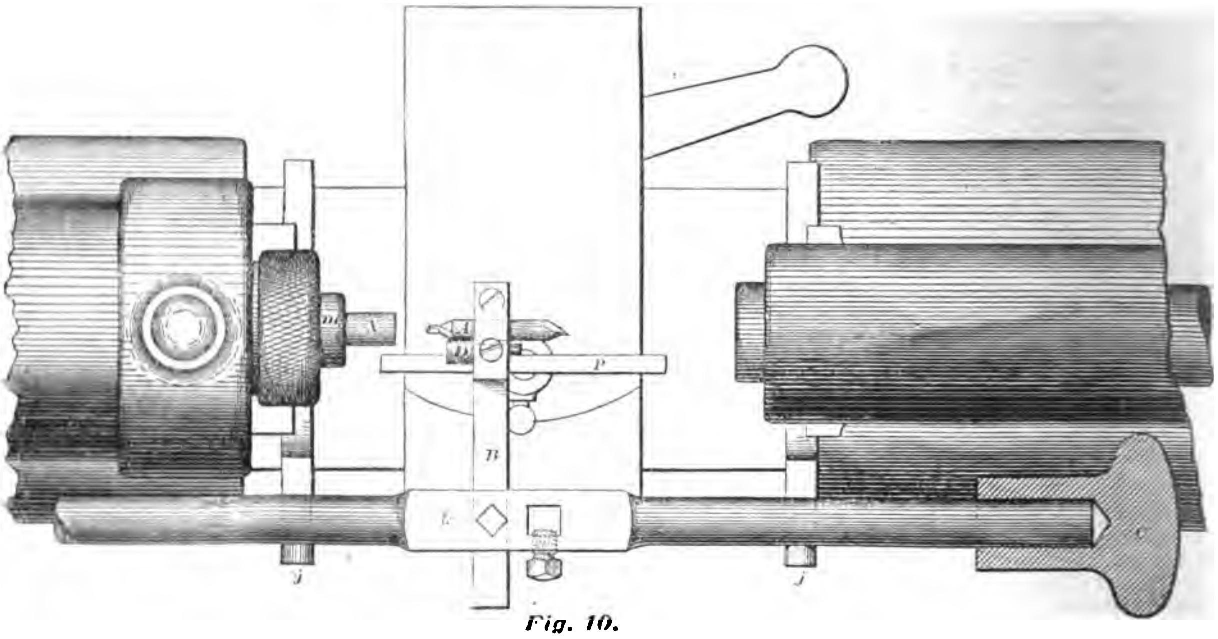


Fig. 10.

of caustic soda, carbonate of soda, and tribasic phosphate of soda, the quantities of which must be calculated from the results of the analysis of the water. To illustrate by an exact experiment, the water of which an analysis has already been given was treated with a mixture of—

Caustic soda (77 per cent.)	17 grains
Carbonate of soda	17 ,,
Tribasic phosphate of soda	5 ,,

The water contained in grains per gallon—

	Before treatment.		After treatment.
Lime	12·9	..	0·78
Magnesia	6·6	..	3·78

having deposited 28·3 grains of a precipitate consisting of—

	Per cent.
Lime	42·10
Magnesia	11·07
Carbonic acid	33·24
Peroxide of iron	4·00
Alumina	6·20
Phosphoric acid	3·45

On such a quantity as five million gallons per week 28 grains of dry solid matter per gallon would amount to no less than *nine tons*, or about 25 tons of semi-dry sludge. The quantity of high strength caustic soda required would be about nine tons weekly, so that the cost of purifying such a water as this would average 3½d. per thousand gallons. This of course is an exceptionally bad water to purify, but I hope I have sufficiently indicated that purification may be effected at a price, and also what that price is. Nearly every water can be successfully treated in one way or another, the exact process is a question for the chemical engineer. One word to the steam user: Do not use any of the secret nostrums, and do not endeavour to "fetch off scale," but rather devote your energies to its prevention; when scale is formed the mischief is done, it is too late then to apply the remedy.—*Chemical Trade Journal.*

SOME FIXTURES FOR HAND-LATHES.

It appears that the Brown and Sharpe Manufacturing Co., of Providence, Rhode Island, are about to issue a work on the "Construction and Use of the Universal Hand-Lathe," and the *American Machinist* has been favoured with advance sheets, from which the annexed selections have been made, with the belief that they will prove interesting to the very large proportion of mechanics and manufacturers who make use of the hand-lathe. The cuts are numbered as we find them in the book, from which we take the following description:

Fig. 10 shows a method of centring needle bars, foot bars, shafts, &c., for sewing-machine or similar work.

The drill A is fastened in the drill-holder B, which is secured in the tool-holder *k*. The tool-holder slides on the guides *j j*, and the outer end of the drill-holder slides upon the tool-rest *p*. The shaft X, to be centred, is held in a chuck shell *m*, while the drill is pressed against it by hand, the palm bearing on a wooden cap C, which is slipped over the end of the tool-holder. The pin D in the tool-holder B serves as a stop in connection with the end of the shaft, and determines the depth of the hole.

It is proper to add here that the tool-holder *k* is used for a large variety of purposes by the insertion of variously shaped tools in the square holes of the bars, by means of which a number of operations are performed at one chucking of the piece operated upon. The tool has long been used among clock-makers, and some few others; but is far less understood and appreciated among mechanics generally than its merits deserve.

It consists essentially of the bar *k*, the ends of which are turned true, and of the same diameter,

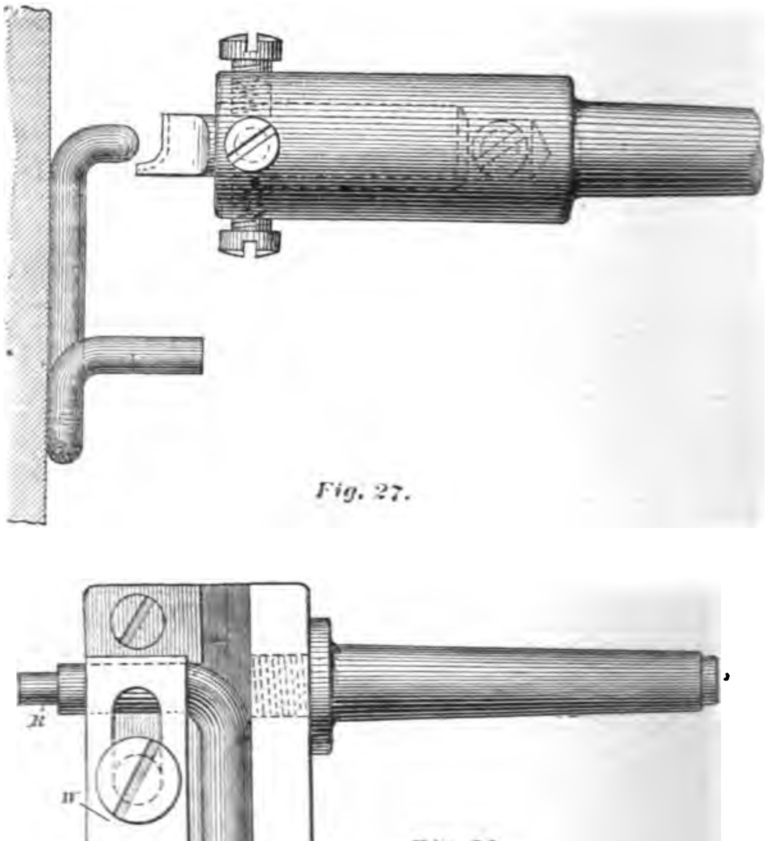


Fig. 27.

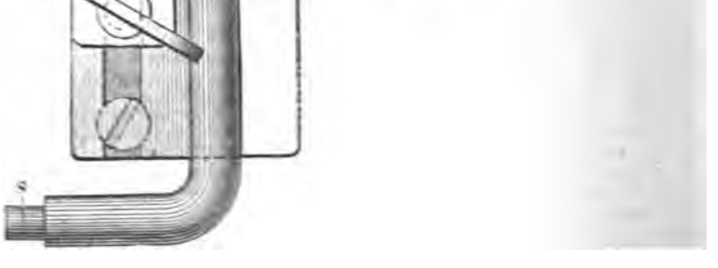


Fig. 28.

resting upon the supports *j j*, one of which is attached to the head-stock; these are adjustable, so that the bar *k* can be held at any distance from the centres, and parallel to them, or at an angle for tapered work. The tool which ordinarily takes the place of the holder B rests upon the T-rest P, and is moved along by hand, the bar *k* sliding in rectangular notches provided in *j j*. The head serves to handle it by, and suitable stops may be attached to *k*, which, coming in contact with *j*, gauge the distance of shoulders from given points.

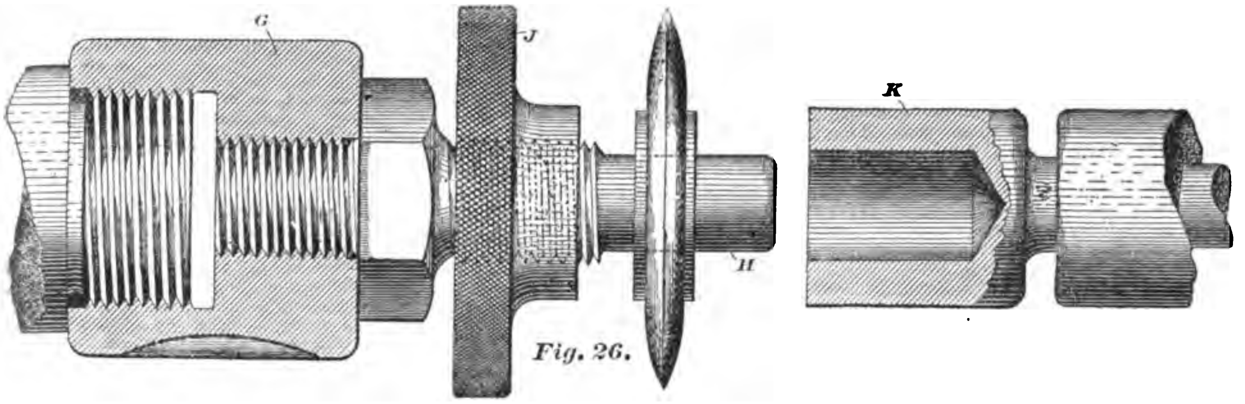
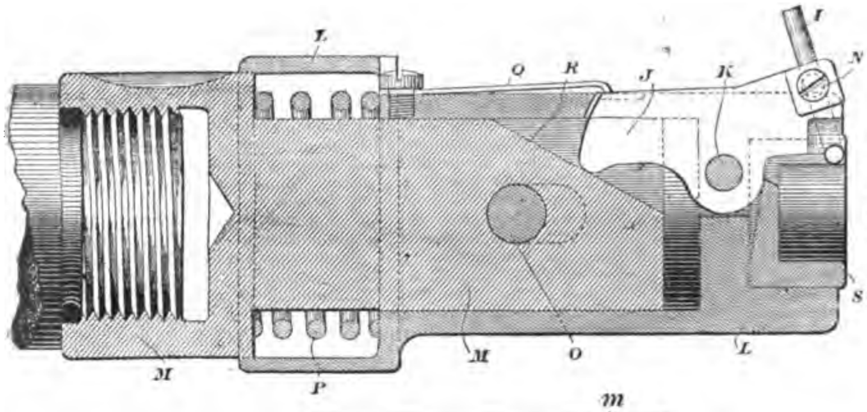


Fig. 26.



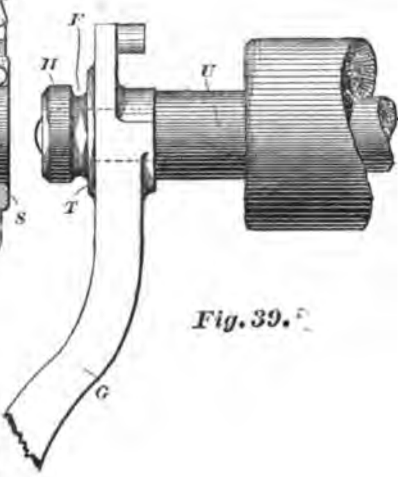


Fig. 39.

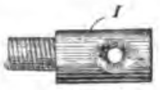


Fig. 15.

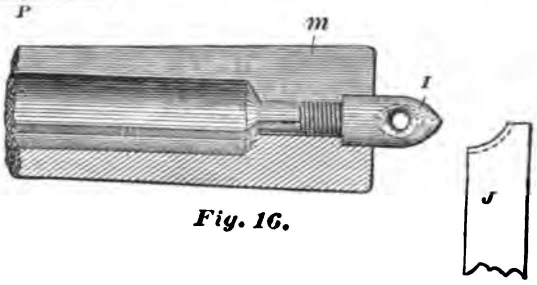


Fig. 16.

In finishing a pin, I (Figs. 15 and 16), we use a ecial chuck, which grips the body and closes about e thread of the pin just enough to steady and hold in line. The pin could not be held by the thread one without damage, and the body is too short to mit of its being held by that alone. To use an dinary chuck for such work would be compara- vely slow and costly.

The foot-stock spindle of this lathe is operated by lever, and Fig. 26 shows a method for forcing a rcular disc or cutter on and off an arbor.

The arbor H is screwed into a cap G, which is rewed on the chuck-thread of the live spindle. hollow centre, K, is placed in the dead spindle, nd the disc is forced on the arbor with the hand ver. When finished it is forced off by the knurled ut J. With small discs or washers the arbor is ot screwed into a cap, G, but is held in a shell uck.

The ends of a great many odd-shaped pins are unded as at M, Fig. 27. This cannot be done ith the arrangement of tools before described, on ccount of the projecting part L; accordingly, the ol is held in a collet, which is inserted in the foot- ock spindle. The work is held on a face-plate, nd the end M located centrally by a clamp and op pins. The length of M is regulated by adjust- g the stop and stop screw, which limit the forward ovement of the foot-stock spindle. The four rews Q are used to adjust the tool when it is worn r ground. Sometimes it is more convenient that e tool should be held in the live spindle, and the ork secured to the dead spindle, as in turning the houlders R and S, Fig. 28. The piece is held by e clamp W in a groove on a special fixture, U, nd is moved to a hollow mill, Fig. 29, by the hand ever.

Sometimes, in order to turn out duplicate parts ith rapidity, or to render the lathe available for ork that would otherwise require a comparatively rge and costly machine, it is of advantage to use special and rather expensive fixture, as, for xample, that shown in Fig. 39. The work to be one in this case is to turn a small groove, F, in he hub of the handle G, and to do this work in the rdinary way, by swinging the handle on a face- late, would not only be much less rapid, but would equire a lathe that would swing 18in. over the bed.

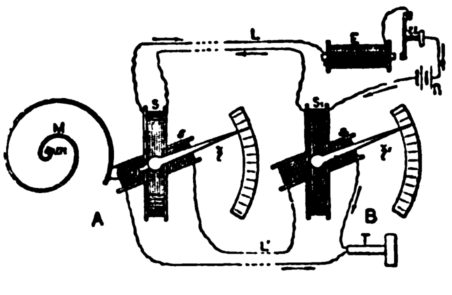
On the hand-lathe the fixture is screwed to the ive spindle, and rotates with it while the piece operated upon is stationary. The cutting-tool I, which turns the groove, is secured in the tool-holder J. This tool-holder is free to oscillate upon the pin K, and is fastened by this pin to the sleeve L, which is fitted on the stud or arbor M.

This sleeve is free to slide endwise on the arbor, but is prevented from turning by the pin O, which is fastened in M and projects through a slot on each side of the sleeve. The spring P continually presses the sleeve outwards against the pin O. A flat spring, Q, holds the back end of the tool-holder J against the inclined surface R. S is a hardened steel bushing fastened to the sleeve L, and fitting freely to the hub H. The centre U in the foot spindle terminates in a pin fitting the hole through the hub H.

In the operation of this device, the work or lever G is held in the left hand, and after it is placed on the centre pin U, as shown, it is brought up by the right hand by means of the hand lever, until the shoulder T bears on the bushing S, the hub H entering the same; then by pressing hard enough to overcome the force of the spring P, the sleeve L slides back on the arbor M. This motion causes the back end of the tool holder J to slide up the inclined surface R, which gradually feeds or moves the tool I towards the centre and places it in position to remove the stock and form the groove. The depth of the groove is regulated by the adjustment foot spindle stop. As the pressure on the bushing S and sleeve L is released, the work G may be simultaneously withdrawn, since the springs P and Q at the same time adjust the parts to the relative position shown in Fig. 39, the tool I being out of the way to let the hub H pass out. The time consumed in doing this work is simply the time required to pick up the handle G from the bench or shelf, place it on the centre pin U, press it against the fixture, and then withdraw it.

THE TELE-INDUCTOR.

THE apparatus shown in the annexed engraving has been brought out by M. P. Moennich, of the University of Rostock. It is based upon a new idea, and may be applied to the indications of all apparatus, such as water-levels, thermometers, barometers, electric measuring apparatus, &c., located at a distance. The figure represents the apparatus as applied to the transmission from A to B of the indications of a metallic thermometer, M The transmission is based upon the extinction of an induced current in two identical and movable bobbins, connected in opposition and submitted to the inducing action of two stationary bobbins placed in the circuit of any electric source (induction bobbin or vibrator, E). The first movable bobbin, *s*, is connected in an invariable way with the indicating apparatus M, and the second bobbin *s* is shifted at the other station until the telephone T no longer renders any sound. At this moment, the position of the index z_1 corresponds exactly to that of *z*. This arrangement is extremely ingenious, although it has certain drawbacks. Thus, four



wires are required, or at least three, on utilising the earth for one of the roturn wires. Besides, the sensitiveness is not the same for all points of the dial. Toward the point of no induction, the position of the second bobbin *s* will be a little uncertain. Finally, it remains to know whether it is possible to obtain practically two pairs of identical bobbins. As this apparatus is nothing else than an induction bobbin, it will be necessary at all times to take care not to leave pieces of metal near either of the bobbins. M. Moennich, however, has made numerous experiments with various specimens or the apparatus, and has convinced himself of their advantages and of the possibility of the use of them in practice. We are persuaded that this arrangement of a distance indicator will be able to render services in many cases.—*La Lumière Electrique.*

HEAT-ENGINES OTHER THAN STEAM.—I.*

ONE of the greatest difficulties with which I have had to contend in the preparation of these lectures has been to determine, for each particular branch of the theoretical portion of my subject, how far I ought to make that which I have to say absolutely elementary, and therefore somewhat popular, or how much I should take for granted was already fully known to my audience.

To an extent I am governed in this decision by the short time at our disposal; but, on consideration, it seems to me better that I should err on the side of repeating to you many things which you already know. I am the more ready to do this, because I think it is well that I should at least put into words my ideas of even the elementary portion of our subject.

It will, perhaps, be as well for me to state exactly what I mean by a "heat-engine." This title does not necessarily imply moving machinery, but such an engine may be defined as any apparatus or machine to which heat is applied, or in which heat is generated, and from which work in any form results; or, to put it shortly, a heat engine is any apparatus in which heat is transposed into mechanical work. For instance, a smelting furnace is a heat-engine—a steam-boiler and a gun are both of them heat-engines; and although you may laugh, and think I am stating a paradox, yet a "cold-producing" apparatus is frequently a heat engine.

The philosophy of heat has been considered, and has from the earliest days been experimentally investigated by some of the ablest men who have ever lived. As a consequence, the literature in connection with it is large.

I hope, however, that there is yet room for me; room for comparison of the theory and of the theoretical values with the practical possibilities, and for comparison of these with the results that have, in practice, been attained up to the present. There is also room for suggestions as to the direction in which further improvement must be sought, not only in those engines which are alone dealt with in the above books and papers, but in others new since their publication, or which have, in new forms, been recently proposed.

It is necessary, in order to consider with understanding the possibilities of heat-engines, that we should investigate, to some extent at least, the science of heat and its laws. I do not, however, propose to do this to any greater degree than will enable us to comprehend the practical points in connection with our subject; nor do I propose to recapitulate the various ideas which have from time to time been propounded as to what heat really is; but I will ask you to accept that which is now universally agreed to be proved, namely, that heat and motion are convertible the one into the other, or in other words, that the title of that interesting book by Prof. Tyndall is correct to its uttermost meaning, and that heat is—"A Mode of Motion."

Two of the earliest of those who investigated and propounded the true philosophy of heat were Count Rumford and Sir Humphry Davy. The latter proved experimentally that, by rubbing one piece of ice upon another in *vacuo*, the temperature of the ice being 28°, or 4° below the freezing point on the Fahrenheit thermometer, heat was produced; the ice was melted, and the resultant water had a temperature some 3° or 4° in excess of freezing point. He showed that the heat necessary for this increase of temperature could only have arisen from the friction of the one piece of ice upon the other This experiment was even more conclusive than it at first sight appears, as we shall see when we come to deal with the questions of specific heat and of latent heat.

Count Rumford also had, in a paper read before the Royal Society, on January the 25th, 1798, shown that in the boring of a brass cannon heat was produced, which heat was sufficient to boil water in which the boring tool and the portion of the cannon being operated upon were contained. He had also, as early as 1778, stated that he had proved experimentally that a gun which was fired without a bullet was hotter after the firing than when fired with a bullet. Count Rumford was not, at that time, cognisant of the dynamical theory of; heat but his suggestion, as I understand it, was that a portion of the heat developed by the explosion of the powder was dissipated or absorbed, in some way or another, in pushing the bullet out of the gun. We now know that this heat which disappears is transformed into the motion of the bullet.

Let us consider this discovery announced by Count Romford in relation to a big gun (which is one of the simplest forms of heat-engine, completing its work, as it does, in one stroke), and let us see whether, when we have realised the reasons for that which Count Romford observed, it will not carry us one step at least towards a complete understanding of our subject.

When a gun is fired the solid powder is converted, as combustion takes place, into gas and heat, and, therefore, heat and pressure are generated, and motion is rapidly imparted to the shot until it is expelled from the gun at a speed which, in these days, reaches approximately a mile in two and a half seconds of time, or if continued, of nearly 1,500 miles an hour. Further, as the shot is moved forward in the gun, the space behind it necessarily goes on increasing, and is at its maximum just as the shot leaves the muzzle. You will realise also that the gases which result from the burning of the powder would, if the burning were instantaneous, be at their maximum pressure at the moment of explosion, and that, as the space in which they are contained is increased by the forward movement of the shot, the gases having to occupy this larger space will become less in density, and, therefore, lower in pressure.

Now, if that which I have told you is correct, and if heat and motion are convertible the one into the other, and if a portion of the heat due to the explosion of the powder charge has really been put into the shot in the form of motion, we should be able to reproduce from the moving shot the heat which in it has been transformed into motion. You, all of you, know we can do this. You, all of you, know that if we suddenly arrest the motion of the shot, heat is developed, and that, in fact, if the shot had sufficient velocity, and was composed of a metal having a low melting point, it might be fused. A peculiar illustration of this transformation of work into heat by the stoppage of a rapidly-moving projectile, is afforded by an incident which Sir Frederick Bramwell has related to me. He was present at the firing of one of the earlier Palliser projectiles. These are, as you know, made of cast iron, the points being chilled in the casting so as to harden them, with the result that, although cast iron is very brittle, yet the shots will penetrate a thick armour plate, such as would stop a softer projectile. When this Palliser shot was fired, it passed completely through the armour plate, the point of it, however, being broken up in doing so. Sir Frederick went to pick up one of the broken pieces. Someone presebt cautioned him that it would be hot; he, however, knowing it could not be hot on the inside—the motion (or heat) in it having been transformed into the work of penetrating the plate—took hold of it on the inside, and found that, as a fact, it was not hot; and it was not, because the "work" which had been put into it by the combustion of the powder charge in the gun had not been retransformed into heat, but had been absorbed or dissipated by the shot passing through the armour plate. If the shot had been of a soft metal, say mild steel, it would have been "set up" or "burred over" when the plate was struck, and its motion would then have been transformed into heat, and Sir Frederick could not have touched the broken piece of shell without being burnt. Of course, on the outside of the shot, where it had been in contact with the plate, it was hot—due to the friction of that contact.

We have learnt that heat and pressure are developed by the explosion or combustion of the powder charge; that as the shot moves forward the gases expand, or their density is lessened, and that therefore the pressure lowers; that a portion of the heat is transformed into motion, and is stored up in the shot, and that we can cause that heat to reappear by arresting the motion of the shot; and this being so, it follows that when the gun is fired without a shot, as none of the total quantity of heat is abstracted for the purpose of giving velocity to the shot, it should be hotter than when fired with a shot in it, proving, therefore, the truth of Count Rumford's assertion.

Further, we can see that expansion or dilatation of the gases produced by explosion takes place as motion is created, or as work is done; we shall find that a similar expansion of the working agent almost invariably accompanies any transposition of heat into work.

We can also realise that, while the addition of heat produces expansion, the converse is true, and the abstraction of heat will lessen the density of a gas; or what is the same thing stated in another way, will lessen its pressure if the volume remains constant.

It is true of almost every body, and in all the various "perfect and complete states" of each body—i.e., the solid, the fluid, and the gaseous—that the addition of heat causes expansion; but it is also true that with almost every body, at the critical periods of change of state from the solid to the fluid, or from the fluid to the gaseous, there is an absorption or disappearance of the heat which may be put into it, which heat can only be caused to reappear when the body is allowed or compelled to reassume the more solid state, or its lower state of being, if such an expression may be permitted.

Solids expand by the addition of heat, though in less proportion than gases. An instance, familiar to those of us who are engineers, is afforded when we have to deal with cast-iron steam-pipes of great length, subjected as they are to considerable variations of temperature. We know that in a pipe of 800ft. we have to allow for a variation of, roughly, 1ft. for each difference of 200 degrees of temperature to which the pipe will be exposed; that is to say, a pipe which is 800ft. long at a temperature of 32 degrees, or at freezing point, will expand to nearly 801ft. if it is filled with boiling water. Mr. Benjamin Baker tells me that at the Forth Bridge he has made an allowance of ¾in. for every 100ft. of length, and this to provide for the difference of summer and winter temperatures, which may be as much as 100 degrees.

A still more familiar instance of the effects of variations of temperatures is afforded by the ordinary mercurial thermometer. Heat causes the liquid mercury to expand or dilate, cold causes it to contract. The expansions of the steam-pipe and of the mercury, however, are small in comparison with the expansion of gases; "steam," "air," or whatever they may be, for an equal increase of temperature.

We know if we have a bladder partly filled with air and we heat it, it expands, filling that bladder—or appearing to fill the bladder entirely; we heat it still more, the expansion is greater; and we can heat it till the pressure increases so much that it exceeds that which the bladder is capable of bearing, and the bladder bursts. This is a simple illustration of the fact of increase of temperature causing expansion, and also causing increase of pressure. Let us now consider the question of specific heat, and let me here caution you as to the difference between the words "heat" and "temperature." This caution is necessary, for, as I am about to show you, heat may be added to, or taken from, a body without corresponding change of temperature.

Experiment has proved that different solids and fluids require varying quantities of heat to be put into them, or to be taken from them, in order to increase or lower their temperature through any given range. The amount of heat absorbed or given off, as the case may be, by any substance to vary its temperature through any given number of degrees, is termed "specific heat."

A "quantity" or an "amount" of heat is always spoken of as so many "heat units" or "thermal units." By an English "heat unit" is meant that amount of heat necessary to raise 1lb. of water from 39·1° to 40·1° Fahr.—i.e., the amount of heat necessary to raise 1lb. of water at the temperature of its greatest density, 1° Fahr.

Of all bodies, water is the one which opposes the greatest resistance to a change of temperature; that is to say, it requires a greater amount of heat imparted to it, or abstracted from it, to cause a given change of temperature in it, than does any other solid or liquid we know. Water, therefore, is used as the standard of comparison, and its specific heat is taken as unity. From this it follows that the specific heat of all other bodies, whether solid, fluid, or gaseous, must be expressed in fractions, or as parts of unity. The specific heat of water itself is not absolutely constant at all temperatures, becoming slightly increased at 212° Fahr., or at its boiling point; but it is sufficiently constant, at all events, for us to ignore the variation.

You will now comprehend the definition of specific heat. It is the ratio of the quantity of heat necessary to raise or to lower a given weight of any given body through a given variation of temperature—say one degree—to the quantity of heat required to raise or lower the temperature of an equal weight of water through the same variation of temperature.

Regnault's experiments have told us that the specific heat of cast iron is ·12983, therefore ·12983 × 200° × 1lb. = 25·966 heat units. The same experimenter gives the specific heat of mercury as ·03332, therefore ·03332 × 200° × 1lb. = 6·664 heat units, or in other words, about $\frac{1}{8}$th the heat needed to raise 1lb. of water 200° would raise 1lb. of cast iron 200°, while $\frac{1}{30}$th the heat required for the water would raise the same weight of mercury through the same temperature; and, as between the two metals, nearly four times as much heat would be required to raise the same weight of mercury through the same range.

One of the distinguishing characteristics of the gases is, as we shall now find, that their specific heat does not vary, under similar conditions, to an appreciable extent.

Let us put this difference of the specific heat of gases, under different conditions, into figures.—The specific heat of a gas—say air—when the volume is kept constant, but the pressure is allowed to vary as the heat is imparted or abstracted, is ·169, or practically $\frac{1}{6}$th of that of water, but the specific heat of the same gas (air), when the volume is allowed to vary as the heat is imparted or abstracted, but the pressure is kept constant, is ·238, or a little less than $\frac{1}{4}$th of that of water. You will see that the ratio between the two is as 1 to 1·408.

This is the way in which this question of the difference of the specific heat of gases, under varying conditions, is usually stated in the textbooks. It has been pointed out by Sir Frederick Bramwell and others that the bare statement thus made is hardly intelligible and is incomplete. They say that the increase of the specific heat of a gas when its volume is allowed to vary, arises from the amount of heat necessary to be turned into work, in order that the gas, in increasing its volume, shall be capable of displacing that portion of the atmosphere which it does displace—that is to say, if while maintaining the temperature constant we allowed the shot to move forward in a gun, and assuming that no work was required for moving that shot, and that no heat was lost in any way whatever, then the extra amount of specific heat which the gas would require as its volume increased would be exactly that necessary to overcome the pressure of the atmosphere, and to do the work of displacing that portion of it which would be occupied by the increased volume of the gas.

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* Extracted from the Cantor Lectures delivered by Mr. H. Graham Harris, M.Inst.C.E., before the Society of Arts.

We have one more question of heat to consider, which almost logically follows from that which we just discussed, and that is "latent heat."

Let us take water again for our illustration. A certain definite addition of heat is necessary to raise any given weight of water each degree of temperature up to the boiling point; but then, in order to change the water—which is at boiling point—to steam, which is not, however, at any higher temperature, a large quantity of heat has to be added, which seems to totally disappear, and can only be caused to reappear by rechanging the gas (steam) into the fluid water. As a fact, we may look upon steam as a mixture of heat and water, the heat really being absorbed by the particles of water at the time of its change into steam, and not making itself sensible in the instrument with which we measure the heat; and we may also look upon water as a mixture of heat and ice. You know we can tell by the sense of touch the difference of temperature of a body. Now, if it were possible for us, without burning ourselves, to put our hands into boiling water and realise its temperature, we should suffer no more from the heat than we should by putting our hands into steam at atmospheric pressure; and yet we find by experiment that, in order to change the fluid (water) into the gas (steam), we must add a quantity of heat which would be sufficient to raise the temperature of the water, if it remained as water, 966·6°.

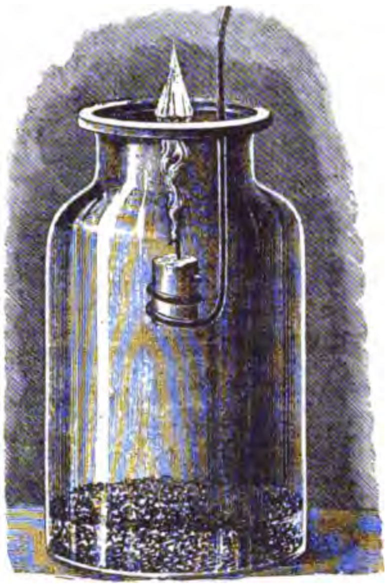
James Watt was one of the earliest to discover and publish this fact of latent heat in reference to water and steam, and in 1781 he estimated the number of heat units necessary to make the change in 1lb. of water as 950, but he subsequently put the numerical value at 960. Corrections were made by Regnault, based on experiments which he had made, and his formula gives the true value—namely, 966·6 units—as the quantity of heat which disappears or becomes latent when each 1lb. of water, at a temperature of boiling point, is transformed into steam, which will only be at the same temperature. Further, I must remind you that in order to change 1lb. of ice at 32° into water which is only at the same temperature, 142·4 units become latent or disappear. You will now fully realise the necessity for the caution not to confuse the terms "heat" and "temperature."

A SCIENTIFIC WILL-O'-THE-WISP.[*]

A VERY interesting experiment that illustrates the phenomena of combustion, destructive distillation, and the relative specific gravity of gases is illustrated in the cut accompanying this article. The experiment depends upon the well-known fact that an organic substance containing hydrogen when heated to a high temperature evolves gas. This is seen in the candle. The body of the flame is composed of gas evolved by destructive distillation from the organic material of which the candle is composed. This material is melted by the heat of the flame, is drawn by capillary action into the wick, and is there heated to so high a degree as to evolve a large amount of gas. A well-known experiment used to prove the presence of this gas consists in lowering into the flame the end of a glass tube held nearly vertical. The hot gas from the interior of the flame rises through this, and can be lighted at its top several inches distant from the flame.

There is a simpler way of showing it, which requires still less apparatus. If a candle is lighted and allowed to burn a few minutes, the wick becomes very hot. If it is now blown out, enough heat will be present in the wick and its contents to cause the evolution of combustible vapour. It can be recognised by a white column of vesicular matter rising like a fine mist from the candle. If a lighted match is held in this rising column a few inches above the candle flame, the vapour will ignite and will carry the flame down to the wick with a quick flash, and the candle will be relighted. It follows that, if the residual heat left in the wick is sufficient for the evolution of this amount of gas, the far hotter flame acting on the same material must evolve still more.

In the experiment shown in the cut some features of the last-described phenomenon are utilised to produce what may be called a parlour will-o'-the-wisp or *ignis-fatuus*. A wide-mouthed bottle, such as a pickle or preserve jar, is filled with carbonic acid gas. To do this a quaniity of sodium bicarbonate or baking soda is placed in it, and more acid is poured over the dry salt as it lies on the bottom of the jar. Dilute sulphuric acid is perhaps the best, but muriatic acid or even vinegar may be used. A very rapid evolution of gas begins, and in a few seconds the jar is filled and overflowing. A candle should have previously been attached to a piece of wire, and should be lighted before the acid is introduced. This will give it time to get hot and into full combustion. The jar being filled with gas, the candle is gently lowered into it. The flame surrounding the wick is extinguished as it reaches and is lowered down into the carbonic acid gas, but if all is rightly managed, the flame will continue to burn on the surface of the gas like a veritable *ignis-fatuus*. The residual heat of the wick and material absorbed by it is sufficient to cause the evolution of a quantity of gas. For several seconds this rises up through the heavier carbonic acid gas, and burns upon its surface. A faint cloud of vapour may sometimes be seen, which indicates the ascending column.



After a few seconds the disconnected floating flame disappears for want of nutriment. The candle may now be removed and relighted, and a variation upon the experiment may be shown. It is again lowered into the gas in the jar, and is extinguished, leaving the same floating flame. But before the latter expires the candle is steadily raised. As it reaches the flame and emerges from the jar, it is lighted again, and continues to burn as before. The flame that is left behind it on the surface of the carbonic acid gas acts like the match in the experiment last alluded to, and relights the wick.

To perform the experiment successfully, the air of the room must be very still and undisturbed. In place of the candle a small glass jet may be used connected to a gas burner. The gas will rise from the jet immersed in the jar, and will burn upon the surface as in the case of the candle. But the experiment is not as full or complete as when the candle is used, and it is not easy to obtain so distinct and marked a separation between the source of gas and the flame when ordinary gas is employed.

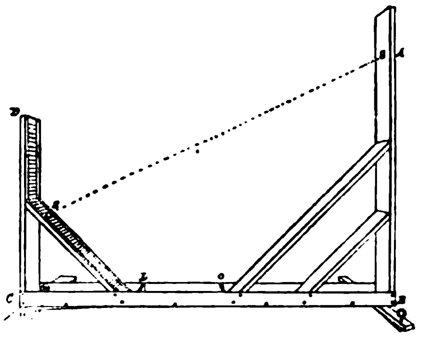
FINDING THE CORRECT TIME.

THE drawing represents a simple, inexpensive instrument that can be used on land instead of a sextant to find the correct time by measuring the zenith distance of the sun. It is easily made, being entirely of wood, except the fastening, two screw-eyes, and two thin pieces of steel at H and B, each having one end screwed fast under the bottom, and the other end free, so that it can be moved up and down by a screw-eye through the wood above it to level the instrument. A piece of an old saw blade will serve for each of these. The drawing shows the construction. The bottom, uprights, and braces are boards (pine, cedar, or redwood, well seasoned and straight grained, so as not to warp), about 3½in. wide. The bottom one may be about 5ft. long, and the others about in the proportion represented. But this is not material.

On each side of the bottom, to stiffen it, a thin strip, 3in. wide, is fastened by screws. Between these, at L and O, two rectangular blocks, having their tops in the same plane, and used to lay the level on, are firmly screwed to the bottom. At A, about a foot below the top of the taller upright, is an opening slanting downward from the outside, so that the sun can shine through it when at a considerable elevation, and covered on the inside with a piece of sheet zinc or tin pierced with a small pinhole. The sun shining through this minute hole, towards the opposite end, will form an image of itself, as at S. If in this case the upright, A B, is vertical, it is evident that the angle, S A B, will be equal to the apparent zenith distance of the sun.

To complete the instrument and find this angle astronomically, a strip of white paper is pasted on the inside of the smaller upright and brace, and divided by a number of equidistant horizontal lines, whose distance apart should be about half the diameter of the sun's image, so that when its centre is on any one line the edges will just touch the lines next above and below. The lines should be numbered.

When this has been done, the instrument is placed on the floor near an open window, through which the sun is shining, in such a position that its image may fall on the scale. The two ends are supported on strips of wood, a foot or more in length, as shown in the figure, to correct the inequalities of the floor. The one at B has a screw-eye and metal strip for levelling transversely. The one at C can be pushed over the floor to keep the image near the middle of the scale while observing. The instrument having been levelled transversely by the screw-eye at B, and lengthwise by that at C, the times at which the centre of the image is on several lines are carefully noted by a good watch. This observation should be made three or four hours before noon, and in the afternoon when it recrosses the same lines the times should be again noticed. The mean of the times when it crosses and recrosses the same line, or when the sun is of the same altitude in the morning and the afternoon, is very nearly the true time of noon. It would be exactly were it not for the sun's change in declination. The correction for this (only a few seconds) is readily calculated, and when applied gives the correct time of noon by the watch. The difference between this and the true time of noon given in the almanac is the error of the watch. The error of the watch being known, we know the true time of each observation, and having this and the latitude of the place, the corresponding zenith distance of the sun can be computed. In the same way it can be found for other lines, and a table of all the angles made, to be used for finding the time by a single observation in the morning or afternoon. The angles found in this way being the true zenith distance of the sun's centre, they require no corrections, such as have to be made for semi-diameter and refraction when a sextant is used, and, with a sensitive level, can be measured quite as accurately. In order to have the image well defined on the scale, the part where it is formed should be well shaded by either covering a part of the window or by hanging a pasteboard or paper screen on the upright with a hole in it opposite A, or by both. This instrument is in use at Santa Barbara, Cal., for regulating the town clock. Before the city had railroad communication it was found especially useful.



Hugh D. Vail.

"DROP A PENNY IN THE SLOT."

UNDER a title somewhat similar to the above, but identical in meaning, Prof. E. J. Houston calls attention to the antiquity of the modern devices—so far as the idea is concerned.

If King Solomon found it so difficult to be original, how much more so must it be now that so many inquiring minds have laboured diligently since the days of Israel of old, to find out something brand-new "under the sun." So much has been recently written concerning anticipations of different patented ideas that some little hesitation is experiencod in calling the readers of the *Electrical World* to a very curious instance of a recent invention that appears to have been known and used before the Christian era. I refer to an unquestioned anticipation of apparatus of the type of "Drop a nickel in the slot," &c. I trust that the novelty of the reference may warrant my calling attention to it. Thos. Ewbank, in his "Hydraulics and Mechanics," published in New York, 1851, describes on pp. 386 and 387, a device referred to by Heron or Hiero in his "Spiritalia." The "Spiritalia" was published by Baldus in the 17th century, and contained an exposure of many of the frauds of the Egyptian hierarchy. In this work will be found a description of a device for automatic dispensing of the purifying water by the worshippers on their entrance to the temple. By a strange coincidence *five drachmæ* were required to operate the apparatus. "*In spondea hoc est in vasa sacrificii injecto quinque drachmorum numismate aqua ad inspergendum effluit.*"—"Spiritalia," XXI.—i.e., a coin of five drachmæ being cast into the vase, the water will run out for sprinkling.

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[*] By T. O'Conor Sloane, Ph.D., in the *Scientific American*.

The following description of the apparatus referred to was published by Ewbank in 1851, in his "Hydraulics and Mechanics" already referred to. "From Heron's description of the figure we learn that heathen priests also made it (water for ablution) a source of revenue; the vessels containing lustral water not always being open for public use, free of charge, but closed, and, like a child's money-box, provided with a slit at the top, through which a certain sum was to be put before the donor could receive any of the purifying contents. In the vase *five drachmæ*, or about 75 cents, were required, and no less sum could procure a drop, although as much more might be put in as the donor thought proper. The device is a very neat specimen of religious ingenuity, and the more so since it required no attending minister to keep it in play. We may judge of other apparatus belonging to the old temples by the talent displayed in this. Near one side is a cylindrical vessel. It is this only that contained water. A small tube attached to the bottom is continued through the side of the vase, where the liquid was discharged. The inner orifice of the tube was formed into the seat of a valve, the plug of which was fixed on the lower end of the perpendicular rod, whose upper end was connected by a bolt to a horizontal lever or vibrating beam. One end of that was spread out into a flat dish, and so arranged as to receive on its surface everything dropped through the slit. The lever turned on a pin or fulcrum, very much like a pump-handle. As the weight of the rod kept the valve closed while nothing rested on the broad end of the lever, so no liquid could escape; but if a number of coins of sufficient weight were dropped through the slit upon the end of the lever, the valve would then be opened, and a portion of the liquid escape. The quantity flowing out would, however, be very small, not only from the contracted bore of the tube, but from the fact that the valve would be open only for a moment, for as the lever became inclined from its horizontal position the pieces of money would slide off, and the efflux would as quickly be stopped; the apparatus would then be ready to supply the next customer on the same terms."

Sunshine at Greenwich.—The number of hours of bright sunshine recorded at Greenwich during 1888 by the Campbell-Stokes sunshine instrument was 1068, which is about 250 hours below the average of the preceding eleven years, after making allowance for difference of the indications with the Campbell and Campbell-Stokes instruments respectively, and it is 333 hours below that of 1887 recorded with the same instrument. The aggregate number of hours during which the sun was above the horizon was 4,465, so that the mean proportion of sunshine for the year was 0·239, constant sunshine being represented by one. A comparison has been made of the records of the Campell and Campbell-Stokes instruments for the twelve months from 1886, June 1st, to 1887, May 31st, with the result that the former registered 1,256 hours of bright sunshine, while the latter registered 1,364. It would appear, therefore, that the indications of the former instrument require to be multiplied by the factor 1·086 to make them comparable with those of the latter.

Lactose as a Diuretic.—Dr. Dujardin-Beaumetz stated, at a meeting of the Paris Academy of Medicine, that he had verified the diuretic action of this substance. He had tried to ascertain whether glucose had not the same diuretic action as lactose. He found that with a dose of 100 grammes of glucose in two litres of milk per day an abundant diuresis was produced, whereas two litres of milk given alone did not produce any, and he mentioned as a curious fact that at this dose the glucose did not appear in the urine—at least, not in the first days. He was led to deduce from M. Sée's communication that all saccharine principles may possess diuretic properties. He, however, recognises the advantage of lactose over glucose, because the first does not pass into the urine, whereas the second renders patients diabetic. He therefore considers it necessary to make further researches on this subject, with the view of ascertaining whether there would be any inconvenience in rendering a subject glycosuric in order to cause his dropsy to disappear.

SCIENTIFIC NEWS.

THE comet discovered by Mr. Barnard on June 24 has been observed from several European stations, and Dr. Kreutz, of Kiel, has calculated an orbit, from which it appears that the comet passed perihelion about the 3rd inst. (July 2·8884 Berlin M.T.). Its position, according to Prof. Krueger, will be July 22, Berlin midnight, R.A. 3h. 41m. 23s.; N. Dec. 49° 17·9′. As the distance from the earth is increasing, the comet, which was only "faint" at discovery, will become fainter, though visible in powerful telescopes.

The comet discovered by Mr. Barnard on March 31, known as 1889 *b*, passed perihelion on June 10·636 Berlin M.T., and is increasing slightly in brightness, though even at the end of this month it will be less than at time of discovery. Its position on July 27, Berlin midnight, will be R.A. 5h. 5m. 53s.; N. Dec. 10° 7·7′.

Barnard's famous comet of last year (1888 *e*) is now decreasing in brightness; but on June 3 he noticed that it had only one tail, which followed the nucleus and pointed almost directly to the sun. The position on July 23, Berlin midnight, will be R.A. 20h. 23m. 44s.; S. Dec. 1° 58·9′, when it will still be more than twice as bright as at time of discovery.

The superintendent of the United States Naval Observatory communicates to No. 194 of the *Astronomical Journal* a paper, by Prof. Harkness, on the "Masses of Mercury, Venus, and the Earth, and on the Solar Parallax." Fourteen determinations of the mass of Mercury and nineteen of that of Venus have been made; but the separate values differ largely amongst themselves, so that a rediscussion of the original data appears to be desirable. The result of his investigation is that the mass of Mercury, compared with that of the Sun, is $\frac{1}{8706850}$, but with a large probable error; that of Venus, $\frac{1}{403831}$. He determines the mass of the earth to be $\frac{1}{332758}$, compared with that of the sun, and from this deduces a value of the Solar Parallax amounting to 8·795″ ± 0·016″.

It is stated that Sir Edward Watkin is the purchaser of "the summit of Snowdon," and has intimated his intention to offer a site on the summit to the Royal Astronomical Society for the erection of an observatory.

The eclipse of the moon on Friday last does not seem to have afforded any opportunity for useful observations, as in most places the weather was too cloudy.

Miss C. W. Bruce, of New York, has sent the sum of fifty thousand dollars to the Harvard College Observatory to be applied in the construction of a telescope having an objective of about 24in. aperture, and a focal length of about 11ft., to be used for photographic purposes, and also for the advancement of astronomical science.

Father Chevalier, S.J., director of the Sikawei Meteorological Observatory, near Shanghai, has issued one of his bulletins containing a study with diagrams of the two typhoons which were experienced in South China during August last. The charts prepared by Father Chevalier are of much value.

The international congress to determine the most suitable methods for carrying out the photographic charting of the heavens will be held in Paris from August 22 to September 3.

Deputy Surgeon-General Francis Day, F.R.S., LL.D., C.I.E., died last week. Excepting the venerable Dr. Henry John Carter, who survives him, he was the greatest of Indian naturalists of the passing generation. He was appointed to the Madras Establishment in 1852, and after taking part in the military operations then in progress in Burmah, for which he received the medal, he thenceforward devoted himself exclusively to the study of the fishes of India, and in numerous papers to scientific journals placed on permanent record a mass of information on the subject. His type collection of Indian fishes is in the Imperial Museum at Calcutta; he contributed collections also to the Natural History Museums at Sydney, Leyden, Berlin, and Florence, and to the British Museum, to which he also sent his remarkable collection of Indian crabs. After his retirement from the Madras Medical Staff in 1877 he devoted himself to the study of the fishes and fisheries of the United Kingdom, publishing a large work on the subject, entitled "The Fishes of Great Britain and Ireland," in 1880—83. In recognition of his eminent services to Indian pisciology, Dr. Day was created a Companion of the Order of the Indian Empire in 1885, and was also presented about the same period with the Cross of the Order of the Crown of Italy.

The death is announced, at the age of sixty-five, of Dr. Charles Elam, M.D., F.R.C.P., "first gold medallist" in medicine at London University in 1846. Dr. Elam was a voluminous writer, and among his more important works may be mentioned the following: "Medicine, Disease, and Death; being an Inquiry into the Progress of Medicine as a Practical Art," 1870; "A Physician's Problems," 1870; "On Cerebria and other Diseases of the Brain," 1872; and "Winds of Doctrine; being an Examination of the Modern Theories of Automatism and Evolution," 1876. He was also the author of treatises on "Moral and Criminal Epidemics," "Civilisation," "Illusions and Hallucinations," "Liberty and License in Science," "The Gospel of Evolution," and "Man and Science," and of numerous contributions to the medical journals.

Mr. Neilson, a name well known to all interested in locomotives, died the other day in his seventieth year. Walter Montgomerie Neilson was born in Glasgow, and was trained in his uncle's works at Oakbank Foundry as a mechanical engineer. He founded, in conjunction with the late Mr. Kerr, the Hyde Park Locomotive Works; but subsequently he entered into partnership successively with Mr. Mitchell, Mr. Dubs, and Mr. Reid. He retired from business about ten years ago.

It may be as well to remind those who think of sending papers to the British Association, which meets at Newcastle on Sept. 11, that they should forward abstracts to the general secretaries on or before August 14, indicating the section in which the papers are proposed to be read.

The meeting of the American Association will be held at Toronto, commencing on August [illegible]. Special arrangements have been made for a discussion in Section B on the dynamometric and magnetic methods of obtaining absolute measurements of electric currents, when Prof. T. Gray, of the Rose Polytechnic Institute, will introduce the subject, and will exhibit some of the latest forms of Sir W. Thomson's electric balances. During the session a meeting will be held with the object of forming a National Chemical Society with head-quarters at Washington.

The French Association will this year commence its session on August 8, almost as a matter of course in Paris. The German Association (Naturalists and Physicists) will commence its session at Heidelberg on Sept. 17.

Sir M. Hicks-Beach, in replying to a question in the House on Monday with reference to the designs now encumbering the rooms at the Patent Office, stated that there are 504 volumes of expired designs in the Patent Office. He had been in communication with the Master of the Rolls and the Lords of the Committee of Council on Education with regard to their removal to South Kensington. The Master of the Rolls has assented to their removal, and the Department of Science and Art have applied to the Treasury that authority may be granted for the provisional occupation of part of the wall space of a room in the Exhibition galleries in Queen's-gate, but the Treasury refuse sanction to such an arrangement. These designs ought to be placed where they can be utilised, and it might be desirable to have them formed into separate collections and lent in the chief seats of the industries they represent.

A novel feature of the Edinburgh University Extension Scheme was inaugurated on Saturday last, when the members of the Physiography Class, which is being conducted at the Philosophical Institution, had an excursion on the Firth of Forth. The party, numbering [illegible] ladies and gentlemen, sailed round Inchkeith and up the Firth as far as Queensferry, returning to Leith in the evening, after a cruise which was the means of conveying a great amount of instruction in a very pleasant manner. Dr. Hugh Robert Mill, the lecturer, assisted by Mr. Pearcey, of the *Challenger* Expedition, showed in operation various forms of deep-sea thermometers, dredges, and tow nets, some of which were lent for the occasion by the Fishery Board for Scotland. The demonstration was accompanied by an informal lecture on the physical and biological conditions of the Firth of Forth. The observations which were made on the temperature of the estuary showed that the surface water was about one degree warmer than at the bottom, and that it increased at the rate of one degree for every five miles towards the river. Thus at Inchkeith the surface temperature was found to be 54·5°, at Inchcolm 55·7, and at Queensferry 56·8. This, it was pointed out, is the typical distribution of the temperature in an estuary in summer. A number of interesting biological specimens were also obtained and described.

A congress on "Physiological Psychology," is to be held in Paris from Aug. 5th to the 10th. The president is Prof. Charcot, and the general secretary Prof. Charles Richet, 15, Rue de la Université, to whom all inquiries should be addressed. Amongst the English members of the committee, which includes representatives from every country on the Continent and from the United States, are Prof. Bain, Mr. F. Galton, Dr. Hughlings Jackson, and Dr. de Watteville. The subjects for discussion comprise—1. Muscular Sense. 2. Share taken by Movement in the Formation of Images. 3. Is Attention always Determined by Affective States? 4. Statistics of Hallucinations. 5. The Appetites in Idiots and Imbeciles. 6. Are there among the Insane Motor Impulsions apart from Images and Ideas? 7. Psychical Poisons. 8. Heredity. 9. Hypnotism.

The New Geological Map of France.—The great chart of France, showing the geological formations of the country on a scale of 1-500,000th has at length been completed, and a copy deposited with the Academy of Sciences at Paris. It is over 50 years since MM. Dufrenoy and Elie de Beaumont published a geological map of France on the same scale, and since that period the rocks of the different provinces have been more intimately studied. In 1882 the new general map was begun under the superintendence of the Commandant Prudent, and published by the Depot of Fortifications. It has just been finished, and is an example of the most accurate cartography. Local geologists have contributed to the work as well as the Government surveyors, and the scale of 1-500,000th has been adopted in deference to the wish expressed at the Geological Congress at Boulogne in 1881, so that different countries can more easily compare the map with their own. The scale of colours recommended at that congress has also been followed—that is to say, the sedimentary series is represented by the colours of the spectrum in their regular order. Thus the trias is coloured violet, the Jurassic blue, the cretaceous green, and the tertiary yellow. Each of these general colours is subdivided into shades which are deeper according as the rocks are more ancient. This is the first time the method has been employed on a large work, and it has given every satisfaction, since it allows the systems of rocks and their different gradations to be readily recognised. The eruptive rocks have been coloured in different shades of red, and the crystalline schists in carmine. As for the primary rocks, on which the congress came to no decision, the authors of the map have been guided by the same principles in choosing their tints. The Silurian has therefore been coloured a flesh pink, and the Devonian a red brown. The carboniferous, according to old habit, has been coloured a black and deep grey, while the Permian is represented by a yellowish grey. No fewer than 50 shades are employed; but all are easy to distinguish. They are obtained by superposition, or difference of intensity, from 13 colours. The entire chart consists of 48 sheets, and it is expected to prove very useful to the nation from an industrial point of view.

The Locomotive a Fire-Engine.—It is stated that the Pennsylvania Railroad Company has decided to make another innovation in its service by placing on engines a connection with the steam pump, by which a hose can be attached, and in case of fire be of great service. Whenever a smash-up or wreck of passenger cars takes place, especially in the winter, when the car stove is doing its best, a great many lives are lost by fire. The new arrangement, it is hoped, will prevent a great many casualties. A few days ago it was given a test. The apparatus was attached to an ordinary shifting engine, and at a given signal the pump was put in motion. The hose, which will be about the length of six cars, will be carried on the tender. It is also proposed to equip the crews of the various trains, and train them in the fire drill. If they prove successful, a number of passenger engines will be equipped.

The University of Durham will henceforth confer degrees in music, after examination, upon students who have previously passed certain examinations in general education.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

RED SPOT ON JUPITER.

[30142.]—For a long time past there has been a complete dearth in the pages of the "E. M." of anything relating to the aspect of the planet Jupiter, and many will doubtless have welcomed with delight Dr. Terby's interesting note on the planet and the red spot on p. 414. I have observed the last-named marking several times during the present apparition of Jupiter with my 6½in. Calver reflector, power 170, and whilst my observations agree in general with Dr. Terby's, in indicating that the spot has become again more uniformly sombre, yet they apparently differ slightly from his in some respects. Thus I have several times seen the south following margin edged by a narrow dark border, a last remnant, it is to be presumed, of the former annular appearance of the spot. A small dark speck has also been seen on several occasions at the following extremity. A similar dark spot was frequently seen in former years at the preceding end, and on the 6th of July last a minute dark speck was again visible on the preceding tip. With these exceptions the spot seems to me very nearly uniform in tint, and it is not a difficult object with my aperture on an average night. Just preceding it is an ill-defined whitish patch, which was also visible last year.

I hope that some other observers will give the results of their observations upon this planet, which now forms such a tempting object in the evening sky. Perhaps also Dr. Terby will kindly say if he has seen the little details mentioned above.

July 12. **A. Stanley Williams.**

POLARIS.

[30143.]—You may possibly think the following worth recording. On July 5th, when the moon of 7·6 days old was low down, definition good, though a little unsteady, directing my 4in. refractor with power of 120 to Polaris, merely for the sake of testing one of its adjustments, I was struck by the appearance of a companion I had never noticed before, and which both a friend and myself had certainly missed three nights previously when expressly looking for the well-known *comes*. I satisfied myself repeatedly of the reality of the existence of this new, as well as of the true, companion, but thought no more about the matter till the next morning, when, looking with another object through back numbers of the "E.M.," I chanced to catch sight of letter 23001 in Vol. XXXIX. p. 436, where Mr. Binns describes the same appearance, and eliciting remarks from "F.R.A.S." and others, subsequently drew it precisely as I had noticed it. Mr. Binns was employing a larger aperture, but had to contend against much stronger moonlight. The coincidence of the dates of the year being almost identical (Mr. Binns's observation being July 6, 1884) may be worthy of notice; but though we are familiar with the fact of variability often agreeing closely with the period of the earth's revolution, it must be contrary to all experience to find stars having such a marvellously brief period of visibility as these observations would point to.

Newbury. **Rev. J. M. Bacon.**

GASSENDI—ζ BOOTIS.

[30144.]—In letter 30092, p. 389, Mr. Herbert Ingall speaks of the crater I have called attention to in my previous letters, as being on the N.W. part of the floor. If Mr. H. Ingall will again read my letters, he will see that the crater in question is on the top of the N.W. wall, at a place where, so far as I know, no crater has been seen before. Mr. Ingall's own drawing, as well as the one of Mr. Geo. P. B. Hallowes, p. 413, bear witness to this. Perhaps Mr. Ingall has been led astray by a minute object coming out of the shadow, in my sketch, p. 257, near the place where the crater was found on May 11th. But his object is not a crater, but a small hillock.

On July 8, from 8h. to 10h. the N.W. portion of the wall of Gassendi and a portion of the wall of the "Spoon" or crater A was on the terminator. At the place where the crater is I saw a break in the wall, much larger than the crater, covered with shadow. Soon after a lower and thinner portion of the wall was lighted up: but still a larger shadow than the crater obtained on the W. About 10h., when the moon was about to disappear behind my house, the circular form of the crater was apparent, but the air had become so unsteady on account of irradiation, that definition was quite spoilt. I also noticed during this observation that either debris or lava was seen, as if a stream had run down from the crater down to the valley, and, of course, out of Gassendi. A short distance W. of the crater another break on the wall, covered at first by shadow, but giving place soon after to a thinner portion of the wall, exists, and has a much larger stream of debris, which appeared to me as of a spongy character, brighter than the rest of the slope. On this stream, near the top, I found a very small crater never seen before by me. On the 9th, crater faintly seen through clouds.

In answer to query 69076, I have several times observed ζ Boötis this season. My best observation I made last evening with my 10¼in. mirror, by With, power 750 ±, I saw two round discs, all but divided, with hardly any appendage, the companion being distinctly seen smaller. I estimated its position at 310°. As for the distance, as the star is rather large, I suppose it is about 0·4″, or perhaps less. I should be glad to know its exact distance.

July 13. **C. M. Gaudibert.**

MOON'S POSITION.

[30145.]—"F.R.A.S.," in letter 30115, of July 12th, is somewhat in error as regards the position of place where the moon is vertical at 5h. 4m. on Aug. 24th; 5h. 4m. is solar time, and must be transformed into sidereal time before it can be added to the sidereal time at noon.

The sidereal time at 5h. 4m., Aug. 24th, is 15h. 16m. 39·02s., from which taking the right ascension of the moon, we have 6h. 23m. 10·46s., and this converted into solar time gives 6h. 22m. 7·69s. west of Greenwich. The point over which the moon is vertical is therefore not north and *west* of Vera Cruz, but north and *east* of it.

A. Dixon.

OBSERVATORY FOR £2—CLOCK-GUN—COMPRESSED AIR.

[30146.]—I redeem my promise of a week or two ago. Taking my dimensions for an observatory from "Astronomy for Amateurs," I found 8ft. square recommended for a telescope of 5ft. length. Digging, then, a foundation 9in. deep, I demolished a small danger house (for I used to be a pyrotechnist before I turned practical astronomer) to supply the few necessary bricks needed to keep the wooden structure off the ground, and this wooden house I proceeded to build of stout quartering and weather board. For shelter, however, I utilised a few yards of spare Forfar (tent-making having been another of my trades), and with this suitably waterproofed, constructed a high-pitched span roof having a ridge of light wood supported by two iron rods which, being bent into elbows at their lower extremities, and working in sockets on the top of the wall-plates, allow of the whole roof being expeditiously put up and down, like the hood of a carriage. This dispenses with the extra cost of a substantial roof rolling back on extended wall-plates, and allows of the ridge and one-half the canvas being kept up, if desired, as protection. It is at the same time very manageable, and in the worst storms of this year has been absolutely weather-proof. When I state that the timber-merchant's bill was £1 18s., I have probably said enough; but, of course, shall be only too glad to furnish any further particulars.

"Experimenter" (query 69070) may try the device quoted from the *Gardeners' Chronicle* by "Saul Rymea" in the "E. M.," Vol. XXIII. p. 464, on the understanding that it by no means follows that a scare or trap which answers in one locality will succeed equally well in another. Few persons in this part of the country, at least, will believe that in some places rats may be caught in gins unconcealed and unbaited; yet it is a simple fact that, staying once at a retired house among the Cumberland lakes, I caught a number of rats in this way, continuing my trapping with great success until I had the misfortune to catch the family cat.

It will probably suffice "G. C. T." (query 69054) to know (1) that air is commonly under a pressure of 15lb. to the square inch; and (2) that, temperature remaining the same, its volume is inversely proportional to the pressure it is subjected to.

Newbury. **J. M. Bacon.**

DAYLIGHT OBSERVATIONS.

[30147.]—I sincerely trust that our most respected correspondent, "F.R.A.S.," will not think me rude or cantankerous when I say that I cannot agree with him when he says (referring to the Krakatao dust) "then would every particle of it above the horizon have been illuminated by the sun *alike in his neighbourhood and in that of the pole.*" The italics are mine. What I meant to imply was quite the opposite of this—viz., that the illumination of a veil of dust interposed *between* the observer and the sun would be very apparent, but the same veil *opposite the sun* would be *far less illuminated*. Am I wrong in this?

On Saturday morning last (July 13), at an hour before noon, I easily picked up Mercury, and noted that, although it was at its greatest westerly elongation, and should, therefore, have exhibited exactly a half-disc, it distinctly had a crescent shape. Power 200.

July 15. **Herbert Ingall.**

KEEN SIGHT AND CELESTIAL OBJECTS.

[30148.]—This is a subject on which I think there has been too little exchange of views. It has been touched upon in the "E.M.," and I was in hopes that correspondents would follow it up after "F.R.A.S." proposed that Mr. Dixon should try at what distance he could distinguish a small crescent. I shall in this letter make a few statements on the subject, and in another will give reasons why I think some have discerned the crescent of Venus with the naked eye.

On the question of seeing stars with unaided vision there has been much written that is misleading. When young I read in "Joyce's Scientific Dialogues," "that, in viewing the heavens with the naked eye, we are very much deceived as to the supposed number of stars that are visible at any time. It is generally admitted, and on good authority, too, that there are never more than one thousand stars visible to the sight, unassisted by glasses, at any one time, and in one place." It is therein explained that we see objects which we take for millions of stars, owing to the rays of light, in travelling so far, being subject to numberless reflections and refractions. "By means of these, other rays of light come to the eye, every one of which, perhaps, impresses upon the mind the idea of so many separate stars. Hence arises that optical fallacy by which we are led to believe the stars which we see are innumerable."

Now these quotations, particularly the latter, are misleading, for persons of ordinary sight readily know whether or not what they see are stars. I, myself, for a number of years was under a wrong impression from the above and similar statements in other books.

It seems now to be generally admitted that about 6,000 stars in the entire heavens are visible to the naked eye. There is no doubt but this is true when applied to persons of ordinary sight, but that it falls considerably below the number that can be seen by those of keen sight. I believe there are men of clearer vision than myself, and yet I know I must see many more stars than is said to be seen. On a good night I count eleven in Pleiades; once I counted fourteen. If a square be drawn between Pleiades and Hiades with its sides equal to the distance between them, I count in such space 16 or 18 stars. Within the square of the Great Bear I sometimes count six and sometimes nine stars. There are places in the Milky Way in which I could not count the stars visible. Mr. Burrows, in No. 30066, p. 350, asks if "D. B. L." can separate ϵ^1 ϵ^2 Lyræ, with his 1in. telescope? Mr. Burrows himself would require only a very small power to do the feat when he can "see a crescent as such cut out of a halfpenny at the distance of 48 yards." That is just my power of vision, and I can see the two stars drawn out. Any person with a little more penetrative vision than Mr. Burrows or myself could separate them. Experiment: I take a piece of close-grained brown paper, and make two holes in it with a thin pin, their centres exactly ½in. apart. I place the same before a reading lamp shade and go back; at the distance of 16ft. I see the two holes just separated, at the distance of 24ft. drawn out, but not distinctly as two, just as I see Epsilon Lyræ on a good night.

The first time I tried to see Venus in the daytime I was successful. I knew that she would be near the moon on Sunday, Nov. 13th, 1887, so that would certainly be a good mark, and at 10.25 a.m. I saw the crescent moon in her last quarter, and Venus just five lunar diameters below. If a line had been drawn from the northern cusp of the moon to Venus (apparently), and another from the same point through other cusp, they would have formed an angle of a little over 10°. Venus at the time looked like a star of the second magnitude, and was of a pale green hue, that being the sky tint at the time. The sun also was shining at the time, and, on looking back, I see it would be two days before new moon. A white mist passed over both four minutes after. I may say also that this was the nearest to each other that I have ever, to my knowledge, seen the moon and Venus.

I was successful also in getting a sight of Mercury on the first attempt I made. I cannot do better than quote here from a letter of my own which appeared in the *Newcastle Daily Leader*, Jan. 29th of this year. "I went out hopeful on Friday evening, January 25th, and knowing where to look, in a few minutes, and at 5.20, I caught the pleasing sight. He showed up fine, of silvery white, clear and distinct; there was no mistaking him. He shone out between very deep, thinly-stratified, black clouds, which were rapidly moving from north to south. A little below the bright object was a deep, dark horizontal stratum of cloud, stretching a long way across the horizon and reaching down to it. Out behind it and above it was a light rosy-tinted sky, and with the exception of a few small stratified clouds immediately above the large mass, all was fairly clear up to the height of Mars, over which—and over Venus as well—there floated large dark clouds. Fortunately, about two minutes after I caught sight of Mercury, and just after he had reappeared from being obscured by a small black cloud, Venus and Mars came fairly in view, and twice within two minutes I saw Venus, Mars, and Mercury by glancing across the almost straight line they form at present. That line, from Venus through Mars and Mercury, and continued to the horizon, would form an angle with the horizon of about 45 deg." Mercury appeared three times as far from Mars as Mars from Venus. Stretching over a period of two weeks, I saw Mercury on five different nights. And it was very interesting to see how the three planets changed their apparent relative positions in that period. L. T. Fleming, in let. 29619, p. 479, mentioned seeing Mercury on Feb. 2, that also being one of the dates on which I saw the planet. I would have sent a copy of a diagram I drew on the subject at the time, were it not an unreasonable request to ask its insertion.

Bedlington. **T. Blacklock.**

A FORTNIGHT IN LAKELAND.

[30149.]—As the season for holiday tours is fast approaching—if, indeed, it has not already begun—and as probably a number of the readers of the "E.M." are thinking of the English Lake District for their present summer's tour, a few words regarding the choice of routes and localities worth visiting, added to some general remarks touching the probable expense, &c., may not be entirely out of place in your columns, albeit the subject cannot be included in "scientific information." I might as well mention that, having spent years of my life among the Cumberland mountains, and wandered far and wide through almost every part of Westmoreland, I am prepared to give a little advice to those who undertake a tour for the first time.

It is a very common mistake to imagine that the whole of Lakeland can conveniently be explored from one point as centre, to which the traveller is to return towards the end of each day—a mistake systematically encouraged by hotel people. No matter where their particular hotel be situated, they will assure you it is the best centre. Of course, by taking carriages, and caring nothing about fatigue or of enjoying more than a passing view of scenes that require hours for their thorough appreciation, much may be done from either Windermere or Keswick as headquarters; but, assuming the tourist to have a wish to see as much as he can, and with the least waste of time and exertion, I should recommend him to change his centre at least twice during his tour. Thus, he might spend a part of his time in the Windermere neighbourhood, which includes the village of Windermere, Bowness, Ambleside, beside such charming lakeside hotels as those of Lowwood, the New Ferry, and others, and part in or in the vicinity of Keswick. Young men bent on mountain climbing may find it in many respects better to put up at some of the small country inns (which, however, christen themselves in all cases "hotels"), such as those at Buttermere, Wastdale Head, Rosthwaite, and Langdale. These are generally good, and cheaper than the more imposing establishments in towns. I have found, as a bachelor, that 15s. a day covers your expenses at a big hotel; and I have never been able to do it much cheaper, although my tastes are by no means extravagant. I will suppose that the tourist has a fortnight at disposal—although, as a matter of fact, the most interesting excursions, assuming the weather to be fine during the time, can be accomplished in a week. The Lake District may be entered at various points, but for people from the South, perhaps Windermere or Penrith are most to be preferred. Penrith, I may observe, is worth a morning, owing to the remarkable antiquities in its immediate neighbourhood—e.g., the fine old Norman ruin, Brougham Castle; King Arthur's Round Table, Maryborough, &c. Leaving the train at Penrith, your route would be viâ Pooley Bridge and Ullswater to Patterdale, whence the carriage road leads you over Kirkstone Pass to the Valley of Windermere; but a day might well be spent about Patterdale, a most beautiful locality. The mountain Helvellyn can be ascended from there. It is of no use, however, toiling up any high mountain except the weather be abnormally clear; and, in my opinion (and I have been up nearly every peak in the Lake country) the most charming views are always obtained from the lower elevations—e.g., Loughrigg Fell (Grasmere), Catbells (Keswick), Brund Fell (Borrowdale), Rannerdale Knott (Buttermere), &c. Four days may be devoted to the Windermere district and excursions from it, there being public conveyances every fine day from several of the hotels to Ullswater, Coniston Lake (from which you can go by rail to Furness Abbey), &c. Leaving Windermere, you next go to Grasmere by coach or omnibus, where two days may be spent in exploring the beautiful valleys of Longdale. Few parts of the Lake country can vie with Grasmere in point of scenery. The drive from Windermere Station to Keswick (21 miles) is perhaps the finest in England, but in no part is it more beautiful than about Rydal and Grasmere. In, and in the vicinity of, Keswick are numerous capital hotels, and at any one of them a few days may be spent in seeing Derwentwater, Bassenthwaite Lake, and making the round (public conveyances every day) of Borrowdale and Buttermere. I consider this by far the most striking day's excursion in the Lake District; but, instead of doing it in one day, I should devote three to the route, spending a couple of nights at Rosthwaite and one at Buttermere. There are most beautiful walks in Borrowdale, making Rosthwaite your headquarters, and from there you can in a day visit that wild lake Wastwater, most of the way to it, however, being only a pony-road. Buttermere is good for mountain walks; so, of course, is Borrowdale and Wastdale Head. At all these outlying places there is ample work for a pedestrian, and he will probably amuse himself better than in the gayer localities, where tourists mostly abound. I need hardly say that, as I have sketched it, the tour ends at Keswick. Allow me to add a few words regarding walking tours. A capital four days' walk is the following:—First day: From Keswick walk or drive over Honister pass to Buttermere, and thence (after a good lunch walk by the Scarf Gap and Black Sail passes to Wastdale Head, where you sleep. Second day: Take a guide and climb either Scawfell Pike or Great Gable; indeed, it is easy to do both these mountains in a day. Third day: Wastdale Head to Grasmere, via Rossett Gill and Langdale. Fourth day: Along the coach road to Thirlmere, and thence over the mountains (there is more than one route) to Keswick.

In conclusion I would advise the traveller—(1) never to go on a high mountain by himself, but always to have some companion, preferably one who knows the way; (2) to wear strong, well-nailed boots, and (3) to carry a shower-proof coat, if he even despises an umbrella. The Lake district is an extremely rainy locality.

Charing. **J. R. C.**

WHAT IS ALCOHOLIC EXHILARATION?

[30150.]—The question, "What is Alcoholic Exhilaration?" is one requiring a deal of answering. If I take the question rightly, I should be inclined to say it is that state which is produced from starchy and other foods which are capable of being converted into alcohol in nature's own laboratory—the digestive system.

We know if a man takes a larger quantity of food than is required for his constitution, or than the digestive system is capable of converting into a fit state for the support of the body, it passes off in the fæces practically untouched. So I think it is with alcohol; nature prepares from the food taken a certain quantity of alcohol during the digestive ferments—just that quantity which the constitution of the individual demands, but no more; this, I take it, is alcoholic exhilaration; any quantity beyond this point is an excess.

Of course, one man requires more alcohol than another, and in each case, provided sufficient and proper food is taken, I believe nature is capable of supplying that quantity, with one proviso—namely that the digestive organs are not impaired. The average adult is, I think, able to get rid of, and use, about 1oz. of alcohol (absolute) daily without anything approaching an appreciable quantity being found in the urine.

It requires an alcohol to go to the brain, and this, doubtless, accounts for the jaded student or professional man requiring more stimulants or alcohol than the average manual labourer. My opinion is this: a young person in health really requires no more alcohol than nature supplies from the food, but that in sickness and old age a little stimulant in the form of alcohol is sometimes very beneficial; in fact, in many cases, absolutely necessary.

Frederick Davis.

A TIGER'S BLOW.

[30151.]—A most beautiful subject of anatomical investigation is the forearm of an adult male specimen: its substance nearly as heavy as metal, its structure of the most powerful elastic force imaginable, the muscles, sinews, and curved cutting weapons at the extremity giving the idea of living catapults, projecting and withdrawing at will a bunch of hooked weapons; and when I say that he forearm of the noble quadruped I am about to escribe measured *two feet six inches* in girth when ead, our readers can realise his performances when ngered by wounds. By a letter received lately, I m told that the Head British Police Officer of the istricts situated on the Taptee (that river long enowned for its tiger-haunted jungles) recently llowed up a large male tiger on foot, and at close uarters gave him a bullet which destroyed an eye nd jaw. He sprang out, luckily with the blind de towards the sportsman, and rushed away ito some dry grass, and this was set on fire, hen the monster leaped out over the flames, illing one of the beaters, and making many imps to reach those who had climbed trees. here is a fearless tiger-tracker in the service the police officer receiving high pay and perquites. It is this man's fearless pride in scorning to imb trees during tiger hunts that has caused him be thrice severely wounded. "He must have een born without any nerves," writes my friend, for he knows not fear." On the above occasion e followed up the savage beast, armed with his mployer's double express rifle. They were in ther close company. The spring was met by a shot, lowing away the active brute's brain-pan as the ighty paw smote the brave's body, shielded luckily y the favourite flat dinner-tray of brass, usually arried by erratic natives, in which they delight collect wild honey, or eat an *al fresco* meal of rilled game. One claw striking outside this tensil gave a long and deep laceration, otherwise ie metal received the intended wound, being ulged and battered, with two perforations through , and now hangs as a companion trophy to the fine kin spread below. That death-dealing paw can mash the head of a buffalo to splinters, and break ie bones of any bull in creation, as though they ere those of a rabbit. **Eos.**

MERICAN ORGAN v. HARMONIUM.

[30152.]—Your correspondent, G. Fryer, is xactly right in saying that "the majority of so-alled harmonium players do not trouble about exression." The real fact is that most so-called layers can grind a tune out of an American organ rithout making themselves disagreeable: hence its opularity. On the other hand, it is very easy for he same class of players to make themselves itensely unpleasant on any harmonium; but for a ne player, with a perfect mastery over both intruments, the American organ is simply not fit to iention beside a good harmonium. The difficulty rith the latter is the blowing, which requires as iuch training as does the bowing of a violin. My wn practice is to play in my stockinged feet withut boots; to use the expression stop always; never o allow my heels to touch the pedals; using the ront part of the feet only, and to depend on the nodulation and expression of every individual note n the feet alone, just as I should give character nd expression to every note with the bow of a riolin. In a harmonium the management and ontrol of the feet is much more difficult than that f the hands, and as very few players attempt to earn this, the result is a succession of dismal groans, honoured by the name of music, but which re capable of giving a real musician an attack of ndigestion and a bilious headache. A good player n an instrument of Mustel's make can make music which will stir the soul and set listeners dreaming; n equally good player on an American organ can nake pretty harmonies and music of a kind which s a good accompaniment to ordinary conversation. One is the soul of music, the other is the playing of pretty tune.

998 (and an Old Player on both).

THE AMERICAN ORGAN.

[30153.]—I cannot help thinking that Mr. asson has rather exceeded limits in his denunciaion of the above. It seems scarcely likely that Sir ohn Stainer would have compromised his reputaion by writing a tutor for the American organ nless he really approved of the instrument. Many ther celebrated pianists and organists might be mentioned who have recorded their appreciation of the instrument—e.g., Sir Julius Benedict, Franz Abt, Saint-Saens, Gounod, Liszt, Brinley Richards, nd E. J. Hopkins.

That the soft tones of the reed organ are superior to the harmonium even Mr. Casson admits. As to the vulgarity of the pagoda-like cases one sees displayed—there, I admit, all the makers seem to have erred. But no one is obliged to buy organs in cases of this kind. All the best makers supply models in neat, low, and unpretending cases, generally called school or chapel organs. Nor yet do I think the American organs especially deceptive in the matter of stops when compared with harmoniums.

Comparing two lists, I find that a harmonium with 4½ sets of reeds has 15 stops—namely, besides the knobs drawing the sets of reeds, the sourdine, expression, tremulant, grand jeu, and two forte stops. An American organ of about the same size, and for the same purposes, has four sets of reeds throughout, with one octave of manual sub-bass, and, besides the knobs controlling these, has a vox humana (so-called, a kind of tremulant) octave coupler, and two forte stops.

The grand jeu is worked by the knee. Here, then, the American organ has only four extra stops, as against six in the harmonium. We must remember, further, that the expression stop is mastered by but few, and that the knee-swell of the American organ offers a possibly less perfect, but quite satisfactory and easily manageable, mode of expression.

If the American organ is really the snobbish sort of production that Mr. Casson seems to consider it to be, why should its price, size for size, always exceed that of a harmonium? Snobbish productions are generally cheap. **Amphion.**

CIRCULAR SURFACE OCEAN CURRENTS.

[30154.]—In No. 1267 there is a notice of a paper on the "Surface Currents of the North Atlantic," read before the Paris Academy of Sciences by Prince Albert of Monaco, apparently demonstrating the existence of a circular movement of the surface waters round a point situated somewhere to the south-west of the Azores.

Short as the above notice is, it appears to me to have a considerable bearing upon a subject you were good enough to give me an opportunity of ventilating in your journal about ten years ago. Under the heading "Gulf Stream" I communicated an experience I had obtained in the year '51 in a passage across the North Atlantic, when for about thirty-six hours we were becalmed upon a surface of water so smooth that the reflection of the sun was in no way distorted, and floating objects cast over the ship's side maintained their relative distances and positions with the ship without change the whole of the time. The direction of the ship, however, changed from nearly east-southward to nearly west; and it was admitted on all hands that this was not in any way due to atmospheric influence.

Only a short time before I had taken great interest in the Foucault experiment, carried out under the dome of St. Paul's, London, whereby the rotation of the earth was said to be demonstrated. Any way, it was plain that a portion of the earth's surface was continually changing its direction with reference to space as the earth revolved on its axis. It did not strike me then, and it was not until we were becalmed in the Atlantic, that I thought it possible there existed a spot where the surface would not turn as it would in the same latitude on the land. The truth dawned upon me, however, that I was then on, or nearly on, such a spot; and I asked the captain of our good ship, as the wind freshened and carried us away, to take an observation and see if we had not altered our position during the past thirty-six hours. Of course he didn't, but I maintain now, as I replied to him then, that although (as he said) "we had not moved an inch" with reference to the surface of the water, we had probably been conveyed by it in a circular path over another portion of the bed of the ocean to that we had been over on becoming becalmed; and, if not exactly over it, at least around the "point" I asserted did exist, and now, according to the researches of the Prince of Monaco plainly told does exist.

I have no intention here of rewriting what I still cling to as my discovery, and which I published in the *New York Tribune* in 1851, and which also you were kind enough to allow me to present to English readers about ten years ago. I have only to state my gratification in seeing the light that is dawning upon so interesting a subject in others than myself, and that facts published by other observers are tending to confirm the conclusions I came to, I may say now, many years ago.

The admission that from the mobile molecular condition of the fluid forming the larger bodies of water on our planet, the force applied by the solid ground containing them is *not* transmitted undiminished through them, and that lagging-behind results in apparent right-hand helical currents in the northern hemisphere, and left-hand currents in the southern hemisphere would open the door to a vast region of research, as well in the matter of the atmosphere surrounding it, as in the semi-fluid contents of the earth's crust, and I may be tempted later on to give my views in these directions too.

J. W. Wilkins.

THE EIFFEL TOWER.

[30155.]—I should like to ask Mr. John Hampden (letter 30138) a question. If the earth is a flat surface, how is it that on the same day shadows of trees, men, or anything else, fall to the north in northern latitudes, and to the south in southern?

L. C.

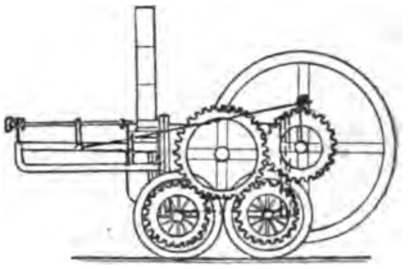
AN OLD AMERICAN LOCOMOTIVE.

[30156.]—On p. 197, No. 1258, Mr. Stretton gives a drawing of the "Old Ironsides," which has evidently been copied from the same source as the diagram given in Edwards's "Modern American Locomotive Engines" (Sampson Low). But this is the point: Mr. Edwards says (p. 99 of his book) built "for the Camden and Amboy R.R." and "attained a speed of 28 miles per hour"; but on p. 141 Edwards says William Pettit "ran her on the Philadelphia and Germantown Railroad at the rate of 62 miles per hour." Was that the "trial," or are the two railways the same under different names? It must be the same engine, as date and dimensions tally. Will Mr. Edwards reply?

Nun. Dor.

TREVITHICK'S ENGINE.

[30157.]—The first railway locomotive ever constructed was built by Richard Trevithick in 1803, and is here illustrated.



This engine had one cylinder placed horizontally 8in. in diameter, the stroke being extremely long, 4ft. 6in. The boiler was 5ft. 3in. diameter, by 6ft. in length, and contained a double or bent flue.

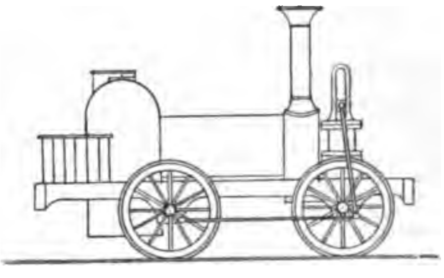
On the 24th February, 1804, this engine was tried upon the Penydarran cast-iron plate-way, or tram-road, and conveyed trucks containing ten tons of bar iron and about seventy persons, for a distance of nine miles to Merthyr Tydvil.

Trevithick employed high-pressure steam, smooth flat wheels, and conveyed the exhaust steam from the cylinder to the chimney by a pipe. It will thus be seen that Richard Trevithick was the "Father of the Locomotive."

Leicester, July 10. **Clement E. Stretton.**

LOCOMOTIVES.

[30158.]—The annexed diagram illustrates an engine constructed by Messrs. Galloway, Borman,



and Glasgow, in 1832, for the Liverpool and Manchester Railway, named "Caledonian," No. 28.

This engine ran upon four wheels of 5ft. diameter, coupled; the makers disapproved of the crank-axle as employed by Stephenson in his "Planet" class, and therefore resolved to place the cylinders vertically in front of the smoke-box, as shown in the diagram.

The engine was not successful, and after having run off the line upon some occasions was rebuilt with inside cylinders and a crank-axle.

Clement E. Stretton.

THE EFFICACY OF LARGE APERTURES IN MICROSCOPY.

[30159.]—I have read with considerable interest Mr. Lewis Wright's letter in your issue of the 5th inst., but I fear the theory which I have suggested to account for the efficacy of large apertures in microscopy cannot be so easily verified or disposed of as Mr. Lewis Wright supposes. Before giving my reasons, I must correct the impression which may evidently be made by an expression of mine, and which it was far from my intention to convey.

In using the words quoted by Mr. Lewis Wright —"Only the centre of the pencil falling on the back surface of the lens reaches the eye"—I was speaking of the intensity of the light illuminating each portion of the object, and all I meant was that the effective emergent pencil which enters the pupil is small as compared with the angular aperture of the object-glass.

I admit that the sentence is ambiguous, and should have been more clearly worded; but I never intended to convey the idea that the back face might be silvered, leaving only a small aperture.

The idea of silvering the lens, as Mr. Lewis Wright suggests, did cross my mind when I was working at the subject, but I saw at once that it could not be used as a means of settling the question, and for this reason: The object-glass is made experimentally, and the outer zone is of the utmost importance, as it is far more easily corrected to give a sharp image than any other part of the lens.

It will be readily seen that if the lens surface be divided into a number of concentric zonular elements, the more nearly these approach the centre of the lens, the less the angle their normals make with direct incident light.

If the aperture were small enough the lens would have practically plane surfaces, and could not give any distinct image other than that given by a pinhole. The outer zones are so corrected that the pencils passing through them come to the same foci as the central pencils—that is, their chromatic and spherical aberration is reduced to a minimum, whilst the intermediate zones are left uncorrected. If by any diaphragm or other appliance the outer zone is rendered ineffective, the next outermost zone must be corrected.

I do not know whether it would be possible to reduce the apertures of an objective, and re-correct the glass without increasing its working distance. If this were possible the glass might regain the definition lost by the reduction of aperture, provided this reduction were not great; but the experiment would be one of great practical difficulty, and could only be carried out by one of the best makers of lenses, and then only with great expenditure of time. I fear we shall have to be satisfied with some less direct method of settling the question.

In my own mind there is no doubt whatever that all definition would be destroyed by silvering the back face and reducing the aperture, which is practically the same thing as putting a diaphragm behind the objective, whether the image is a purely dioptric or a diffraction phenomenon, unless some compensatory change could be made in the glasses without altering the curve of the front lens or its working distance.

I would remind microscopists that what I have said applies only to critical images with high powers, and I would ask them to compare such images with those seen by dark ground illumination and lower powers. The resemblance between the images produced by the two methods of illumination is very striking.

Benjamin T. Lowne.

65, Cambridge Gardens, W.

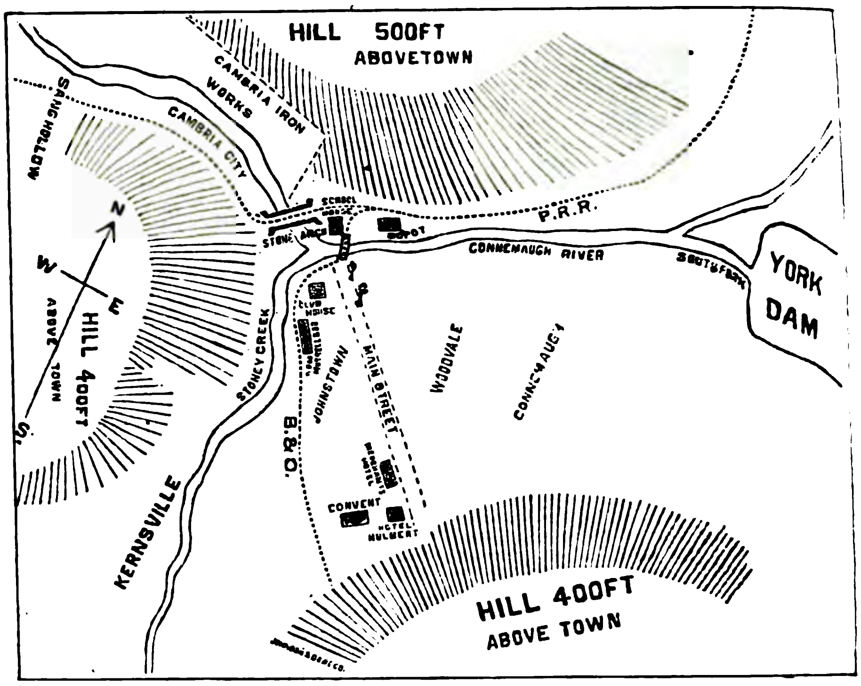
BLOWPIPE ANALYSIS — THE ARTIFICIAL LAKE OF LA GILEPPE.

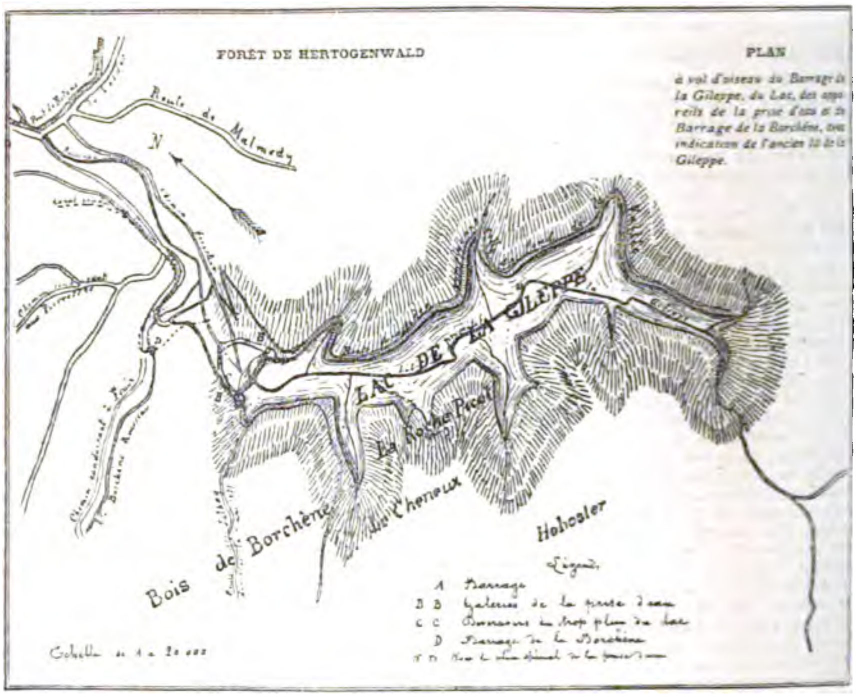
[30160.]—I have been much interested in the exceedingly concise and almost epigrammatically brief description of "Blowpipe-bellows and Furnace-making," quoted in "E. M." No. 1262, page 277, from the article by Geo. M. Hopkins in the *Scientific American*. In this, full details of the construction of Mr. T. Fletcher's foot-blowers and blowpipe-furnaces are given. But what will Mr. Fletcher say to this? If he has no objection, I may say that I am now translating the article into French, in order to have some blowers made here, as a heavy duty is charged on articles of foreign manufacture, if new—not to speak of the delay.

What a pity it is that Mr. Hopkins says nothing about the chemical blowpipe and its extended use when the aid of Fletcher's ingenious apparatus is called in. It almost looks as though English students and teachers had given this up now, although if the science masters, &c., who have favoured me lately with correspondence on the subject had only addressed their communications to the English Mechanic, a different conclusion would possibly have been arrived at.

At all events, if English chemists have abandoned the study as hopeless, or not of sufficient importance, some consolation is derived from the fact that the German ones have now definitely adopted it, for I expect the German translation of my latest work on the "Chemical Blowpipe" is now nearly ready, and will be published at Leipsic in a few weeks, or even days. The subject has always been a favourite one in Germany, and will probably spread from there into Austria, Russia, and even France.

I inclose two sketches—one of the York dam. Pennsylvania, the bursting of the "south fork" of which caused such fearful loss of life lately at Johnstown and elsewhere in America; the other, of the artificial lake of La Gileppe in Belgium, probably the largest artificial reservoir of freshwater in the world, the result of a dam or barrier devised by the Belgian engineer, Bidant, in 1867 (he died next year), and constructed from his plans by Messrs. Braive, Caillet, and Co., in a period of nine years from that time.





This gigantic dam or "barrage" of La Gileppe—which may really be said to represent one of the small surrounding hills clapped into the throat of a valley, along the bottom of which runs (or rather ran) the insignificant brook of La Gileppe; thus stopping the progress of the latter, and turning the former into a lake three miles long by about a mile broad—is 270ft. long and 216ft. thick (!) at the base, and 768ft. long and 48ft. thick at top. The lake thus formed is nearly 200ft. deep, and is supposed to contain about three thousand million gallonsof water. The water, which is beautifully soft and pure, is thus stored for the use of the cloth mills and dyeworks of the industrious city of Verviers, about nine miles away, which were approaching ruin and decay from want of it.

There are two "bye-washes," or safety-valves, one on each side of the barrier (the word dam is too feeble an epithet for such a construction), by which, in times of flood, the surplus water rushes in foaming cascades over artificial terraces some 200ft., to the bottom of the remaining part of the valley not barricaded, forming the principal part of the romantic little river Vesdre, which flows through as beautiful scenery as any in Europe (out of Switzerland), and runs into the Ourthe, at Chaudfontaine, near Liége. Unfortunately, these waterfalls were not playing when I visited the place; but I have seldom admired a more beautiful scene than the sun rising over the thickly-wooded hills of the eastern end of the lake La Gileppe, which is only four miles from the German frontier, and turning its broad, placid waters into molten gold.

Now, here is a "dam" that can never burst, but must evidently last as long as its neighbours, the surrounding hills do; and it only cost £200,000! Uncle Sam should take the hint, and build his "dams" more substantially in future.

Belgium, July 7th. **W. A. Ross.**

BEST SHOE FOR HARNESS HORSES.

[30161.]—I must apologise to "Dimraid" (p. 3 for not answering his letter sooner. Undue pressure of work has prevented, and for some few weeks I fear will prevent, my writing details and sending sketches of the two horseshoes in question; but if agreeable to "Dimraid" to send me his address, I will try and procure a little book giving all particulars, and shall have much pleasure in sending it to him.

May I add that I have no pecuniary interest in any of these patent shoes? It is only my love for our dumb fellow-creatures that prompts me to take the matter up. **Herbert Wilkins.**

11, Bow-lane, London, E.C.

LARGE APERTURES IN MICROSCOPY.

[30162.]—The letters of two correspondents have remained unnoticed, because I am unwilling to answer questions privately to readers of the "E. M." I cannot refer to any experiments or points of discussion on the "aperture question," now so long past that half those who so fiercely opposed me are dead; and, in accordance with the natural term of existence, the rest of us may pass away in another five years. I am without references for date or incidents, as I have long since turned out or destroyed every paper or journal that contained matter relating to the subject. Some of my opponents, though mature in years, were barely fledged in optics,' and picked up crumbs of knowledge during the discussion.

I have never changed my views, and still hold that the dictum of the R.M.S., that the value of extreme apertures arises from the collection of more and more "diffraction spectra" from the object is absurdly nonsensical. That the list of "numerical apertures," consisting of a series of intangible decimals pompously put forth, is useless twaddle, inasmuch as there are no correctly-known apertures in the objectives to correspond. I first pointed out that the value of aperture was not in direct proportion to the angle, but to the chord of the arc, or otherwise the sine of the half-angle. I gave a list of comparative values, but never dreamt of proposing that such, taken as relative whole numbers, should substitute the readily understood expressions for angle. When a person having a pet object-glass has told me that it has a N.A. represented by such or such a decimal, I dismiss the thought at once, as it conveys no idea to the mind, and I will not waste a moment in reckoning back to interpret the supposititious angle. If I ask for the angle corresponding to the said N.A. decimal, the propounder usually cannot state it—he has forgotten his catechism, or never learned it.

Considering how this aperture question has been ruled as settled by the R.M.S., its list paraded forth, and all adverse discussion excluded, the appearance of the letter of our ever-welcome correspondent, Lewis Wright, has taken me by surprise. It seems a kind of heresy now to question the dictum of that body.

I briefly notice the means of measurement upon which this N.A. list is based—that is, by the so-termed "apertometer." I need not describe this appliance—its action is thus: Two points or marks are set up, so as to be seen at the same time by the rays at the limit of the extreme margins of the field of view, and the angle from the focus read off. With one mark shifted across the field the result would be the same, and also if the mark were stationary and the objective swung round. It is the measure of this *angle of field, widely differing with every eyepiece used*, which this learned association imagines to be the angle of aperture of the object-glass, and upon which their N.A. list is based.

Now let us step aside and ask an intelligent practical photographer a few questions, for his battery of lenses, his constant use of all-sized diaphragms, and keen watchfulness of every optical defect has trained him into a kind of practical optician —say I have been playing with his camera having 'a wide-angledoublet attached." I remark: "What are these overlapping images seen at the edge of the field?" He says at once, there is some object (which I have purposely placed there) intervening in the path of the ray, and so splitting it; remarking, "We call them 'ghost' images." The R.M.S. term them "diffraction spectra"! and attribute the efficiency of large angles of aperture in micro. lenses to the scraping up or collection of a pile of them. The connoisseur in photo. lenses will tell you bluntly these have nothing to do with the value of aperture. I now ask my informant, "What is the angle of your lens?" He will answer at once, 50°, 80°, or 100°, as the case may be, and his reply is quite correct, for it is the angle taken from the lens to the margin of the field of view on the ground glass (in the optician's works this angle is measured not on ground glass, but by a refined optical arrangement sliding transversely on a graduated scale, so that by a peculiar form of Coddington lens eyepiece, all errors in the consecutive rays can be detected). This in principle and effect is the same as the apertometer of the microscope—it is a measurer of the *angle of field*. This angle is mauled back by the list of the R.M.S. into a wretched decimal expression, and garnished with a symbol, thus obscuring without dignifying a very simple matter.

I now ask my photographic friend "What is the *angle of aperture* of your lens?" Again is the question immediately comprehended, and answered correctly. "I am using diaphragm so and so, this is the working opening of the lens, while from diameter to focus represents the *angle of aperture*." It is this smaller inner angle of which the microscope man is totally and blindly ignorant; he has never seen it, nor can he by the means used or adopted even measure it. This has afforded scope for the R.M.S. to adopt and foster what I consider one of the greatest fallacies in optics ever promulgated, and which remains for more competent successors to correct. I cannot now undertake to make any instrument for demonstration, as I have abandoned this kind of work, and life is not long enough to wade into the subject again.

F. H. Wenham.

SMALL MOTORS.

[30163.]—MAY I inquire of your numerous readers whether they find steam, gas, or hot-air engines cheapest in the long run: the question may also include petroleum engines, especially for my purpose, as I can obtain the oil at a low price? There is so much diversity of opinion here (U.S.A.) that I cannot discover which is most economical for engines of small power—say, from ½H.P. to 4H.P. I have come across one paper by a Mr. G. B. Grant, in which he seems to declare for steam. Having occasion, he says, to purchase a small engine, I supposed that a gas-engine would be the most economical for my purpose; but, after making careful inquiries, I have reached a conclusion which may be as interesting and instructive to thousands as it is to myself. The manufacturers of small gas-engines make great claims, and give plausible reasons in support of statements that do not seem to me to be able to stand a close comparison with the claims of the makers of small steam-engines. I wanted a power that would run all the way, from 1 to 7 or 8H.P., and average about 4H.P., and, in addition, I had to provide heat for a shop 80ft. by 30ft. in dimensions. I compared a well-known make of small automatic cut-off steam-engine, with a gas-engine that makes its own gas from gasolene, with the following results:—The steam-engine sells for 400dols., complete, with boiler and all necessary fixtures, and to carry this at 6 per cent. interest, taxes, repairs, &c., is worth 40dols. per year. The makers claim that it will use about 4lb. of coal per H.P. per hour, and this, for an average of 4H.P. for ten hours a day, and 300 days a year, with coal at 5dols. per ton, will cost 120dols. per year. Such a small engine requires no special engineer, any good mechanic being able to take entire charge of it, and 75 dollars per year is sufficient to allow for attendance. The exhaust steam will nearly heat the shop in the coldest weather, is all that is required in mild weather, can be used to heat the feed-water in warm weather, and is worth at least 50dols. a year. Therefore, it appears to me that the automatic steam-engine will give me an average of 4H.P. for a year, at an expense of 185dols., or less than 40dols. per horse-power per year. On the other hand, the gas-engine can be put in for 1,100dols., which, by the way, is about 300 per cent. profit, and will cost 110dols. per year to carry. The makers claim that it will cost one cent per horse-power per hour with gasolene at 10 cents per gallon; but as the gasolene will cost the user at least 15 cents per gallon, in the quantities he must use, and delivered in position to use, the cost will be 1½ cents per horse-power per hour, or 180dols. for 4H.P. for a year. The attendance on the engine is at least 25 dols. per year. If a gas-engine is used, stoves or a boiler must be provided for heating the shop, and, with attendance and extra fuel, will cost at least 75dols. a year. This gives a total cost of 390dols. per year. From this reasoning it appears to me that it will cost me twice as much to provide such a small power, and heat my shop by the use of a gas-engine, as it will by the use of a steam-engine, in spite of the statements of the gas-engine makers to the contrary. If I am wrong, I should be glad to be corrected with the figures and facts. There are thousands who need small powers, and therefore the matter is an important one, and well worth careful consideration. The comparison will be still more against the gas-engine if the gas must be purchased from the city. I requested the makers of the gas-engine to show me where my comparison was wrong, and received the following very conclusive argument:—"We do not care to figure on relative cost of your . . . . automatic steam-engine and the . . . . (gas-engine), neither of operation nor the first cost. If the advantages of the . . . . are not there, of course you can't see them; if they are there, you can see them as well as anyone." I have looked at the matter from the point of view of the makers of the respective engines, and have taken their own figures as to the consumption of fuel, and yet I cannot see the advantages of the gas-engine for a steady running small power. It is to be acknowledged that, for an intermittent power, in the hands of a person who is no mechanic whatever, to grind coffee for five minutes in a grocery, or pump an organ once a week in a church, the gas-engine has no rival but the water-motor, but I am not now ready to admit that it compares with the steam-engine under ordinary circumstances, and according to the claims and statements of their makers.

The prices of the engines and the motive fuel will vary in your country, but I suppose they are relatively proportionate. What about water-gas engines? Can they be used on a small scale, and does not the furnace quickly give out owing to the action of the oxygen? The question I wish to put is, Which is the cheapest small motor for regular work?

Worcester.

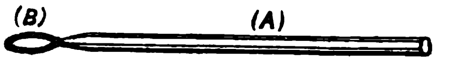
THE PREVENTION OF SMELL FROM OIL-STOVES.

[30164.]—IN the Editorial Answers to Correspondents (p. 379), you say that all oil-stoves smell. I have no doubt they do—mine do—and, in the nature of things, they must, unless certain precautions are taken. Presuming that the stove is of good construction, and burns, when turned up well, without smoke, and that it is perfectly clean (in the common sense of the words), the maker will assert that it will produce no smell, and he is right—a *new* one will not smell; but lay it aside for a few days, and then light it, the usual offensive vapour will be given off copiously. The reason is not far to seek; the more volatile constituents of the oil have vaporised, and have partially condensed on the burner, and now are driven off in visible vapour. The remedy is simple, but troublesome; the burner must be removed (in those I use it is easily done by bending outwards one of the pieces which form the hinge), and placed on a clear fire, when copious fumes will be given off, which have the same smell as that complained of. It should not be allowed to get red-hot, but moved about until it stops smoking; when cool it can be replaced, and the stove, on being re-lighted, will burn absolutely free from smell. I have used those stoves for the last ten years for cooking, and latterly for warming, and so completely free from smell are they that a stranger would not know how the rooms are warmed. If they are unused for a long time it is necessary to heat the stove itself in the same manner until it stops fuming.

J. A. F.

A MOTE EXTRACTOR.

[30165.]—THE sketch illustrates a simple instrument which I have made for my brother for extracting small particles out of the eyes of his fellow-workmen, a job which he (being blessed with a steady hand and good eyes) often has to perform, but which was somewhat difficult with the instruments he had at hand, especially if the offending particle happened to be hot when it entered the eye, or went in with sufficient force to imbed it in the eyeball; and as he says it answers its purpose perfectly, I thought some of my fellow-readers would find it useful.



Description of sketch: A is a piece of fine glass tube about 3in. long, drawn to a fine point, to act as a handle; B is a piece of fine flat steel wire (a piece of fine watch hairspring is the best) bent into a loop, and the ends inserted in the point of the glass tube A, the tube is then filled with powdered sealing-wax and then heated to melt the wax and seal the loop in its place, and the instrument is finished.

To use it, the loop is placed over the particle of scale, dust, emery, or the like, and it is drawn out of the eye without any difficulty.

If any of your readers should be unable to make one for themselves, I should be pleased to make one for them, if they will forward me six stamps. My address is in the Address Column.

F. Russell.

STEEP GRADIENTS—OLD LOCOMOTIVES.

[30166.]—THINKING some one better informed than myself would be sure to reply to the question, I refrained from doing so; but as Mr. Stretton only gives one (the Lickey), I may as well add a few other steep inclines.

There is a steep bank of about 1 in 36 between the St. David's and Queen-street stations at Exeter. The gradient on one of the lines leading up to Oldham is very severe—I think more so than the one at Exeter; in fact, I have an idea it is nearly 1 in 26.

On a colliery line near Brynmawr I came across a gradient of 1 in 25, and in the same neighbourhood some of the old disused tramroads had the racks still in place for the toothed driving-wheels of the locomotive of that day.

There are many gradients of 1 in 45 in different parts of the kingdom, and I believe 1 in 40 is the legal maximum in both Australia and Cape Colony. As an experiment, I have heard of an ordinary locomotive ascending an incline of 1 in 11.

Referring to Mr. Stretton's very interesting sketches of old locomotives, I possess a photograph which I had specially taken some thirty years ago, of an early specimen. The cylinders are upright on each side of the boiler, and stand their whole height above it. They are inverted, and work on to the hinder pair of wheels, the engine being a "six-wheeler" coupled.

The slide-valves are worked direct from the eccentrics by rods and levers. The feed-pump is workable either by hand or by attaching the end of its lever by a link to the guide-block on the head of piston-rod. The guide-bars (or, rather, rods) extend from the cylinder covers to the side extension of the foot-plate. The boiler has a somewhat large steam dome, from the top of which a branched pipe leads to the steam-chests (I doubt if this part is the original arrangement), and a Y-pipe conveys the exhaust steam to the chimney. The furnace, I think, is merely a U-shaped tube, the furnace-door and chimney being side by side at the forward end, though the driver stood on the hinder foot-plate. There is no smoke-box, the chimney leading out by a bend from the end of the boiler. The chimney has two stay-rods. The wheels are nearly solid discs, lightened by small openings. The engine bears a general resemblance to Hackworth's "Royal George," illustrated in an early volume of *The Engineer*, but differs in the details. I do not know where it came from, or what became of it. Perhaps some correspondent may recognise the portrait, and supplement my own description by further particulars, such as details of the reversing gear, which can't be made out on the photograph?

Has Mr. Stretton ever seen a drawing of an old locomotive with vertical cylinders, the connecting-rods to the driving-wheels being, however, horizontal, the change of direction being made by big "bell-crank" levers? I remember the illustration in some book or other, and should like to know if such a form of engine ever had an "objective existence." Not many years ago there was a loco. on the Llanelly line with the cylinders on top of the smoke-box, and set at such an inclination as to work the hinder pair of six wheels coupled—a hideous, ungainly monster. A. S. L.

DEATH CAUSED BY BAD MEAT.

[30167.]—I inclose an extract in which the death of one person, and severe illness of others, is attributed to beef which had been kept a little too long, but was otherwise of good quality:—

"Death Caused by Bad Meat.—Last week Mr. W. W. Lumb, coroner for West Cumberland, held an inquest at the Seacote Hotel, St. Bees, on the body of Elizabeth Sly, aged 48, widow, of Waterhead, Coniston, who died from the effects of blood-poisoning through partaking of some beef on the previous Saturday. About a dozen other persons who partook of the beef, including Mr. Scott, the landlord of the hotel, and his wife, are now suffering from the poison, and Mr. Scott was too ill to give evidence. Mr. Dalzell, butcher, Whitehaven, who sold the meat to Mr. Scott, deposed that the meat was perfectly healthy. Miss Smallpiece, daughter of the foreman of the jury, bought the next cut to that purchased by Mr. Scott, and the whole carcase had been sold to customers. In the present condition of the weather it was difficult to keep meat. In the course of the evidence it was shown that all who had partaken of this beef at the hotel had been taken ill, while others in the hotel who had not partaken of the meat had not been ill; there was, however, no reason to think any kind of poison was put in the meat. Dr. Braithwaite, of Egremont, attributed death to blood-poisoning through the absorption of some putrid animal matter. All the sick persons were suffering from the same symptoms. The jury returned a verdict that Mrs. Sly died from blood-poisoning through partaking of beef in a decomposed state, but that no one was to blame."

Can this be the true explanation, when, not to speak of the improbability that hotel-keepers and their guests would eat meat as tainted as large numbers of the lower orders are likely to eat it, the Mhars and Mangs of India eat with impunity the carcases of animals dying of all kinds of diseases, and at times how far from fresh I leave your readers to imagine? L. C.

ROSE ENGINE, ORNAMENTATION OF IRREGULAR SURFACES, &c.

[30168.]—Many thanks to Mr. Maclean for information given in 30130, p. 415, and for the refreshing tone of that letter. Professionals and amateurs ought to mutually assist each other. As Mr. Maclean truly says, the subject is so wide that one hardly knows where to begin. Rose-engines may be divided into four classes.

1. The geometric engraving lathe for banknotes, &c., and mostly flat work and professional.
2. That suited for Sheffield ware, watch-cases, &c., fine rosettes.
3. That with bold rosettes for ivory and hard woods.
4. *Vide* infra.

Of the intricacies of Class 1 I know nothing; with Class 2 there is no difficulty whatever in arranging a "touch" to govern the penetration of the tool, but to accurately "stop off" or "work in" a pattern upon a curved surface requires years of practice; moreover, for turning metals the edge of the tool must receive a cunning polish by a touch upon copper or goldstone or something else, or the lustre of the metal will be lost; this "touch" requires, as Mr. Maclean says, a "personal interview."

Now with No. 3 things are reversed; there is no difficulty in sharpening the tool; but very great difficulty in arranging a "touch" to regulate its penetration, whilst allowing it to wander into the sinuosities of any irregular curves; this may to some extent be overcome by adjusting a tube of steel or ivory around the shank of the drill. I have contrived a somewhat complicated "touch" which is far in advance of the tube, enabling one to cut mouldings, &c., and am at present busy with another, which I hope will do still more. The description of these I withhold for the present, not from any selfish motive, but because they are not by any means what they might be, and still more because I hope some brothers in the art will invent something for the same purpose on new lines, the comparisons and modifications of all probably resulting in a really valuable adjustable "touch."

Class 4 differs from the other three in having the headstock fixed, whilst in Classes 2 and 3, and I believe in Class 1 also, the headstock rocks, bringing its rosettes into contact with a fixed rubber, and the work against a fixed tool. In Class 4 this is reversed. The mandrel, by means of geared wheels, imparts motion to a shaft upon a second mandrel, which carries the rosette, and imparts motion to the slide-rest, producing the pattern of the rosette upon the work. Upon the merits of this system I hope to write hereafter, when I have worked upon a very fine lathe, embodying Mr. Jesse Lowe's invention, which is now being constructed for me by Messrs. Birch and Co.

Permit me again to inquire for any man who understands Rose E. work in ivory. There are in the Kensington Museum specimens of work produced just 200 years ago, of such complicated character that I cannot find anyone who knows how they were done, let alone doing them. C. C. E.

USEFUL AND SCIENTIFIC NOTES.

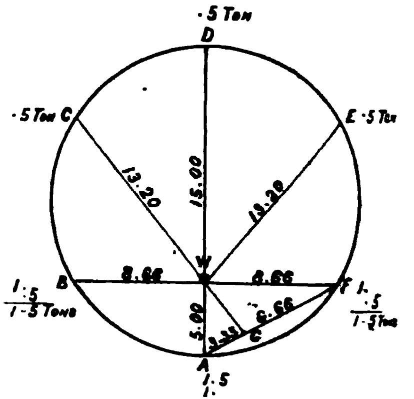
Lemon Cultivation in Sicily.—The United States Consul in Messina, in a recent report, says that the well-knwn variety of lemon called the "lunare," or ever-bearing, produces blossoms and fruit every month in the year. When, however, during the Indian summer rainy days are succeeded by dry, clear weather, lemon-trees of different varieties immediately put on bloom, and if, owing to the mildness of the season, the fruit sets in at the beginning of winter, it will come to maturity at midsummer. Lemons are divided into two classes—the true and bastard lemon. The former is produced by the April and May blooms, the bastard by the irregular blooms of February, March, June, and July, which depend upon the rainfall or regular irrigation and the intensity of the heat during the summer and winter seasons. The true lemon re-requires nine months to reach maturity—from the bloom in May to the mature fruit in January. There are but three harvests of the true lemon; the first in November, when the lemon is green in appearance, and not fully ripe. These lemons are the most highly prized; they possess remarkable keeping qualities, and are admirably preserved in boxes in warehouses from November until March, and sometimes as late as May, and then shipped. The second harvest occurs in December and January. These lemons must be shipped three weeks after gathering, by which time they have acquired a yellowish appearance. The third harvest occurs in March and April. This fruit is shipped as soon as gathered, spring prices being very high. The uniformity in size of lemons is due to the monthly harvestings from October to March. Bastard lemons present well characterised peculiarities in shape and appearance; their inner skin is fine, and adheres tenaciously to the meat; they are hard, rich in acid, and seedless. The bastard lemon, produced from the bloom of June 1, is still green the following April, and ripens only towards the end of July. It remains on the tree over a year, and sells well in summer. Besides the March and June bastards, there are yet others that remain on the trees from twelve to eighteen months. The true lemon can be left on the tree until the end of May or the first week in June; but it interferes with the new crop, drops off from over-maturity, and is liable to be attacked by insects. The bastards, on the contrary, withstand bad weather and parasites, and they mature from June to October. It is estimated that four times more oranges than lemons are lost in the groves and warehouses. Good drainage is most essential in orange and lemon culture. In Sicily lemon cultivation is 30 per cent. more profitable than that of oranges, for the trees are more prolific and the prices higher.

Tea came into use almost by accident. Some Buddhist priests, going on a missionary expedition from Northern India to China, took with them the dried leaves and also some cuttings of an indigenous shrub, which was said to have the power of correcting any injurious properties in the brackish water they might meet with on the way. The decoction thus made pleased the missionaries so well that they continued, as a matter of taste, to drink it after they had reached China, and introduced it to their converts. They also set about planting the precious shrub, and, although it did not thrive so well in China as in its native Assam, becoming smaller both in stem and leaf, it was so well liked that it soon formed the foundation of the favourite beverage of all China. Thence it was brought to Europe, to be drunk and desired by Englishmen of every degree. And it is only of late years that Assam tea has come into the European market, to be looked upon rather suspiciously as the rival of its own degenerated Chinese daughter.

REPLIES TO QUERIES.

. *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[67862.]—**Distribution of Weight.**—Although late in the field, will you allow me to offer a true solution of this interesting problem, which seems to have puzzled a goodly number of your mathematical correspondents, and been finally shelved as "indeterminate?" I sent a solution at the time; but, unfortunately, a change in the Russian postal charges caused the letter to be refused by you and returned to me, and I hesitated to trouble you with a repetition, feeling sure that it would be solved by others nearer home. Some of your correspondents' mathematical theories are too advanced for me to follow, and I can only look at the matter in a practical light, and submit a practical solution. The conditions of the problem will be perfectly maintained and the solution simplified by supposing the central weight to be raised above the plane and transmitted to the indicated points of support through vertically-inclined struts. The thrust of these will determine the weight supported at each point. The struts must be considered as acting in pairs opposite each other. When single struts occur without a directly opposing one (two in the problem) the thrust of these is laden by the nearest two opposite struts. When the opposing struts are equal in length (or the distance from centre of pressure), the thrust will be equal at each end. When these vary, it will be inversely proportional to the distance from centre of pressure to point of support. I may remark that a weight supported on a series of struts or beams, whatever their relative lengths or angles to each other may be, will be equally distributed over each pair, and, further, that if a central support be introduced into the combination, this will take one-half of the entire load, and the other half distributed through the struts. This may be taken as an answer to "Z.," who submits an analogous problem as a key to the solution of this, if it can be determined; but which he also concludes to be indeterminate. Let him suppose his weight to rest on two bars or beams. Each will take half the weight, and it is obvious that one bar may be removed by substituting a central support to take its load; therefore, in his problem the central weight equals one half. Referring to the original problem and the diagram



illustrating it—consider the weight W as resting on four pairs of struts and equally distributed over each. To facilitate calculation take the radius of the circle as 10, and the weight W as 8 (say, 8 tons). The figures on the several lines will be their relative lengths in terms of radius. The central load being 8, that on each pair of struts will be $\frac{8}{4}$, or two tons. We will now find the weights at the ends of each pair. Commencing with the pair B F, these are equal in length, therefore the weights are uniform, or 1 ton at each end. Taking the pairs E D, their relative lengths are 5 to 15, or 3 to 1; therefore D supports half a ton, and E 1½ ton. Taking now the single strut C W, which has not one directly opposed to it, the thrust from this is thrown on the points A and F. Draw the line A F, and prolong the line C W to intersect this at G. W G will be the length of an equivalent strut from which we can calculate the distributed weight. The relative lengths are 4·40 and 13·20, or 3 to 1; therefore 1½ ton is thrown upon A and F, and half a ton on C. The weights on A and F are inversely proportional to their distances from G, 3·33 and 6·66, or 2 to 1; therefore 1 ton is thrown upon A, and half a ton at F. The same effect is produced on A and B by the single strut B W. Collecting the weights on the several points of support thus found, the total will equal the normal load of 8 tons. The problem is simply a question of distribution of forces, and resilience does not enter into the matter at all. If any of your correspondents should take exception to my definition, I beg to remind them that I am at a month's postal distance.

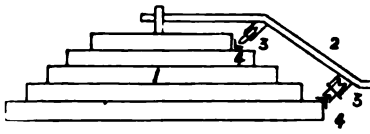
Bakov, July 1. Caspian.

[68428.]—**Lamp (U.Q.)**—You could light a 6-volt, 5 c.p. easily.

Meran. A. R. B.

[68554.]—**Railway Accidents.**—The following engines with names, have been in serious railway accidents:—Taciter, L. C. and D. goods, ran into the river Ravensbourne near Beckenham. Juno, L. and Y., was in the Burscough collision, January, 1880. Prometheus, G.W.R. broad-gauge express, West Drayton collision, 1874. If some other readers would kindly help with this query, I feel sure the information gained would be welcome to many. P. H. N.

[68683.]—**Boiler Flanges (U.Q.)**—I inclose a rough sketch of plan adopted in bending angle iron at Forth Bridge works. I believe that many thousands of rings in angle iron were bent with this simple contrivance up to 12ft. diameter. These were all bent hot. J. K.



[68722.]—**Methods of Studying Organic Chemistry (U.Q.)**—I desisted from answering this when it first appeared, thinking that the widespread importance of the subject, symbolised possibly by the Brobdingnagian dimensions of the query itself, would receive its due number of replies. Before arriving at the root of the matter embodied in the extensive query, I should like to protest against the so-called "Practical Organic Analysis" being confounded, or even mentioned, with the truly magnificent science of organic chemistry. It is like calling bricklaying architecture, or butterfly-catching, entomology. If organic chemistry is to be learnt as "Aurora," evidently desires to learn it, it must be treated, as old Izaak did his frogs, as though you loved it. In my opinion there is no science which offers such a reward of philosophic pleasure as does that of organic chemistry, provided it be studied for its own sake, and none, perhaps, so difficult to "cram." Let "Aurora" once thoroughly grasp the doctrine of valency, and he will find that "the heap of ugly-looking formulæ" not only become beautiful, but are so plain and natural that the effort of memory is reduced to nil. There is so little that is arbitrary in this science, that when once its principles are lovingly and thoroughly mastered, all the apparent complications disappear, and a wonderful and beautiful symmetry and order take their place. To acquire this *sine quâ non*, I can certainly recommend reading, patient, careful, and thorough—not "cramming," mind, with a real desire to understand, as being the surest means. In the following three books the subject is treated in a really fascinating matter. I give them in the order in which they should be read: "Experimental Chemistry," Part IV., Reynolds; "Organic Chemistry," Remsen: "Outlines of Organic Chemistry," H. F. Morley. Let these be read carefully, never passing over anything until it is thoroughly understood, working out all the formulæ graphically, endeavouring to grasp the principles of valency on which the formulæ depend, and trying to cultivate the admiring love for the "order in disorder" which specially characterises this science, and all the difficulties which the querist mentions will gradually disappear. "Experientia docet."

Richmond. Young Analyst.

[68756.]—**Gas-Engine.**—Thanks to "J. M. T." for his few remarks on gas-engines, and unless "J. M. T." can offer better advice to those asking questions in future, I should advise him to abstain from trying to speak of something he appears to me to know nothing about, as, in my opinion, it is these sort of replies that oftentimes shuts the mouth of many a man, and he does not like to ask another question, in case of being snubbed again in the same way. I think it the duty of every reader or subscriber to carefully read the queries published in the "E.M.," and, if it lays in his power to help another, he should do so, without telling a man that he must copy someone else, and not invent something for himself. One in a Fix.

[68759.]—**Focus of Lenses.**—On page 417 a reply signed by "Derfla" appears, in which he gives a method for finding the focal length of spectacle lenses. His method is to measure the distance between the lens and the screen, when the image thereon is the same size as the original object. Every student of optics must know that this distance is twice the focus of the lens, inasmuch as the word "focus" means the point where parallel rays of light are brought to a point.

F. H. L.

[68759.]—**Oculists' Formula.**—Perhaps I may be allowed to correct "Derfla's" answer in so far as it relates to finding the focus of convex lens. I may say I am very much tempted to ask whether he ever tried to find the focus of a lens. It does not require the paper with a hole in it, nor a dark room, and his method does *not* give the focus. To show this: Let us take, for example, a 10in. lens. Parallel rays passing through will come to a focus at 10in. from lens; conversely, rays coming from a point 10in. from lens will be rendered parallel. According to "Derfla," the flame and the image must be the same size; therefore the flame and the paper must be equidistant from lens. If the flame were at the focus the passing rays would be parallel, and parallel rays give *no* image; therefore neither flame nor image gives the focus. Had he said half the distance from lens to paper would give the focus, he would have been correct. To prove this, let us take a 10in. lens, and having a flame 10ft. away, we find, on holding the lens 10in. from wall, an image of the flame. On bringing the flame nearer the lens, we find the image grows larger and indistinct; by drawing the lens away from wall, we find the image once more growing sharp and clear. It will be noticed that the nearer the flame is brought the larger the image grows, and flame and image are in direct proportion to the distances. The rule, then, to find where the rays coming from a given point and passing through a given lens will be brought to a focus is: Multiply the distance of the point from the lens by the focus of the lens, and divide by the difference. For example—10in. lens, flame 30in. distant, $30 \times 10 = 300$; divided by difference, $300 \div 20 = 15$in. The image will be formed 15in. from the lens, and will be exactly one-half the size of flame. Again, lens 14in., flame 28in., $28 \times 14 = 392 \div 14 = 28$; thus flame and image are same size, and are twice the focal length from lens.

Bon-Accord.

[68798.]—**Shells, to Clean and Polish.**—The shells are pickled in a hot solution of hydrochloric acid, and after scrubbing and rinsing in water, are polished with any of the usual polishing powders. The process is described in back volumes, and in many of the recipe books. T. M.

[68800.]—**Chemical.**—The method of cooling the acid is to pass it through pipes immersed in cold water or exposed to the action of cold air.

C. P.

[68802.]—**L. and N.W. Compounds.**—Full details of these have been given some time ago, and scale drawings in the engineering papers.

M. D. C.

[68807.]—**L. and N.W Engines.**—I believe this querist could easily get a list of the engines he wants by referring to back volumes. At any rate, the query seems to be of little interest. J. P.

[68811.]—**Water-Glass.**—Why does not the querist try the experiment, and so settle the question in his mind once for all? X.

[68819.]—**Magnet.**—To F. W. Mason.—Thanks for noticing my last query. Would you please give dimensions, &c., of the Minotti battery; also to kindly to decipher chemical signs, as I don't understand them; also number required and probable cost per cell, how long will it work without recharging at one hour per day six days per week?

Locomotive.

[68821.]—**Foxed Engravings.**—Anything that cannot be got off with a bit of bread can possibly be bleached with weak chloride of lime solution; but the parts must be well washed with water afterwards—preferably distilled water, using blotting-paper to soak it up after it has been on a second or two. J. M. T.

[68822.]—**Noisy Fan.**—This fan is simply in such a position that it can set up vibrations in a column of air which then becomes like an organ-pipe. Stop the vibrations and the noise will cease.

O. P.

[68823.]—**Painting on Zinc.**—Rub the zinc over with sand and water, applied on something like a bit of coker-nut husk (nothing better); wash down with acidulated water, and apply the paint as soon as it will take on. The colour ought to "dry," if properly prepared, as the base on which it is put has very little to do with the drying. For "flat" colours mix the pigments with more turpentine than oil, and try as "driers" the addition of terebene.

S. M.

[68829.]—**Mushet's Self-Hardening Steel.**—The makers of this tool steel will supply all necessary information on application; but, of course, it has been given in back volumes, although F. Allen says there is "nothing in back numbers of any practical value." That being the case, I am afraid anything I could say would be without practical value; he wants somebody to show him—or better, to do the work for him. Anvil.

[68831.]—**Cleaning Marble.**—Mix up some soft soap, whiting, and soda into a sort of paint, and dab that over the marble tombstone, working it well into the carved foliage, &c. Leave it on for, say, an hour, and then syringe it off, using some force. A fire-engine hose would be useful. Repeat the dose if very dirty. It may be necessary to use a weak solution of hydrochloric acid and a brush; but I should try the solution above given first.

Nun. Dor.

[68832.]—**Archimedes.**—If this querist means the Archimedean water-lifter, it is described in most of the textbooks, and is briefly a pipe coiled spirally on an axle. The lower end is always below the water, and as the thing is revolved it, of course, "screws" the water up to the top end. C. L.

[68840.]—**Newtonian Telescope.**—I beg to thank "F.R.A.S.," Messrs. J. C. Linscott, T. Westlake, and "Ecnal" for their kind advices as to size of flat, which were read by myself and several friends with much interest. I also wish to state that I have tested it by distending an angle from a base-line 12½in. the diameter of mirror, and extending it out 14ft. the length of the focus, and allowing for the width of the moon's image, I find that 2½in. minor axis is the most suitable size for flat. This will take in all the rays from the moon, with a slight margin; also nebulæ or clusters of stars of the same angular diameter—viz., about ½°.

J. P.

[68841.]—**Pocket Camera.**—Is not the article sufficiently explanatory? No doubt any photographic dealer would supply suitable plates and a lens to a customer. What is it "Cam" means?

Actin.

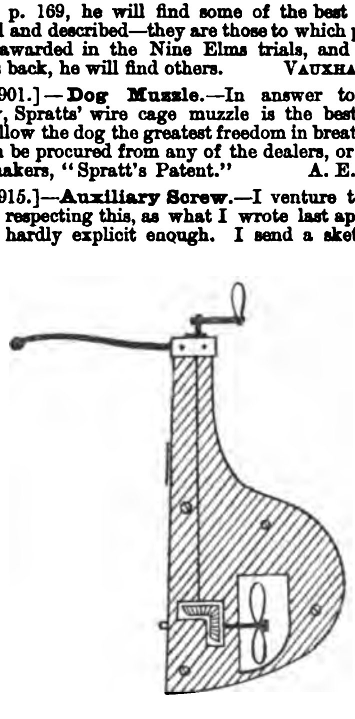
[68843.]—**Hot-Neck Grease.**—What does Mr. J. H. Thomas mean? All sorts of recipes for lubricants for journals, &c., have been given in back numbers, and he must really say what kind of "hot necks" he means if he expects a special answer.

R.

[68844.]—**Railway Coupling Appliances.**—"Old Hand" must be rather young, or he would know that the coupling appliances have been fully described in back volumes. If he will refer to No. 1100, p. 169, he will find some of the best illustrated and described—they are those to which prizes were awarded in the Nine Elms trials, and if he refers back, he will find others. Vauxhall.

[68901.]—**Dog Muzzle.**—In answer to this query, Spratts' wire cage muzzle is the best, and will allow the dog the greatest freedom in breathing. It can be procured from any of the dealers, or from the makers, "Spratt's Patent." A. E. B.

[68915.]—**Auxiliary Screw.**—I venture to add a line respecting this, as what I wrote last appears to be hardly explicit enough. I send a sketch of the rudder complete, only adding dotted lines where the ½in. rods pass through the middle. I have gone miles when becalmed, using a thwart of the boat to propel myself, having no paddles on board; and I think under such circumstances a screw rudder would be a blessing. "If Tredagh" thinks of trying this, he can regulate speed of screw by having driving gear larger, or equal to gear being driven. I should like to know the results if two or three knots can be obtained. Of course this would be used only as a spare rudder in case of necessity.



Wm. Hosken.

[68933.]—**Electrical.**—In reply to F. W. Mason, I proceeded as follows:—I mixed up a solution of phosphorus and bisulphide of carbon—1oz. phos. to 20oz. bisulphide—and painted my wax mould with same, and, when dry, poured on a pretty strong solution of silver nitrate, which immediately turned the surface black. I then allowed it to dry, and as soon as dry, poured on the silver again, to be sure of getting the surface well metallised. I then allowed it again to dry in the strong daylight, and upon putting same into bath it was covered all over in about twenty minutes or half an hour. The size of mould I was operating upon was about 1ft. square, with a head in the centre very much in relief; but when I separated the copper from the mould after it had been in the bath about a week, it was very rough on the surface, and this is what I want to avoid again. The centre head, especially tip of nose, was no thicker than paper, so that I was unable to polish much for fear of going through. I have tried blacklead, but with that have failed to get it to cover the nose of face at all. The battery power I was using were 12 Daniell's elements, each holding about a gallon in outer cell, and each porous pot about two pints of acid-sulph. solution, coupled up in four lots of series—one of acid to twenty of water. I kept my zincs well amalgamated, and should have thought the deposit would have been thicker. But the main thing I want to get is a perfectly fine smooth surface, and covered all over in a short time. I may add my mould is composed of Japan wax and beeswax mixed with white-lead, and, when separated from original, has a beautifully smooth and shiny surface. IGNORAMUS.

[68943.]—**Staining Terracotta.**—Many thanks to "Potter" and "Jack of All Trades." The articles have been burnt in the clay state. However, I have advertised my address, and shall be glad if "Potter" and "Jack of All Trades" will write me. DUM SPIRO SPERO.

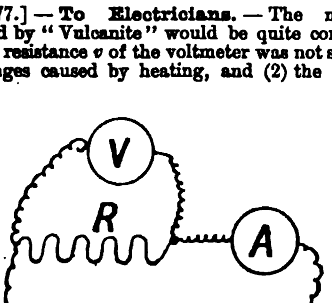
[68953.]—**Differential Equations.** — In the latter part of my reply, sin. θ is given $\sqrt{\frac{2c^2}{T}} . t$; the small t should be included under the radix. Perhaps it is safer to write such an expression with brackets, thus $\sqrt{\left(\frac{2c^2}{T} . t\right)}$. I am glad to see "A. H. G." appreciates these problems. The way in which the calculus produces results after a page or two of x, y, z, with a short "snap" as it were, is really wonderful.

Bath. M.I.C.E.

[68955.]—**Barlow Lens.**—Although not specially addressed in this query, perhaps my small experience with a Barlow lens may be of use to "J. M." I have an excellent 3in. achromatic by Dollond, which originally had three Huyghenian e.p.'s, magnifying 40, 80, and 160 diams. respectively; in addition to these I had a Barlow lens fitted by the makers. They said that at the distance they would place it from the field lens it would raise the power of each e.p. about one-third. Since I have used it I can thoroughly endorse what Webb says in his admirable work, "Celestial Objects," on page 6: "The interposition of a combination called a Barlow lens raises the power with little loss of light; and as one may be made to suit all e.p.'s, it doubles the set at a small expense." (1) My Barlow, in its normal position, raises the power about one-third; but of course the power varies according to the distance between it and the field lens of the e.p. (2) In my opinion it does not absorb much light, but it cuts off a great many heat rays. (3) I think it affects definition very little; (4) although probably the light and definition would be better in using a higher-power e.p. alone rather than one of low power together with the Barlow lens. (5) There is no particular position for it as regards the e.p. (within limits); but the power is increased by moving it further from the field lens; mine admits of an adjustment of about 3in. (6) I find it particularly useful for double-star work, as it affords a means of gradually raising the power. I always use it for Solar observations, since, not having a diagonal, it saves the screen glasses, cutting off the greater portion of the heat. (8) I should not think it would secure a larger field, since it increases the magnifying power, and consequently decreases the actual amount of the object taken in. If "J. M." wants to know further particulars, I shall be pleased to give him them in about three weeks, as I have not the telescope by me now, so consequently the measurements, &c., are only from memory.

Bradfield College, Berks. G. DIXON.

[68977.] — **To Electricians.** — The method adopted by "Vulcanite" would be quite correct if (1) the resistance v of the voltmeter was not subject to changes caused by heating, and (2) the sum of the resistances of the ammeter and dynamo $g + b$ was infinitely small compared with that of the voltmeter. Rewind your voltmeter with much finer copper wire, and use a large fixed platinoid resistance in series with it; you will then have a fairly reliable instrument. The best arrangement for calibrating a voltmeter by an ammeter is shown in the illustration. V is the voltmeter, A the ammeter, R any suitable resistance of thick platinoid wire, which is practically nil compared with v. A R = volts at the terminals of R—*e.g.*, R = 2 ohms, v = 10,000 ohms, A = 3 ampères, then V ought to read 6 volts. The method suggested by Mr. Bottone is hardly practical or reliable, even if a set of standard coils are used. GILBERT B. LUCKHOFF.

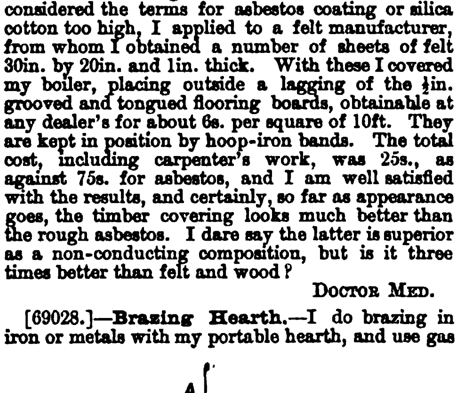


[69016.]—**Railway Gradients.**—One of the worst inclines in England is the Lickey incline, which rises 1 in 37, the whole distance from Bromsgrove to Blackwell, on the Midland. An assistant engine is used for pushing up both goods and passenger trains. On one occasion the train I was travelling in had a coupled express-engine in front and two coupled tank-engines at the rear, in order to save time in the ascent; but possibly this is not an uncommon occurrence. The South-Western have a similar gradient between the St. David's and the Queen-street stations at Exeter, of 1 in 37; but this is a very short one. The train engine is sufficient generally; but until recently men were employed to place sand on the rails, but this is now discontinued. The North British have a stiff gradient, rising 1 in 45 for 1¼ mile, mostly through a tunnel, on leaving Queen-street station, Glasgow, for Cowlairs. On the Somerset and Dorset line there is an incline of 1 in 50 from Shepton Mallet to Masbury (which also passes through a tunnel), and after passing Masbury station descends at 1 in 50 towards Binegar. On the Bridport branch of the Great Western there are some short pieces of heavy road, 1 in 50, near Toller, and six-wheeled coupled saddle-back tank-engines are used. The Beattock incline on the Caledonian is 9¾ miles long, rising towards Carstairs. For the first two miles it is 1 in 88, the next two miles 1 in 80, and the last five and a half, 1 in 75. This was the incline over which Mr. Dugald Drummond's single engines made such splendid running this time last year with the North-Western Scotch express. There is also a very severe gradient on the Malton and Whitby branch of the North-Eastern at Goathland Mill. My only authority, however, is a newspaper paragraph, which says it is a mile long, and falls 1 in 14 and 1 in 20; but I have no means at hand of verifying the statement. WOOTTON RIVERS.

[69019.] — **Boiler-Covering Composition.**—Some months ago I asked a similar question, to which our Editor gave a similar answer; but as I considered the terms for asbestos coating or silica cotton too high, I applied to a felt manufacturer, from whom I obtained a number of sheets of felt 30in. by 20in. and 1in. thick. With these I covered my boiler, placing outside a lagging of the ½in. grooved and tongued flooring boards, obtainable at any dealer's for about 6s. per square of 10ft. They are kept in position by hoop-iron bands. The total cost, including carpenter's work, was 25s., as against 75s. for asbestos, and I am well satisfied with the results, and certainly, so far as appearance goes, the timber covering looks much better than the rough asbestos. I dare say the latter is superior as a non-conducting composition, but is it three times better than felt and wood?

DOCTOR MED.

[69028.]—**Brazing Hearth.**—I do brazing in iron or metals with my portable hearth, and use gas applied in the manner shown in sketch sent herewith. A is the forge bottom and side, B firebrick, through which the cast-iron tuyere or blast pipe C passes. At D is inserted a gas pipe, E, having a thumb-tap, F, to regulate flow of gas. The blast pipe ¾in. diameter inside, and the gas nozzle tapers from ⅜in. at D to $\frac{5}{16}$in. at C, inside, and is extended to about point G. I use good forge breezes, but no coal at all. To light my fire I simply start blowing gently, rake the breezes back so as to expose the nose of the blast pipe, turn on a little gas, light it, and gradually draw the breezes together. I increase the blast, and when I get a good fire I reduce it to very small limits. If find this method very effective, convenient, and clean.



Birmingham. HALL.

[69031.]—**Anemometer.** — The measurements given are for a standard instrument, and I think I am right in saying the dial registers 500 when a mile of wind has passed. "Hallett" would do well to refer to "Buchan's Handybook of Meteorology" and several papers in the *Journal* Royal Meteorological Society, before making his instrument. Besides, unless you have an exceedingly good exposure, your labour will be in vain; and, at the same time, the axis or spindle must be get-at-able, or your readings will be interfered with through friction caused by want of oiling. They should be cleaned and oiled regularly. Conical cups will not do at all. F.R.MET.SOC.

[69032.]—**Colouring Plans on Skins.**—After the plan is drawn and penned in, make a careful tracing of each colour, cut out the spaces to be coloured, and lay the tracing upon the skin, either pinning down or weighting with pennies. Mix your colour thick and sprinkle by using an old tooth-brush and drawing a knife over it towards you, as in the well-known "splatter work." The advantage of this method, over laying washes, is that the skin does not "cockle," and the skin may be perfectly even, with practice, hill shading, rocks, trees, &c., may be indicated. HALL.

[69032.] — **Colouring Parchment Plans.**—Maps on parchment are difficult to colour, as the water soaks through and spoils the parchment, and without an abundant wash it is difficult to get an even hue. I have tried two plans with some success—first, stippling, which is tedious in the extreme and second, splashing, which is done by drawing a tooth-brush charged with the colour across the back of a knife, which results in a large number of very small spots being thrown down. The surface of the parchment to be coloured must be carefully traced on tracing paper, and the piece to be coloured cut out. The rest of the tracing paper is then pinned down on the parchment and splashed as above. It should be said that when it looks to be about half-done it is generally coloured more than enough. VINDEX.

[69034.]—**Dynamo.**—The machine, being series-wound, finds the resistance of a single lamp too great for it to overcome, and to allow sufficient current to pass to energise the F.M.'s. Procure four 6-volt lamps, arrange all four in parallel—i.e., tandem fashion, drive your dynamo at 3,000 revs. per minute, and you will find that you will light up your lamps well. S. BOTTONE.

[69036.] — **Platinum Contacts Becoming Oxidised.**—I would suggest that the contact points be examined. It is probable that the solder used in fixing the platinum wire to the screw has formed an alloy with the wire, and when the current passes this alloy is burnt into oxide. Or, perhaps, if the platinum wire is too short, the spark developed at the contact burns the brass screw. PRINCIPIA.

[69036.]—**Platinum Contacts, Oxidising.**—To MR. BOTTONE.—A complaint too common, alas among those who use electrically-driven clocks. I can only advise you to arrange the contacts in such a way that the pieces slide along each other, or make a "rubbing" contact, and not a mere dotting one. A rubbing contact tends to keep the surfaces bright. Also, if possible, use a piece of platinum-iridium alloy. This is even harder and more inoxidisable than platinum. S. BOTTONE.

[69039.]—**Bichromate Battery.**—Scrape off from carbons any adhering pitch or black varnish. Soak carbons in warm water for several hours, as long as any colour is imparted to the water, which should be changed frequently. When quite clean, dry carefully on the hob. Now rig up a Daniell's battery, and having cleaned the end of the carbon which has to be soldered to the copper or brass strip on the cover of cell with a bit of fine emery-paper, connect it to the zinc of the battery by the other end, and deposit on the cleaned end a thin layer of copper; this ought to take a few minutes only. Again wash the plates in plenty of running water, to remove sulphate of copper, and dry quickly. The copper coating will enable you to solder the plates to the strip. See also reply 688 for fuller instructions as to soldering the carbons.

S. BOTTONE.

[69041.]—**Engine Slides.**—You had better use the slides as they are, or else consign them to the scrap heap. The blowholes as they now are simply act as oil containers, and assist lubrication. By stopping, you run the risk of same working out, and causing the slides to fire when in motion. Holes outside the working surfaces can be stopped by means of founders' expansion metal. Any founder will do it for you, and the price is trifling.

F. W. CANNON.

[69042.]—**Electric Bells.**—What you mention is in many cases due to carelessness in keeping the wire in the same case as the salammoniac. If in any part of the circuit the covering of the wire has before erection been saturated with salammoniac, in the course of time the wire is reduced to the fine grain powder you describe. In your case, it may have been caused by something else.

F. W. CANNON.

[69042.]—**Electric Bells.**—Prossible causes:—1. The wires were uncovered; 2nd, the wires were joined with "killed spirits" as a flux; 3rd, the wires were covered, but the place is very damp, and the air is charged with acid vapour, or with ammonia from some cesspool or privy; 4, mice will sometimes eat through a copper wire. As a remedy for all, I should advise the wires to be run in a wooden casing or a metal tube.

S. Bottone.

[69042.]—**Electric Bells.**—If a copper wire is fixed across a board and a drop of salammoniac solution is put on any part of it, in a few days it will completely divide the wire with the formation of copper oxychloride. This is what has probably happened in your case—a drop of the battery solution running down the wall, or a particle of the salt "creeping" over, lodging on the wire, and becoming damp. I have had an 18 B.W.G. wire cut in half in 24 hours in this manner.

Principia.

[69043.]—**Alarm Guns.**—Gamekeepers' alarm guns, of two or three kinds, making more or less report, are to be had—gun and fixture, about 10s.; ammunition, 12s. per dozen; wire, 100 yards 2s. 6d. The Birmingham gunmakers can supply these articles.

Eos.

[69044.]—**Dynamo.**—Since your armature will only hold 1¼oz. of wire, you had better use No. 24 silk-covered wire on the armature, and 6oz. of the same wire on each of the limbs of the F.M.'s. Do not connect up in series, but in shunt—that is to say, bring the ends of the wires of the field-magnets to the brushes direct, and take the current to feed the lamp from the brush pillars also. If driven at about 3,500 revs. per minute, you will be able to light one or two 6-volt lamps. You will have to try in which direction to drive to get current.

S. Bottone.

[69046.]—**Photo. Enlargement.**—You can obtain prepared canvas for direct enlargements from most photographic dealers. I have some very good results on canvas obtained with transferrotype paper, which is more economical than prepared canvas, and the results are equal.

F. W. Cannon.

[69047.]—**Paraffining Carbons.**—Cast the lead cap on before you dip the heads only of the carbons in the paraffin wax, and you will find it protect the cap, whether it be lead or copper, all right. Half an inch below the cap is ample; if lower down it reduces the conducting surface of the carbon needlessly. Solder will not hold to amalgamated zinc—at least, I think Mr. Urquhart says so in his book on "Electro-Plating."

F.R.Met.Soc.

[69047.]—**Paraffining Carbon Plates.**—To Mr. Bottone.—Carbon plates to be used with chromic acid should not be paraffined. Solder, if properly applied at connections, does not lessen either the E.M.F. or current of a battery. You will find full and exhaustive details for making electro-motors of all kinds, from small ones to be worked with a single cell, up to large ones as used in tram driving, in my articles on "Electro-Motors: How Made and how Used," which begin at p. 271, Vol. XLVIII. of the "E. M.," and are still continuing.

S. Bottone.

[69048.]—**Locomotive.**—The power to move a train is not usually estimated by the strain put upon the crank-pin, but by the ratio of the diameter of driving-wheels to piston area and pressure. The diameter of one cylinder is squared and multiplied by the effective mean pressure of steam per square inch, and by the length of stroke, and the product divided by diameter of driving-wheels in inches. To obtain tractive power from pressure on crank-pin the mean work done on the pin is taken, because the rotational force constantly varies, being *nil* at dead points, and at the maximum at about half-stroke. The piston travels through two diameters of the crank path circle while the crank-pin travels through the circumference; hence, the relationship between piston and crank-pin is as 2 to 3·14159 or as ·6366 to 1, and the mean work of a single revolution of the crank-pin is to that of two piston strokes as ·6366 is to 1. Multiply, therefore, length or radius of crank by ·6366, and divide the product by radius of wheel, and this by 2, there being two cranks. Thus, with crank of 12in. radius, and mean effective pressure on each piston of 20,000lb., and driving-wheels of 6ft. diameter, we should have $\frac{12 \times \cdot6366 \times 20,000}{36} = 4,244 \times 2 = 8,488$, the tractive power.

J. H.

[69049.]—**Zinc Casting.**—To Mr. Bottone.—Do not attempt to cast cylinders so thin: you would surely fail. Procure some sheet zinc at about 4d. per lb., make it as hot as the hand can bear before the fire, and roll it round a wooden collar of the desired diameter. You will find that you can do this by hand. The depolariser has much greater staying powers than plain chromic acid.

S. Bottone.

[69049.]—**Zinc Castings for Bunsen Cells.**—Some time ago I made a lot of these. The mould I used was made by a stove-pipe maker, and consisted of two pieces of sheet-iron bound round with wire, and kept apart at intervals by small pieces of iron. Suppose a zinc 9in. by 4in. diameter is wanted, and ¼in. thick; the outer iron would be 9in. by 4in., and the inner one 9in. by 3½in., small pieces of iron ¼in. thick and ½in. wide being inserted at equal distances. After casting one, let it cool well before taking out of mould. Bottone's (?) depolariser is chromic acid.

F.R.Met.Soc.

[69051.]—**Observatories.**—If "G. G. B." has a telescope large enough to require a room, he will of course want to use high powers. He will find the vibration of a room in London built over another room such as to render any power over 60 useless.

C. M.

[69052.]—**Saddle Boiler for Greenhouse.**—The setting will depend to some extent upon the size; but, as a rule, the fire would be about half the length of the boiler, and at the end of the fire build a bridge of firebrick. The flue would either be split at back and return along both sides, or come along one side from back to front, over the top, and along other side from front to back, depending upon position of chimney. The highest point of boiler must be below the lowest part of pipes, and there must be two cleaning plugs, one at each side, and quite close to the bottom. Fawkes, of Chelmsford, publishes a small but reliable book on hot water.

Hall.

[69053.] — **Incandescent Lighting with Leclanches.**—Six 6-volts marked on lamps means that is the amount of current required; hence six Leclanchés should be sufficient.

Meran. A. R. B.

[69053.] — **Incandescent Lighting with Leclanches.**—You are quite right; what you gain in brilliancy you gain at the cost of breaking down the filament more quickly. The use of the word volts in connection with lamps is entirely erroneous and misleading. Originally applied to lamps intended to be used with dynamos in which the E.M.F. is greatly in excess of the resistance, it pointed to the number of volts in the dynamo required to drive the required current (about one ampère) through the lamps. But in a battery, and especially in the Leclanché, the resistance is so very high, that the volts in the battery will not supply the same amount of current. The No. 2 Leclanché is 1·6 volt with 1·1 ohm resistance. Hence 10 cells = 16 volts, with 11 ohms resistance and 6 of the lamp = $\frac{16}{17}$, not quite an ampère, which will not injure your lamp.

S. Bottone.

[69054.]—**Compressed Air.**—You have simply to divide your volume by 2, and multiply your pressure by 2. For example, take a cubic foot of air, 1,728 cubic inches at 15lb. per square inch; you divide the former by 2, which makes it 864 cubic inches, and multiply the 15 by 2, which makes same 30lb. pressure; the following serves to show the rise in pressure with the fall in volume:—

Volume of air in cubic inches.	Pressure in lb. per square inch.
1728	15
864	30
432	60
216	120
108	240
54	480
27	960
13·5	1920

F. W. Cannon.

[69054.]—**Compressed Air.**—By Boyle's law the volume of a gas at constant temperature is inversely as the pressure, or, in other words, the product of pressure and volume is constant. Taking 15lb. per square inch as the normal atmospheric pressure, and assuming that you mean 100, 500, and 1,000lb. above atmospheric pressure, we easily obtain the volumes required. For, let V = vol. at 15lb. pressure, X = vol. at n lb. pressure, then $15\,V = n\,X$, and $X = \frac{15\,V}{n}$. This equation gives the volumes as $\cdot13\,V$, $\cdot029\,V$, and $\cdot0147\,V$ respectively.

H. C. Haycraft.

[69054.]—**Compressed Air.**—The volume of a gas is inversely proportionate to the pressure. The ordinary atmospheric pressure is about 14·6lb. to the square inch; hence, a volume of air measuring x cubic inches at normal would occupy $\frac{100x}{14 \cdot 6}$ cubic inches at a pressure of 100lb. per sq. in., and $\frac{500x}{14 \cdot 6}$ and $\frac{1,000x}{14 \cdot 6}$ at the other pressures mentioned. Of course, the direct answer to the query—viz., as to by how much the volume would be reduced—is, of course, the original volume minus the respective ones under the altered conditions.

Richmond. Young Analyst.

[69055.]—**Blue Salt.**—Both nickel and hydroxides are soluble in excess of AmHo to a violet-blue and dark blue solution respectively. Chromium also gives a violet-coloured solution.

Richmond. Young Analyst.

[69055.]—**Blue Salt.**—A soluble salt of copper precipitated with ammonium carbonate or hydrate in excess will give a splendid blue solution; the same happens with salts of nickel, though in a less degree as to colour.

Principia.

[69056.]—**Black Needles.**—By what precipitants; or as metal? This is rather a vague query.

Principia.

[69057.]—**Lavender Beads.**—Manganese forms a violet bead in oxidising flames; cobalt a blue bead in both flames. Perhaps it is a trace of either of these two metals.

Principia.

[69057.]—**Lavender Beads.**—"True Blue" does not say under what conditions—whether hot or cold, oxidised or reduced; but "manganese" gives an amethyst-coloured bead in the oxidising flame. "Lavender" is rather a vague definition. It might be the result of a mixture of metals. However, the presence or not of manganese can be determined with the greatest ease. Fuse a small quantity of the substance with $KNo_3 + Na_2Co_3$ on platinum foil until effervescence ceases. If Mn is present the liquid mass is pale olive-green and transparent, and, on cooling, becomes of a fine opaque dark bluish-green colour. Refer to "Blowpipe Analysis," by Landauer.

Richmond. Young Analyst.

[69060.]—**Hardening Steel.**—Permit me to reply to "Oil Furnace," and others who have not tried the under-mentioned method of hardening steel, with the remark that nothing but constant experience and a thorough knowledge of the temper of the steel on which you are about to operate, will enable one to harden steel successfully. The following processes have stood the test of eighty years or more, and are still practised by practical men who know what they are about. I admit it is expensive, and only applicable to steel which has, besides its worth as mere metal, an intrinsic value. "Oil Furnace" wants to know how to harden pieces of steel ⅜in. by 12in., which in the ordinary way is extremely difficult. This can be done in an ordinary good house fire, and still better in a furnace heated by coal, or in a blacksmith's fire. Get cast, in metal, a box calculated to hold the articles to be hardened, which should be ⅜in. thick on all sides; next take a quantity of leather cuttings, and put them into the box, and the box into the fire, and convert into charcoal, taking care that all moisture is eliminated. Next place in the box the pieces to be hardened, laying these at regular intervals, each with a covering of charcoal, until the box is filled; then place in the furnace until the box and its contents are at that heat, which none but an experienced eye can tell—viz., a bright cherry red (a result dependent upon the fire and constant watching at the last stage); now withdraw the box and its contents, and plunge bodily into clean, cold water. Now take the lid off the box, which, by the bye, I have not spoken of before, and lay it on top of the fire until it is red-hot; bring this lid out into a good light, and proceed to temper. Have at hand a deep dish or can of any kind of oil, and stand ready to operate. Bring out the red-hot lid of the box into the strong light aforesaid, and lay on, one by one, the articles to be tempered, and temper to colour required. I regret very much that I can give no reliable guide to temper, as what will do for one person will not do for another; but if my correspondent will come to Sheffield, and seek out some table-blade, razor-blade, or pen-blade forger's smithy, and pay him a trifle, he could soon learn how to harden and temper his long pieces one by one. In looking over my letter, I see that I have alluded to an "ordinary good house fire." Perhaps some of our Southern readers have very little notion of what a Yorkshire house fire is like; and perhaps when I tell them that when the master of the house is expected home, and the fire is supposed to be at its brightest—i.e., scorching within 6ft. from its centre—they will not feel inclined to think I have been romancing.

N. Maclean.

117, Harwood-street, Sheffield.

[69061.] — **Magnetising a Dynamo.** — A bichromate or chromic-acid cell, with plates exposing about 16sq.in. of surface in the liquid (that is about 4in. by 4in.), will do nicely to magnetise your dynamo. While being thus connected to the cell the dynamo's F.M. will pull from 5lb. to 10lb., according to the softness of the iron. Of course, nearly all this will disappear on disconnecting the battery; but sufficient residual magnetism will remain to start the dynamo into action.

S. Bottone.

[69063.]—**Flies.**—If you do not mind the smell, burn some sulphur in your room occasionally.

F. W. Cannon.

[69063.]—**Flies.**—I have tried fly-papers, fly-jars, and burning Persian powder, but without success. I have at last found out for myself how to bother them—namely, have a good draught through the room. They can't stand this. The temperature is not very material; they will multiply in a tolerably cool place if still, but a current of air makes them disappear. Vindex.

[69063.]—**Flies.**—It is said that if a bottle of bromine is left open all night it will settle all insect pests. Perhaps the best plan would be to make a light frame to fit the window, and stretch a square of mosquito netting over it. Principia.

[69063.]—**Flies.**—I have seen Burnet's chloride of zinc, also chloride of lime in shallow trays, expel them from rooms where corpses were laid. By closing the doors and vapourising carbolic acid over a spirit-lamp they may be slaughtered. Branches of elder, bruised and hung up, are used by butchers and farmers. Quassia chips, steeped in a soup plate with a little sweetened water, attract and stupefy these winged pests. So densely do they swarm in Northern India that I have actually used gunpowder; some sugared milk being smeared on any flat surface, the spot is encircled by a train of the explosive, a match being applied when the black swarm have alighted. I noticed lately that on driving into a green lane, its hedges planted densely with elder in full flower, the crowds of flies disappeared from our horses' heads, and we saw no more till we entered the open country.
Eos.

[69065.]—**Preserving Mixture.**—One of Goadby's solutions, according to what he is preserving, would, I think, best suit F. H. Harvey. He will find the recipes for making them in Carpenter's "Microscope," so I need not repeat them. The substances have only to be dissolved in water. Jargoons: I should not like to say what this means; but I remember that "giargone" is Italian for an inferior diamond. Vindex.

[69066.]—**Heating Swimming Bath.**—This depends on the surroundings—i.e., have you steam for other purposes, have you any skilled attendance available, whether in or upon the ground? If you have steam or can arrange for it, fix a perforated pipe 3in. to 4in. diameter across the deep end of the bath and connect to your steam-pipe and inject steam direct, the effect is rapid but noisy. If noise is objected to, use three or four lengths of 1in. steam tubing, according to the temperature required and the time available; connect one end to steam-pipe and leave the other open over the bath. An ordinary circulating boiler, working into the bath as a tank, has been used; but it is difficult to maintain a regular temperature. Hall.

[69074.]—**Children's Teeth.**—In reply to "Pater," I think the sooner his daughter goes to a good dentist and has out the aching teeth, and those slightly decayed stopped, the better for the future health of his child. My opinion, as a dentist, is that every child should be examined periodically—say, every three months, by a good dentist, so as to stop the teeth when only slightly decayed, and not for the parents to wait until the child cries with pain, and then take her to a dentist and ask for the tooth to be preserved when it is too late. Let it be thoroughly understood that only by the periodic-examination process can the teeth be preserved, and that regularly from the age of 6 to 16, after which education the grown-up children would go themselves. I make no charge for this examination business; the recommendations pay for the trouble given. Jas. T. Hoare.

[69074.]—**Children's Teeth.**—When the second teeth decay rapidly it is a sign of bad general health. As you say the child is somewhat nervous, it may be that she is growing quickly and requires toning up. Girls at the critical period are very subject to functional derangements, and it is well to let them have plenty of fresh air and exercise, even if they neglect their examination studies a little. If the girl were mine I should take her to a good, trustworthy old doctor, tell him about the state of the teeth and frequent toothaches, and get him to prescribe; which he would most likely do in the form of quinine and iron, beefsteaks, and plenty of fresh air. As to magnesia affecting the teeth—well, I don't think it is possible. If it had been calomel, there might have been some probability. Above all things, don't quack the child, don't frighten it by letting it suppose anything is wrong; but quietly get the opinion of a good medical man, and follow his advice. S. Bottone.

[69076.]—**ζ Bootis.**—The most recent measure I know of this pair is one by Mr. Tarrant—

296·56° : 0·65″ : 1885·407 (3 nights).

Mr. Ingall's observation would therefore seem to show that the components are rapidly closing up; but his estimated position angle appears to require a correction of 180°. J. E. Gore.

[69077.]—**Pocket Battery.**—You have been using the black sulphide of mercury, and this is absolutely no use for this purpose. What you want is the bisulphate of mercury, which is a greyish-white crystalline powder. S. Bottone.

[69079.]—**Accumulators.**—About one yard No. 20 g.s., if you couple the cells in series.
S. Bottone.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "A. R. B." has replied to 68428; "J. K.," 68683; "Young Analyst," 68722.

68572 Power of Eyepieces, p. 227.
68578 Patterns for Ashpan Bars, 227.
68591 Tramway Gauge, 227.
68608 Organ at St. Thomas, Salisbury, 228.
68616 Force of Explosives, 228.
68619 Measuring Time, 228.
68620 What is it? 228

68799. Another Old Locomotive, p. 311.
68801. Checking Blood Flow in Animals Accidentall Killed, 311.
68803. Snake and Animal Poisonous Secretions, 311.
68806. Electrical, 311.
68833. Kansas, Mo., America, 312.
68846. Shadowgraphs, 312.
68847. Galloway Boiler, 312.

QUERIES.

[69082.]—**Agriculture.**—A boy of sixteen, fairly well educated, and of middle-class parentage, wishes to be a farmer. Which is the best way to make him one? Would it be well to send him to an agricultural college? If so, for how long? I have heard of two, one at Cirencester, and the other at Downton, near Salisbury. Can any reader describe the course of training at either or each, and say which is the best, and what the cost at either or both per annum? I had some thoughts of the Horticultural College at Swanley, and went down there on the occasion of the Lord Mayor's visit; but I cannot say that what I saw gave me much faith in the success of the undertaking. Supposing a boy finished off at an agricultural college, what is the best thing to do with him before putting him into a farm, and what is the average cost of setting up the youngster at last? I should prefer his final settlement in Devonshire or Cornwall: the farmers there seem to me physically ahead of their brethren elsewhere, except, perhaps, Yorkshiremen, and not obliged to work like slaves for a living. If, however, any other locality is thought preferable, hints would oblige, remembering that our aim is for the youngster not to make money, but to live a wholesome pleasant life, and if possible to send one pair of hands back to the country amid all the thousands that are deserting it for the thankless grinding life of the great cities.—K.

[69083.]—**Painting or Colouring Photographs.**—Will some one give me practical instructions on colouring ordinary photos.? Are they done in water colours or oils? Also what method am I to pursue in order to remove the glaze? I have been told licking is the usual expedient among experts. Is this so? I have utterly failed to remove the glaze after sundry applications of the tongue.—Dismal Jimmy.

[69084.]—**Making Accumulator Cells Acid-Proof.**—To Mr. Mason.—Would you please tell me the way to apply the recipe (given by you to querist 68640) for making accumulator cells acid-proof? Do you put the cells in the boiling cement? My cells are made of sycamore.—Samoht.

[69085.]—**Electric Alarm Clock.**—Will any of our electrical friends give me particulars as to fixing a battery and bell to clock, so as to ring at the time required?—British Mechanic.

[69086.]—**Dynamo.**—To Mr. Bottone.—In your kind reply to my query about the building of dynamos you gave the calculation for the amount of wire on an armature at a certain angular velocity. Now, I do not exactly understand what this means. Does it mean revolutions per minute or periphery speed? I find in a book on mechanics that it is the speed expressed in terms of the radius—what is this, and also what arc ought the pole-pieces to embrace in, say, a Manchester-type dynamo?—R. H. H.

[69087.]—**Pump Valves.**—Would some one please say what lift the valves of a double-acting pump should have, ram 7¾in. diam., 2ft. stroke, valve 9in. diam., going at 22 strokes per minute. Sometimes the valves stick up and then come down with a knock likely to shake the pipes to pieces. Head of water, 380ft. I have them set at 13-16in. Will some competent friend oblige?—Engineer.

[69088.]—**Prevention of Rust.**—I am constructing a model loco. for exhibition, and find a great difficulty in keeping the burnished iron and steel parts from tarnishing. Could any of our readers give me formula or recipe for a colourless liquid or lacquer for coating them to prevent them rusting? I saw some on show at the marine exhibition at Agricultural Hall some four or five years ago, which stood the test of standing in salt water without any effect on the bright parts of steel or iron.—Namlio.

[69089.]—**Out of Door Staging for Spectators.**—The Queen is to pass here shortly. Along the route it is proposed to erect seats for spectators. They will be in fields adjoining the turnpike road on which the queen will drive. Some of the fields are on a level with the road, and some a little higher. We shall be glad to have some information as to the best way of erecting the seats. Should they be 3in. thick? Will 7 or 8 or 9in. wide be right? How should they be supported so as not to give way either sideways, or backwards, or forwards, or downwards? As the timber may have to be hired, the less damage to it the better. If nails can be dispensed with it will be well. The seats will only be used for a few hours. They should be in tiers, say five, or thereabouts, rising from front to back. Three inch deals are readily obtainable, or they could be sawn into 1½ or 2in. thick. Which would you recommend? If the weather should be wet, the dirty boots of those in back seats might be awkward against those in front. How is this to be obviat rights might be let into the ground. Perhap recommend some small book containing wh —W. X.

[69090.]—**Brighton Engines.**—What ar of the following Brighton engines: 38, 42, 4 77 to 80, 83, 99, 107, 109, 114, 118, 122, 127, 135, 162, 166 to 176, 178 to 193, 197, 198, 234, 238, 2 to 324, 363 to 373, 376 to 463, 465 to 475, 484 any higher numbers after 488. Where there ar it is the name of the older engines that I requir

[69091.]—**Accident to Royal Train.**— Stretton give me any particulars of an accide to the 11.30 express from King's-cross, conv Prince of Wales to Bedford about 1865-66? Th I believe, broke away from the tender, and escaped a serious accident. What was its —P. H. N.

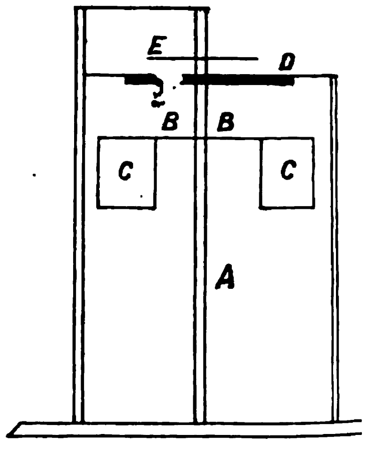
[69092.]—**Thermograph.**—Can any of scribers give me description of a thermograp &c.? I have had to make a large slate slab to shape for the above.—G. C. S.

[69093.]—**Babbitting a Screw.**—I hav machine worked by a large screw, 3½in. d pitch, treble threaded. The nut is of white 12in. long, and has evidently been "run on" I shall have to renew this nut some day, and if any of your readers can give me any hints own experience as to best mixture of white best coating with which to cover the screw running on the metal.—Langdon.

[69094.]—**Midland Engines.**—Would M kindly give a sketch of one of the old Midland singles (of the 35 type) which used to do such between King's-cross and Leicester in 1866? could also mention the numbers of the engin that date, were stationed at King's-cross and sheds. I should like to know also, the numb engines in the Welwyn tunnel accident, and Eaton collision.—Wooton Rivers.

[69095.]—**South-Western Engines.**— engines of this company are fast being scr someone help me to make my list of locomotiv I wish to know the names of the following en old type, which must have been built prior to 18 numbers are 9, 11, 12, 21, 26, 37, 39, 40, 41, 42 to 56, 60, 65, 77, 83, 91, 104, 106, 109, 112, 120, 123, 156, 161, 170, 176, and any higher numbers th names. I should like to have a sketch of a type of engine which used to run, of the Nymph class.—P. H. N.

[69096.]—**Sunlight Measurer.**—I hav account of one of these instruments in a book, b not give a clear description of it. A is a spindl four arms, B, and from which are suspended pie



C D is a dial divided into a hundred parts, and pointer. What I want to know is, how are the p tinfoil blackened, and how is it pivoted?—Expla

[69097.]—**Rubber Bandsaw Tires.**—I esteem it a favour if some of your readers would me how to fasten together indiarubber tires fo saws. We have two or three lately broke, and ha them to various places to be fastened, but they w stand to be pulled on.—Anxious.

[69098.]—**Hoists.**—Could any of the reader "E.M." give me a description of some modern ho want a hoist to lift 40 tons of coal 20ft. in eight The weight of box of coal about 7cwt.; plenty of hand. Please give sizes and sketch if pos Engineer.

[69099.]—**Glaze for Pottery.**—How do the p in Staffordshire get such a good glaze on their not to crizzle like the ware round about her "earthenware" as it is called at Castleford.—Pot.

[69100.]—**Sextant.**—I have one of Sir Douglas's Reflecting Protractors, which is very m a small sextant, but has an addition, consisti diagonal scale, which is part of the instrument, an on the right hand corner the number 1,760, which, sume, means 1,760 yards. Will some of your kindly inform me the use of this scale? I also no when the index of vernier is at zero, the first and division seem in contact. Is this right?—J. B. B

[69101.]—**Defective Sight.**—Should be than any "E.M." correspondent acquainted with the th vision, would kindly explain the cause of objects ap double to my view when looked at sidewise to my It will, perhaps, be necessary to state at once tha two years ago I was treated by an oculist for infla of one of my eyes. Ever since then I have expe this illusive effect of vision. At a distance, sa three feet, two images of one object present themselves, the real object appearing about 4in. higher than the illusion. At that short distance I have only to stretch out my hand to ascertain which of the two is real. But what puzzles me is this: If I close the defective eye with my finger the mock image vanishes; if I then reverse the experiment by closing the eye that is not affected, the real image then disappears, and the mock image becomes a reality, although it still retains it place in space, i.e., 4in. below the situation of the real object; but if I place my finger on the false image where it appears to be, then close the eye not affected, my finger appears suddenly to have dropped 4in.—W. F. P.

[69102.]—**Injectors.**—I have two injectors to feed large Galloway boilers, 50lb. to 60lb. pressure, which used to work very well; but lately there is a quantity of water running away through overflow pipe when on. I have cleaned them time after time, but cannot alter it. Will any kind reader give any information as to the cause of this?—One in a Fix.

[69103.]—**Water Gas.**—Will some reader kindly explain the nature and manufacture of water gas, as exhibited at the Royal show, Windsor? Also what advantages it has over coal gas.—B. Hiscock.

[69104.]—**Leclanche.**—I have a circuit on which currents will be sent at the rate of five per second. Which form of the Leclanché battery recovers itself the most quickly?—the porous pot, or agglomerate blocks?—And why?—J. E. S.

[69105.]—**Electric Battery.**—To Mr. F. W. Mason.—I have a bichromate battery, bottle form, the zinc plate of which I have tried to amalgamate. I dipped it in sulphuric acid, and then put some mercury on it; but it would not silver it over. Will you kindly tell me where I am wrong, and oblige?—Macclesfield.

[69106.]—**Electric Bells.**—Will some one kindly say if it is practicable to work six or eight bells in parallel over a half-mile of line, using water pipes for the return, instead of double line overhead? Could possible leakage to earth be overcome by using a few extra cells at the ringing station?—Desirous.

[69107.]—**Pressure in Loco. Boiler.**—When a loco boiler is being blown off under a pressure of 40lb. of steam, the needle of the pressure gauge does not fall back until very near all the water is out of the boiler, then the pure steam rushes out, and the needle drops almost instantly. I should have thought as the water went out of the boiler, the steam would expand in its place, and so reduce the pressure on the indicator of steam pressure gauge. Would some kind friend explain this, why it is not so?—J. B.

[69108.]—**Picture Frame.**—I have a gilt picture frame which has gone black. Will some reader kindly tell me how to regild it?—A New Reader.

[69109.]—**Steam and Tide.**—Say a river runs at the average rate of five miles per hour; a vessel steaming at the rate of fifteen miles per hour (in same direction as river is running), what assistance, if any, does the vessel receive from the tide? Do we get the correct result by adding rate of tide to the speed the vessel is steaming at?—Severn.

[69110.]—**Non-tarnishing Copper.**—I have seen copper ornaments stated to be untarnishable: the metal appears of a slightly lighter shade, as if it might be alloyed. Information about this would be valuable to me.—Y.

[69111.]—**Red-Hot Water.**—Water may be made red-hot without boiling. State how this result may be obtained? The above question was set in the natural philosophy paper at the Irish intermediate examinations for 1889. I am at a loss to understand how water can be made red-hot in the ordinary acceptation of the term. Can any of "ours" throw light on the subject?—Doctor Med.

[69112.]—**Spectacle Lenses.**—Is there any easy way of distinguishing between real Brazilian pebble lenses and glass, and also between pebble lenses which are cut in the proper direction, and those which are not so? What is the difference between periscopic and concave lenses? Are the former the best for reading? Do spectacles have to be frequently changed (for higher magnifying powers) with advancing years? If glasses of too high a power were commenced with, and worn for a year or two, would it be advisable to use a lesser power afterwards?—Edwards.

[69113.]—**Engine Query.**—Would "T. C., Bristol," reply to the following? Kindly give dimensions of a 1H.P. horizontal steam-engine to run at 200 revolutions a minute for driving a 7½in. centre engineer's screw-cutting lathe. Give the following particulars:—Length of bore and diam. of cylinder; length and width of steam ports and exhaust; length and width of face on which valve slides; thickness of sides of cylinder; thickness of flanges; amounts of lap and lead; at what portion of stroke to cut off; thickness of piston, and diam. of rod; diam. of valve rod; diam. of cross shaft; diam. and weight of flywheel.—Mechanic.

[69114.]—**Packeting Powders.**—Which is the most expeditious way of packeting powders similar to dry soap?—Salol.

[69115.]—**Small Naphtha Launches.**—Would some kind reader tell me the principle of engine used in small naphtha launches? I have seen one lately which works nicely—no noise, no smell. It worked the same as a steam-engine, high-pressure, then condensed the naphtha, and used it over again. The engine and boiler were all in one, the boiler standing on the engine, which was closed in an iron box. I should like to know how the engine reversed, and whether rotary or any other kind. In three minutes after the match was struck full pressure was up, and she travelled at a speed of six to seven miles an hour.—Peee.

[69116.]—**Area of Spherical Zone.**—For the area of any zone on the celestial sphere, parallel to Equator, I find the following formula. Area = $2\pi r^2 (\sin\theta - \sin\phi)$; where θ is the declination of the northern limit of the zone, and ϕ that of the southern limit, or, since $2\pi r^2$ = area of hemisphere (= 20626·5 square degrees), the area will be 20626·5 (sin. θ − sin. ϕ) square degrees; thus for zone between 20° and 30° declination, area = 20626·5 (sin. 30° − sin. 20°). Will "F.R.A.S." or other mathematical correspondent kindly say if this is correct?—Snow Cap.

[69117.]—**Rats.**—Our place of business swarms with rats. We have tried traps of every conceivable kind; have half a dozen set every night; and it is marvellous how they detect and avoid them. A friend told us that when a rat had once been in a trap it left a scent behind it that warned all others off; so we tried smoking them, heating them, varnishing, and lime-washing, covering them up in sawdust, &c., &c., but all to no use. Cats and dogs do a lot of mischief among the stock, and weasels disappear in the sewers, and do no good. I have been told that there is a substance known to professional rat catchers which attracts rats as Valerian does cats. Is this so? Can any of your numerous correspondents render any assistance, as these pests do us a lot of mischief?—Hilliard.

[Our own experience is, that chloride of lime forced into the rats' holes, and plentifully strewn in their runs, and renewed weekly for a month or two, and then occasionally at intervals, will drive away rats.—Ed.]

[69118.]—**Electric Launches.**—I am obliged for F. C. Allsop's reply to my query [69023.] I am prepared to purchase the batteries or accumulators, if necessary, but desire to endeavour to construct the motor. Will someone therefore give me the size and best design for same, and the approximate weight of it, and the accumulators in working order, so that I may obtain a vessel suitably proportioned. The boat will not exceed fifteen feet in length, will only be required to carry four or five persons at most (generally only two), and will be as shallow as is consistent with properly covering and utilising a small screw propeller. The whole boat and its equipment will, therefore, be so light that I imagine but little power will be required to drive it along.—Punch.

[69119.]—**Oily Skin.**—From my youth up I have been troubled with an oily skin; my face especially is covered with oily eruptions, and this in spite of careful dietary and plentiful exercise. Can any reader help me with his experience in this matter, and thereby oblige an—English Mechanic.

[69120.]—**Chamber Organ.**—I am having a small two-manual and pedal chamber organ built for practice. There are to be four slides in the soundboard of the swell, and three in the Great. A stopped diapason is to go in the swell, and a dulciana on the Great to begin with; and I would ask Mr. Audsley, Mr. Robinson, or other authority on the subject for advice relative to the filling up of the slides left vacant. There will be provision made for a soft Bourdon on the pedals.—Prorsum Celere.

Railway Races.—In an article on some of the after-effects of last year's railway race to Edinburgh, Mr. W. M. Acworth says in the *St. James's Gazette*:—Continental railway officials have been over here since last summer in great numbers, bent on finding out the secret of English speeds. Already a great many alterations have been introduced. For example, there is a new *rapide* in connection with the night mail out of London, leaving Paris at 8·40 every morning for Marseilles. Of course it carries no second or third-class passengers; but as it is only four hours slower than the new third-class train from Aberdeen to London, which it exactly the same distance, perhaps that could hardly have been expected. Then there are two new expresses from Paris to Berne with English connections; so that the time viâ Paris is now as quick as by the old route through Lâon and Chalons. Even Germany has got a new express from Berlin to Belgrade—perhaps as it only runs once a week it would be more accurate to say the seventh part of one. But the improvements in the Italian services are so remarkable that they must be noticed. A few years back there was a railway revolution in that country; the whole of the lines were taken into the hands of the State, and then leased to two great companies in such a way that there is competition throughout the whole length of the peninsula. Last winter the system produced the effect designed, and a "Race to Rome" began which has not yet seen its finish. The Western (Mediterraneo) Company started a "lightning express" (*treno lampo*) in about fourteen hours from Milan to Rome; the Adriatico promptly replied, and now that the lightning has been, if we may be allowed the expression, "greased" by a further acceleration of twenty minutes, which took effect on the 1st of June, the levin fires dart over 400 miles of country at an inclusive rate of nearly 33 miles an hour. Within six months four hours have been cut off the length of a journey between Milan and Rome. Will anyone assert that a change such as this is of no importance? There is, however, one point of which sight must not be lost. The English railway companies had been in training for their race for half a century. Ever since railways began English roads have been getting stronger and more perfect, English engines more capable of speed and endurance, English signalling appliances more complete, English discipline and organisation more capable of bearing the strain of an emergency. There is a question whether some foreign companies, the French especially, are not trying to run before they have learnt to walk.

In 1816 it took just one bushel of corn to buy one pound of nails, now one bushel of corn will buy ten pounds of nails. Then it required sixty-four bushels of barley to buy one yard of broadcloth, now the same amount of barley will pay for twenty yards of broadcloth. It then required the price of one bushel of wheat to pay for one yard of calico, now one bushel of wheat will buy twenty yards of calico.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 17, and unacknowledged elsewhere:—

E. Crossley.—T. G.—A Country Smith.—Old Hand.—Lydney Dispenser.—Temper.—G.—Tubing.—Croft.—W. H. S. Monck.—T. W.—A Fellow of the Royal Astro. Society.—Major.—R. T.—Filer.—P. Tacon.—G. Richards and Co.—J. P.—Saxon.—We Two.—Seaman.—Mill Hand.—Seventeen.—C. C. E.

Print. (The method of making indiarubber stamps has been frequently described in back numbers, and apparatus and materials can be bought from most of the warehouses supplying dentists with their requisites. The indiarubber is masticated by powerful machinery, and is mixed with a suitable proportion of sulphur. It is then ready for use. A cast of the type forming the stamp is then taken, generally in plaster of Paris, the type having been covered with powdered steatite, or French chalk. The rubber, in a sheet of the required thickness, is then placed on the plaster mould, and the two are put between iron plates which can be screwed together gently while being heated—the heat "curing" the rubber, while the pressure forces it into the grooves. It is then known as vulcanised. The best way is to place mould and rubber in a flask, and put the flask into a vulcaniser, such as dentists use. The pressure and heat of the steam then effect the curing.)—John Graham. (What do you mean? An oscillating engine is still a reciprocating engine: it is not a rotary. There are few oscillating engines, except on board Thames steamboats, for which they are well adapted. 2. The four-coupled engine is mostly in use for passenger trains; but for many of the expresses single drivers are preferred. You can find all about such matters in back volumes.)—Bristol Enquirer. (Bell's Transmitter is rarely used for telephone work: it is generally Blake's or Edison's. All have been described in back volumes. If you will give "some idea" of what it is you want to know, we shall be able to give you some idea of the details.)—J. W. W. (Snow 2, crystallised chloride of calcium 3 parts, probably, is the simplest method of obtaining low temperature; but when you ask for the "lowest possible," we must refer you to Pictet's and Cailletet's experiments for an idea.)—Amateur. (We do not know of anything better than the tire cement sold by dealers in cycles. It is a mixture of pitch and guttapercha. 2. The countersunk head on the spokes must be made by hammering the end of the spoke into a die, or by "upsetting" the end. Full details have been given, even in recent volumes.)—D. Johnson. (The same. If you have the work referred to, the address is given in it; and if there has been any change, no doubt a letter addressed care of his publishers will reach him.)—Norfolk Dumpling. (Simply what is popularly called "poorness of blood." The stoutness is rather suspicious in so young a man; but only a medical man could give useful advice. See Dr. Allinson's remarks in the *Weekly Times and Echo.*)—Veri Investigator. (It is quite possible to communicate with an operator in a moving train by means of the telegraph wires, although there is no wire connection. The method has been in use in America for some time, and full details will be found in back volumes. See pp. 221, 259, Vol. XLVI., and especially p. 25, Vol. XLI. The actual signals are made by what electricians call induction.)—E. Horton. (We do not supply books; but any bookseller ought to be able to procure such works as have been published on "Coopery," which we presume is what you mean.)—Modle. (You can get books on model yacht building and boats from L. Upcott Gill, 170, Strand, W.C., and buy such fittings as you require from Stevens, Aldgate, E.C.)—B. Natal. (Any of our advertisers who deal in electrical wares will fit out an electric light and send it to you; but the question is, Can you get the requisite acids and salts for recharging the battery? If you have "power," a small dynamo would be much better than bothering with a battery and its solutions; would be cheaper, and altogether much more useful and interesting to your Kafirs.)

All in Search of Health should wear HARNESS' ELECTROPATHIC BELT. It is guaranteed genuine, produces no shock, is comfortable to wear, and has cured thousands of sufferers from Rheumatic and Nervous Affections, Liver and Kidney Diseases, Functional Disorders, &c. Book of testimonials, pamphlet, and advice free on application to the MEDICAL BATTERY CO., Lt., 52, OXFORD-ST., LONDON, W. Those who cannot call should write at once, and procure one of these invaluable health appliances.

The Glasgow Town Council has agreed to apply to the Board of Trade for a provisional order to supply electric light in the city.

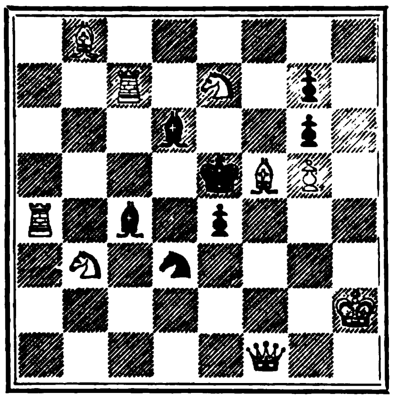
CHESS.

◆

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLVIII.—By Jas. Rayner.

Black.



White. [9 + 7

White to play and mate in two moves.

Solution to 1,156.

White.	*Black.*
1. Q-Q R 3.	1. Anything.
2. Q, R, or Kt mates.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,156 by Mendelssohn, J. Kilbee, H. C. Haycraft, F. C. Cook (very pretty, but not at all difficult), Litho (rather weak), Fr. Fernando, A. Dean, and Janus; to 1,155 by Janus, J. C. B., and James Ough.

F. C. Cook.—Thanks for last corrected version of No. 5, with notes.

Mr. and Mrs. T. B. Rowland intend to bring out the "Chess Player's Annual and Club Directory" for 1890; the price will be 2s. 6d. Among other subjects handled there will be four-handed chess, laws, rules, systems of notation, articles by well-known writers, and prize problems in British Tourneys, 1889. The authors invite the following particulars from chess clubs: Town, club name, year established, place of meeting, days, hours, number of members, annual subscription, laws, president, hon. secretary. Address, 9, Victoria-terrace, Clontarf, Dublin.

Received with thanks: the *Wesley College Quarterly*, *Sunny South*, and *Jamaica Gleaner*.

Holloway's Ointment and Pills exercise priceless power over lumbago, all pains of the muscles, nerves, and joints, and quickly reduce all swellings, caused by accidental injury, weakness, or hereditary taints. The intelligible instructions enveloping Holloway's medicine give full counsel for using it most advantageously for regaining health, strength, and mobility.

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Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

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Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

War Ships, unique models, magnificent speciality, no toys. Exchange Jewellery, Diamonds, microscope or such, and half cash.—Particulars, 19, Plymouth-street, Broughton, Manchester

Lathe (foot), 4½ centres, planed bed, 2ft. 6in., heavy driving wheel, 2ft. 2in., quantity tools. What offers?—Payne, 100, Upper Charnwood-street, Leicester.

Important.—All kinds of **Scientific Properties**, Apparatus, Instruments received for others or cash by A. Caplatzi Chenies-street, Tottenham Court-road.

52in. **Bicycle**, Singer's Royal Challenge, a perfect machine. Will take part exchange, good Field Glasses, or set of first-class Fishing Tackle, or anything useful for half value of £4.—Apply, No. 4, Cross-street, Mexbro.

Powerful **Microscope**, slides, condenser, object box, in polished case. Will exchange for Induction Coil (¼in. spark), in working order.—W. Tole, Newport Pagnell.

Six-plate Wimshurst **Influence Machine**. Exchange for Model Engine and Boiler, or offers to value £5.—R. Crowther, Crimble Mills, Slaithwaite, Huddersfield.

Wanted, Portable Forge, Anvil, Surface Plate, 1H.P. Vertical Boiler, for new Domestic Machine or Oil.—Monkhouse, 7a, East-street, Bromley, Kent.

Patent **Gas Regulator**, and 8in. Emery Wheel on spindle. Wanted, two-horse Injector, or offers.—Beach, Taunton.

I offer 40in. Ellis **Facile** or **Knitting Machine** in exchange for Lathe.—Wellesley House, Colchester.

I offer 40in. Ellis **Facile** or 52in. **Roadster** in exchange for second-hand Circular Treadle Saw.—Wellesley House, Colchester.

Wanted, Model Hot Air Engine. Will give exchange, Electrical and Mechanical.—E. Thornton, Stafford-street, Barrow-in-Furness.

Printing Press and Type, &c. What offers? Bicycle, Harmonium, or Drapery.—*Eagle* Office, Daventry.

Small **Lathe**, with brass oval chuck, and Air Gun, in exchange for ¼-plate Camera and Accessories.—J. R. Pybus, West Burton, Bedale.

12in. **Emery Wheel and Spindle**, muzzle-loading Gun, Magneto-Electric Machine, 3½ Condenser and Lenses. Exchange Electric Bells, &c.—Walker, 55, Radcliffe-street, Nottingham.

Bicycle, 56in., double roller bearings, worth £2, for Rocking Horse, moderate size, or C Clarionette, anything useful.—Wm. Knott, Chadwick-street, Marple, near Stockport.

Exchange **D Flute**, 8 German silver keys, by Wrede, London, for Joiner's Tools, Slide Rest, or offers to value of 30s.—192, Burgoyne-road, Sheffield.

Hopkinson's Indicator, nearly new. Will exchange for one of Richard's in good condition.—S. Hemingway, Adwalton, near Bradford.

40in. **Facile Bicycle**, splendid condition. Wanted Stopped diapason in wood CC for small chamber organ.—A. B. W., Old Rectory, Wimbledon.

Will exchange a beautifully finished new Duchess whole-plate Camera, and three double-slides with spring catches, reversing back, &c., for a good Enlarging Apparatus, with eight inch compound condensers or larger. Will exchange Swift and Son's new long-focus, whole-plate Landscape Lens with Iris Diaphragms for pair of good Stereoscopic Lenses, or well finished light stereoscopic Camera and three double slides.—Apply to Doctor Cooper, Bank-place, Bandon, co. Cork.

Wanted, stero. or electrotype of Electrical Apparatus, in exchange for "Chemistry," 2 volumes, by Thorpe, value 4s.—W. Upton, 13, Bridge-street, Banbury.

Gas-Engine, 2-man, out of order, worth £5. Will exchange for small Lathe, Watch or Gold Chain, Musical Box, or offers.—Address below.

Small **Electro-Motor**, valve of 15s., Camera Lens, dark slide, 1¼ plate, 16s. Complete set of castings for a ¼in. scale model Midland locomotive, 55s. Exchange all or part of the above for Engineer's tools, American Chucks, Lady's Gold Watch, Surface Plate, &c.—102, Teviot-street, Bromley, E.

Cornet, in case, Butler. Will exchange for B flat tenor slide Trombone.—T. Teague, Ashcott, Bridgwater.

Splendid brass **Model Locomotive**, value, 20s. Good Magic Lantern, value 7s. What offers.—P. Clifford, 127, Upper Dorset-street, Dublin.

Exchange offers wanted for **Galvanic Machine**, 6 Musical Instruments, 12 Medical Works, &c., &c. List, stamped envelope.—43, Shirley-street, West Brighton.

20 Volumes of "**English Mechanic**," 1872 to 1881, cost £4 4s. 6d. Will exchange for anything useful to value of 18s. 6d.—33, Bournemouth-road, Peckham, S.E.

Will give new 30c.p. **Hand and Power Dynamo**, for good 10 by 8 lens, and double dark slides, printing frames, &c.—E. Southwell, 10, Stall-street, Bath.

Patent **Gas Regulator**, and 8in. Emery Wheel, on spindle. Wanted, 2 horse injector, or offers.—Beach, Taunton.

Exchange **Electric Motor Engine Casting**, some part turned, and flywheel, boiler, on mahogany stand. Exchange small foot Lathe, or good slide-valve Engine.—V. Hill, May Villa, Swiss-road, Weston-super-Mare.

Horizontal Boiler, marine type, 6ft. by 3ft. Wanted, 4½in. Screw Cutting Lathe, or offers.—Beach, Electro-Plater, Taunton.

Organist will exchange **Organ Music**, for Music (3 staves) of like value.—W. Liptrott, 309, Blackburn road, Bolton.

Lathe wanted, about 6in. centre, long bed, slide-rest, and gap and back-gear, must be first-class, for new or second-hand first-class Cripper Tricycle, by Starley Bros., of Coventry. London district, so that both can be inspected.—C. Levi, 133, Hammersmith road, West Kensington.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

New Illustrated Price List of **Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

Billiards or **Bagatelle**, or **Requisites** for ditto, or Billiard Work.—Hennig Bros., High-street, London W.C.

Manchester Electrical Stores.—Medical Coils, Magnetos, Bells, Cells, Wires, Fittings, Chemicals. Best terms.—J. Bentley, 7, Newton-street.

Electric Depot, 14, Deansgate, Manchester.—Handiest shop in the trade. Largest stock.. Greatest variety. Lowest price.

Microscopy.—Instructive list of really high-class botanical preparations, with sample, 2d.—Walter White, Litcham, Swaffham.

Cyclists.—Use "Graphine" on your chains; no grease, will not hold dust, 6 stamps, free.—Wolff and Son, Falcon Pencil Works, Battersea, S.W.

"**The Amateur.**" A paper for Fretworkers, Carvers, Inlayers, Painters. Sixpence monthly. Lists of latest designs free on application.—Henry Zilles and Co., 24 and 26, Wilson-street, Finsbury, London, E.C.

Safety Bicycles, superior make, warranted all ball bearings, from £10. Catalogue free.—Harger Brothers, Settle.

Lard Oil, 3s. per gallon.—69, Commercial-street, E.

G.M. Fittings, cheapest house in London.—69, Commercial-street, E.

Cyclists.—Anti-vibration Safeties, Tandem Safeties and Tricycles. Send for list.—Bradford Cycle Co., Ltd., Bradford, Yorkshire.

Bellows for Cameras, all kinds. Price list, 1d.—J. Thomson, Camera Maker, Portgordon.

Write for **King, Mendham and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

Electric Bells, 2½in., 3s. 6d.; 3in., 4s. Presses, from 6d. All materials required by fitters in stock.

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Recipe for Raspberry Sherbet, refreshing beverage, very fruity flavour, 7 stamps.—Robinson, Chemist, 93, Trafalgar-street, Brighton.

Hats made easy. Braces made perfect. Fits all sizes. Six stamps.—T. Rawson, Heaton-lane, Stockport.

Important to Females.—Mrs. Austin Herbert's Ladies' Herbal Compound will remove bilious headache, sickness, and all irregularities. Advice.—23, Muskham-street, Arkwright, Nottingham.

Haydon Cutter-Bars, correctly made of best steel.—Britannia Co. Call at 100, Houndsditch, London.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JULY 26, 1889.

THE ORIGIN OF ROCK-OIL.

THE phenomenal rapidity with which petroleum has sprung into economic, and therefore commercial, importance has naturally attracted great attention, and the general interest which has been excited in this natural commodity has only been equalled by the wonderful impetus which it has given to chemical research.

Natural petroleum was soon ascertained to be a complex mixture, and to contain a series of interesting substances bearing to one another a certain definite relation expressed by the general formula C_nH_{2n+2}; these were named paraffins, from *parum affinis*, indicating their chemical indifference. Some of these substances are gaseous, others liquid, and others solid. The term *paraffin* was applied originally to the solid members of the series, and the liquid members were then called *paraffin oils*; but the term is now conveniently applied as a generic name for the whole series.

Petroleum is found native in a great many places. By far the largest supplies of the oil are obtained from Canada (county Lambton, Ontario), Pennsylvania, and other parts of America; but these sources are rivalled by the oil-springs on the north-west of the Caspian Sea near Baku. The Russian petroleum industry is being rapidly developed into a position of prime importance: it is worked with all the most recent appliances, and backed by some of the leading capitalists of Europe,—notably the Rothschilds, who are interested in at least half of the annual output. A graphic description of the Russian oil industry can be read in the *Journal* of the Society of Chemical Industry for January and February, 1885. Petroleum has also been found at Rangoon, in Burmah, in Persia, in the Crimea, and in various parts of Italy. There are oil-wells now being worked at a profit in Germany, and discoveries have been made at Manutaki in New Zealand, and also in South Australia, which are likely to develop into important industries. The Scotch oil industry is well known.

The uses to which the various petroleum products are applied are of a wide range. In America the natural gas is used at Pittsburg for illuminating purposes, and at the forge. The refined oils are everywhere used for burning in lamps. Some of the higher fractions obtained by distillation form excellent materials for lubricating machinery. Under the name of vaseline the more solid portions find extensive application in pharmacy. Paraffin wax is coming into use for laundry purposes. Petroleum has already entered the competition with coal as a fuel, while steam and gas-engines are threatened with a rival in the paraffin-oil motor.

Petroleum, then, may be regarded as cosmopolitan in its application, and it is little to be wondered at that speculation is rife in scientific circles regarding its origin or formation.

The various theories current respecting the genesis of petroleum may be referred to two general ideas, namely—

1. That it is formed by natural synthesis from inorganic elements.
2. That it is the result of the decomposition of organic matter, which may be
   (*a*) Of vegetable origin,
   (*b*) Of animal origin.

The first of these theories has received much support from those *savants* who devote themselves to chemistry, while the other has chiefly been elaborated by the geologists.

Mendeljeef, the great Russian chemist, supposes that petroleum has been formed by natural synthesis from the elements, and that its production is continuous. This theory looks very well from a strictly chemical point of view, for so many organic compounds, at one time only obtainable from organised matter, or which are elaborated under the influence of the life process, have been prepared from the elements in the laboratory, that it seems as though almost any synthesis is merely a question of time.

In criticising this theory of Mendeljeef's a little while ago before the New York Academy of Science, Prof. J. S. Newberry pointed out that the author of this hypothesis has no personal acquaintance with the great oil-producing districts. Hence this fact must discount the value that might otherwise be attached to the opinion of such a distinguished scientist.

It must also be noticed that in districts which are subjected to volcanic and other metamorphic disturbances, all the requisite factors for the production of rock-oil must necessarily be present; but, as a matter of experience, oil is never found there, as it should be, according to Mendeljeef's theory.

As is well known, very great things have been accomplished in the laboratories of chemists, and the formation of the saturated hydrocarbons or paraffins is a comparatively easy matter—for instance, they can be made by either of the following methods :—

1. The simultaneous action of zinc and water on the alcoholic iodides.
2. Heating the alcoholic iodides with zinc alone.
3. The electrolysis of the fatty acids ($C_nH_{2n}O_2$).
4. Brominating the olefines C_nH_{2n} forming $C_nH_{2n}Br_2$, and then heating with potassic iodide, water, and metallic copper.

But until the theory of synthesis from the elements receives some support from observations in the field, it must be merely regarded as ingenious and interesting.

The theory of the formation of petroleum from organic remains is the especial property of the geologists, or to those amongst them who specialise in palæontology.

Amongst the geologists there are two rival schools—namely, those who attribute the genesis of petroleum to the decomposition of vegetable matter, and those who refer it to the decomposition of animal remains. Of these two rival modifications of the "organic theory," the one which appears at first sight the most credible is that which connects the origin of the oil with the destructive distillation of coal, and it is credible chiefly on account of the familiarity which people have with the immense accumulations of ancient vegetable matters which are found in various countries in the coal measures, &c.

Additional probability is lent to this theory by many observed facts. Oil is usually found associated with bituminous shales and limestones. Both oil and gas springs occur together in connection with carbonaceous shales, wherein they seem to originate. Marsh gas (CH_4), the first of the paraffin series, can be seen in process of formation in any stagnant pool in which much vegetation is undergoing decay. Moreover, petroleum is obtainable by the artificial distillation of the so-called "oil shales" of the Scottish coal-fields, as well as from ordinary bituminous coal. This is not merely a laboratory experiment; it forms an important industry.

In the light of these facts it requires but little mental strain to imagine a process of slow distillation in progress at the present time, or at some far-distant epoch, acting at great depths, and consequently under high pressure.

This is a very comfortable belief, and one with which perhaps we ought to be satisfied; but geologists have never wholly yielded their assent to the theory, and some very awkward difficulties have been suggested which may eventually entirely prevent the acceptance of the "vegetable origin" theory, and result in the establishment of a novel and highly interesting mode of regarding the question.

The most extraordinary of these difficulties is perhaps the following:—It appears that the greater part of the world's petroleum stores exist in rock strata, which were deposited during an epoch of time long anterior to that in which coal was formed—at a time, in fact, when vegetable life was very feeble and scanty, and in striking contrast to its intense luxuriance in the Carboniferous epoch, when the coal measures were formed. If the sources of petroleum exist in strata laid down at a time when vegetation had not developed to any important extent, how can its formation be associated with the destructive distillation of such matter?

In Pennsylvania the chief supplies of petroleum are obtained from certain beds of sandstone, which are a long way below the Carboniferous, representing a period ages before the formation of coal. In the oil-bearing territory of Canada, at Petrolia, Oil-springs, &c., rock oil is obtained in strata which are lower down than the top of the Silurian rocks.

The formation of petroleum, then, in these ancient strata, evidently cannot be satisfactorily connected with the destructive distillation of coal, because the coal-forming plants had not then been called into being.

It has been proved up to the hilt that when these ancient strata were laid down the conditions of life were eminently marine. Lowly animal organisms flourished in countless myriads, and their fossilised skeletal remains are found throughout the oil-bearing rocks. On the other hand, the evidences of vegetable life are confined to traces of a few algæ and other humble water-plants. At that time a mollusc that has been named orthoceras flourished in great abundance; its shell was composed of chambers built one on the other; the fossilised remains of these creatures have been found at Pakenham with their chambers full of petroleum.

Many of the less conservative amongst the geologists have, upon weighing these and other similar observations, hazarded the opinion that rock oil owes its origin to the combined action of heat and pressure in the presence of water upon animal matters accumulated in vast sedimentary deposits.

This idea may at first sight appear to be chimerical, for many minds unaccustomed to a certain habit of thought and unpractised in observing the effects of small agencies spread over a great lapse of time, will find nothing but absurdity in such a theory. But the merest tiro in geology is sufficiently familiar with the enormous cumulative effects of the activity of living matter. For instance, to take two well-worn illustrations, the tiny coral polyp has dotted the South Pacific with countless isles, while the skeletal remains of the Globigerina and other Foraminifera, almost microscopic in size, are paving the floor of the North Atlantic with a soft limestone resembling chalk.

On examining the evidence of metamorphosis by igneous or volcanic agencies, of cleavage produced by great pressure, of contortion due to great earth-thrusts, &c., it appears more than probable that the palæozoic period was much disturbed, and that the agencies of high temperature, pressure, and water, were all present, and exerting their own peculiar or their combined influences. Doubtless volcanic disturbances and mighty storms caused great destruction of marine life in those days, just as they do now, for if our own islands are quiet and undisturbed, there is plenty of evidence of mighty convulsive action in other parts of the world. But, although this consideration appeals to the well-informed rather forcibly, the fact remains that coal, on distillation, yields a petroleum comparable with the natural product, and such a fact being tangible is more able to carry conviction than any general induction.

This has quite recently been paralleled in the theory of the animal origin of rock-oil.

Two German scientists, Herr Hans Höfer and Herr Carl Engler, have independently carried out a number of experiments, which plainly demonstrate the possibility of producing petroleum from animal matter by imitating the assumed conditions of formation in nature. There are several notices of their work in the *Polytechnische Journal*, the *Drogisten Zeitung*, &c.; but Herr Engler has himself described his investigations in the *Berichte der Deutschen Chemischen Gesellschaft*," XXI. pp. 1816-1827, and XXII. p. 592.

In his preliminary research, he submitted fish-oil, such as ordinary cod-liver oil, to a slow distillation at a moderately high temperature, and under a considerable pressure. He succeeded in obtaining a distillate consisting of a large percentage of true petroleum, strictly comparable with the natural product.

In subsequent experiments, the results of which have only been recently published, he submitted fish-oil and various other fatty matters (trioleïn, &c.) to distillation at a temperature varying between 300° and 400° Centigrade, and a pressure of from 4 to 10 atmospheres. When fish-oils are treated in this way, as much as 63 per cent. of liquid hydrocarbons are obtained, while about 9 per cent. of gaseous products, such as olefines, carbon-monoxide, carbonic anhydride, methane, &c., pass over.

Amonst the paraffins which Engler isolated by fractional distillation from the petroleum obtained by treating fish-oil in this way, were the following—viz.:

Normal pentane.
,, hexane.
Secondary ,, (di-isopropyl).
,, heptane (ethyl-iso-amyl).
Normal octane.
Secondary ,, (di-isobutyl).
Normal nonane, &c.

It has been stated that ordinary rock-oil contains no nitrogen, and many have therefore argued that this alleged absence of nitrogen is opposed to the theory that the oil is formed from the remains of ancient animal organisms. But this statement is not strictly true, for nitrogen has been sparingly found in samples of oil obtained in the most widely separated countries. Its presence in small and insignificant quantity is a natural consequence of the decay of the nitrogenous matter of the animal tissues.

The decomposition of animal matter into petroleum oil takes place in two principal stages according to Herr Engler. First, the nitrogenous matter of the animal tissue decomposes, and nitrogen gas escapes, either free or in combination with hydrogen as ammonia or other compounds, or else it is carried off in solution with the water which plays an important subsidiary part: the fatty matters which remain are converted into petroleum under the action of the agencies and conditions already indicated. This view is further supported by the fact that when the bodies of animals decay in damp ground, a waxy substance called *adipocire* remains behind, consisting of 97 per cent. of fatty acids, and containing no trace of ammonia.

The result of Carl Engler's researches are highly interesting from their scientific aspect, and they have imparted a certain robust vitality to this new theory of the genesis of natural petroleum; if this theory cannot yet be accepted as the true solution of the question, it at least forms a valuable contribution to our knowledge of a very important natural commodity.

ASTRONOMICAL NOTES FOR AUGUST, 1889.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 6 4·08 P.M.	8 47 12	17 55 18	8 41 8·32
6	0 5 37·75 ,,	9 6 29	16 35 34	9 0 51·10
11	0 4 56·28 ,,	9 25 30	15 9 9	9 20 33·88
16	0 4 0·82 ,,	9 44 18	13 36 42	9 40 16·65
21	0 2 52·94 ,,	10 2 52	11 58 48	9 59 59·42
26	0 1 34·02 ,,	10 21 16	10 16 8	10 19 42·19
31	0 0 5·42 ,,	10 39 30	8 29 22	10 39 24·96

The method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 348 of Vol. XLVIII.

The actual period of minimum of sunspots would appear to have passed, but they are still very rare on the solar surface. A fine one is visible as we write.

The Moon

Enters her First Quarter at 1h. 26·9m. p.m. on August 4th, and is Full at 4h. 42·9m. in the early morning of the 11th. She will enter her Last Quarter at 10h. 51·5m. a.m. on the 18th, and be New at 2h. 0·1m. p.m. on the 26th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	4·5	3 38·5 p.m.
6	9·5	7 51.1 ,,
11	14·5	*12 54·9 a.m.
16	19·5	4 9·7 ,,
21	24·5	8 0·0 ,,
26	29·5	0 3·9 p.m.
31	4·9	3 58·3 ,,

* Early morning of 12th.

The Moon will be in conjunction with Jupiter at 8h. p.m. on the 7th (Jupiter 1° 6′ S.); with Venus at 10h. p.m. on the 22nd (Venus 1° 59′ S.); with Mars at 6h. p.m. on the 24th (Mars 1° 29′ S.); with Saturn at 8h. p.m. on the 25th (Saturn 2° 28′ S.); and with Mercury at 10h. p.m. on the 27th (Mercury 4° 42′ S.).

At noon on August 1st the Moon is in Virgo; in which constellation she remains until 2h. a.m. on the 4th, when she enters Libra. She has completed her journey through Libra by 7h. 30m. on the 5th, at which hour she passes into the narrow northern spike of Scorpio. By 5 o'clock the next morning she has traversed this and come out in Ophiuchus. She quits Ophiuchus for Sagittarius at 4h. p.m. on the 7th, and Sagittarius in turn for Capricornus at 9h. p.m. on the 9th. She remains in Capricornus until 1h. 30m. p.m. on the 11th, when she enters Aquarius: just 48 hours later—i.e., at 1h. 30m. p.m. on the 13th—she passes from Aquarius into Pisces. As she travels through Pisces, she, at 3h. a.m. on the 14th, arrives on the boundary of an outlier of Cetus, into which she then plunges, to re-enter Pisces at 10h. 30m. a.m. on the 15th. What we may call this second journey across Pisces is completed by 7h. 30m. a.m. on the 16th, when she enters Cetus for the second time. When she finally leaves Cetus at 9 o'clock that night, it is to emerge in Aries. At 1h. 30m. a.m. on the 18th she passes from Aries into Taurus. Having travelled over the entire length of Taurus, she arrives at 4h. a.m. on the 21st on the boundary of the extreme northerly part of Orion. It takes her barely three hours to cross this, and when she has done so she comes out in Gemini. She leaves Gemini for Cancer at 11h. 30m. a.m. on the 23rd; and Cancer, in turn, for Leo at 3h. 30m. a.m. on the 25th. Her journey through Leo terminates at 11 p.m. on the 27th, when she passes into Virgo, and she remains in Virgo until 7h. 30m. a.m. on the 31st. At the hour just named she enters Libra, and is obviously in that constellation when these notes terminate.

Mercury

Is a Morning Star during the first week of August, but comes into Superior Conjunction with the Sun at 8h. p.m. on the 7th, and, of course, subsequently travels to the east of him. The planet is but indifferently situated for the observer, rising, southing, and setting as he does in daylight (or strong twilight) all through the month. Moreover, his angular diameter at no time exceeds 5·4″ from the 1st to the 31st.

Day of Month.	Right Ascension.	Declination. North.	Souths.
	h. m.	° ′	h. m.
1	8 19·4	20 57·3	11 38·3 a.m.
6	Behind	the Sun.	0 1·9 p.m.
11	9 43·2	15 33·8	0 22·5 ,,
16	10 20·1	12 2·1	0 39·8 ,,
21	10 53·7	8 17·9	0 53·6 ,,
26	11 24·4	4 31·0	1 4·5 ,,
31	11 52·7	0 48·3	1 13·0 ,,

The path indicated by the above ephemeris begins in Cancer, traverses the entire length of the Constellation Leo, and terminates in Virgo. On the 13th and 14th he will be a little to the north of Regulus; but he will not approach any other very conspicuous star. He will be in conjunction with Saturn (0° 38′ N. of that planet) at 2h. p.m. on the 11th.

Venus

Is a morning star throughout the month, and is a conspicuous object to the North of East before sunrise. As an object in the telescope she becomes daily less interesting, as her angular diameter shrinks from 18·8″ on August 1st to 15·1″ on the last day of the month, and her disc is now notably gibbous.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	5 38·5	20 45·7	8 57·9 a.m.
6	6 1·6	21 7·5	9 1·2 ,,
11	6 25·0	21 17·4	9 5·0 ,,
16	6 48·9	21 14·4	9 1·1 ,,
21	7 13·0	20 58·0	9 13·5 ,,
26	7 37·3	20 27·7	9 18·0 ,,
31	8 1·6	19 43·5	9 22·6 ,,

It will hence be seen that Venus starts from a point a little to the East of ζ Tauri, traverses a very short arc indeed in the extreme north of Orion, travels right through Gemini, and finishes in Cancer. On the 7th she will be rather more than 1° South of η Geminorum, in roughly the same position with reference to μ Geminorum on the 9th, and with δ Geminorum on the 21st, after which her path lies through a barren region of the sky.

Mars, Saturn (who comes into conjunction with the Sun at 2h. p.m. on the 16th), Uranus, and Neptune, are all invisible, and the night sky would be a blank but for

Jupiter,

Who, though most wretchedly placed for the observer, and towards the end of August rapidly approaching the west, may still be caught for an hour or two after it is dusk enough to pick him up. His angular equatorial diameter diminishes from 42″ at the beginning, to 38·6 by the end of the month. The caution to observe him as close to the meridian as possible becomes more imperative than ever,

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	17 56·8	23 22·5	9 14·2 p.m.
6	17 55·5	23 23·1	8 53·2 ,,
11	17 54·4	23 23·7	8 32·4 ,,
16	17 53·7	23 24·3	8 12·0 ,,
21	17 53·3	23 24·9	7 52·0 ,,
26	17 53·2	23 25·6	7 32·3 ,,
31	17 53·5	23 26·2	7 12·9 ,,

So that Jupiter is travelling in a south-westerly direction from μ Sagittarii.

Occultations and Near Approaches to Fixed Stars, and an Occultation of Jupiter by the Moon.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
6	B.A.C. 5758	6	10 35 p.m.	Dark	101	77	11 43 p.m.	Bright	275	243
7	JUPITER		7 4 ,,	Dark	139	155	8 1 ,,	Bright	242	250
8	B.A.C. 6161	6	†12 18 a.m.	S	180	151				
12	56 Aquarii	6	4 7 ,,	Bright	101	73	4 57 a.m.	Dark	208	175
13	33 Piscium	5	9 13 p m.	Bright	24	62	9 55 p.m.	Dark	292	328
13	B.A.C. 17	6	11 46 ,,	Bright	46	73	12 54 a.m.	Dark	259	276
17	B.A.C. 830	6	†4 35 a.m.	NW by N	331	335				
20	B.A.C. 1563	5½	1 37 ,,	Bright	97	138	2 35 a.m.	Dark	228	270
20	ι Tauri	5½	†3 33 ,,	NNW	342	21				
24	η Cancri	6	2 59 ,,	Bright	37	73	3 50 a.m.	Dark	329	7

† Near Approaches. An illustrated explanation of the above table will be found on p. 349 of Vol. XLVIII.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
2	*IV*	*Oc D*	12	53	A.M.	12	*II*	*Tr E*	7	46	P.M.	22	I	Sh I	8	15	P.M.
4	*II*	*Ec R*	12	6	45,,	12	II	Sh E	9	52	,,	22	I	Tr E	9	22	,,
4	*III*	*Tr I*	7	54	P.M.	13	I	Tr I	10	48	,,	22	III	Ec D	9	43	52,,
4	III	Tr E	10	49	,,	13	*I*	*Sh I*	11	51	,,	22	*I*	*Sh E*	10	32	,,
4	III	Sh I	11	31	,,	14	*I*	*Oc D*	8	7	,,	23	*I*	*Ec R*	7	49	14,,
5	*I*	*Oc D*	11	52	,,	14	*I*	*Ec R*	11	25	29,,	26	II	Tr I	9	56	,,
6	I	Tr I	8	59	,,	15	*I*	*Tr E*	7	32	,,	28	II	Ec R	9	17	47,,
6	I	Sh I	9	55	,,	15	I	Sh E	8	37	,,	29	III	Oc D	8	46	,,
6	I	Tr E	11	16	,,	15	III	Ec R	8	37	16,,	29	I	Tr I	8	57	,,
7	*I*	*Sh E*	12	13	A.M.	19	*II*	*Tr I*	7	30	,,	29	*I*	*Sh I*	10	10	,,
					P.M.	19	II	Sh I	9	46	,,	29	*I*	*Tr E*	11	14	,,
7	I	Ec R	9	30	33	19	II	Tr E	10	10	,,	30	I	Ec R	9	44	15,,
10	II	Oc D	10	3	,,	21	I	Oc D	9	57	,,	31	*I*	*Sh E*	6	56	,,
11	*III*	*Tr I*	11	26	,,	22	*III*	*Oc R*	7	58	,,						

Ec, Eclipse; Oc, Occultation; Tr, Transit of Satellite; Sh, Transit of Shadow; D, Disappearance; R, Reappearance; I, Ingress; E, Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

Minima of the Variable Star Algol

Will occur on the 2nd, at 1h. 50m. a.m.; on the 4th, at 10h. 39m. p.m.; on the 7th, at 7h. 28m. p.m.; on the 22nd, at 3h. 32m. a.m.; on the 25th, at 12h. 21m. a.m.; and on the 27th, at 9h. 10m. p.m.; as well as on other occasions, when the phenomenon will be unobservable.

Shooting Stars

Are plentiful in August, the notable shower of August 10th having been observed from Classical antiquity. Mediævally known as St. Lawrence's Tears, these meteorites are now called the Perseids, from their radiant point in the sky, which is situated approximately in R.A. 2h. 56m., and 56° Declination North to the N. of γ and the East of η Persei. Watch should really be kept from the 9th to the 11th inclusive. Between the 21st and the 25th, too, is a meteoric period. Fireballs may be expected during the early part of it, and may also be looked for on the 10th.

Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of August 1st, 1889.

Star.	Souths. h.	m.	s.	
α¹ Herculis	8	27	5·10	p.m.
α Ophiuchi	8	47	13 60	,,
γ Draconis	9	11	24·79	,,
Vega	9	50	27·49	,,
ζ Aquilæ	10	17	30·64	,,
Altair	11	2	27·00	,,
α² Capricorni	11	28	54·44	,,
α Cygni	11	54	35·57	,,
α Cephei	*12	32	47·07	a.m.
β Aquarii	*12	42	31·42	,,

* Early morning of 2nd.

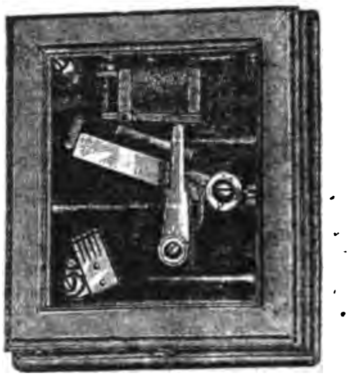
The method of finding the Greenwich Mean Time of Southing of either of the other stars in the above list for any other night in August, as also that of determining the Local instant of its Transit at any other station, will be found on p. 350 of Vol. XLVIII.

ZAEHNSDORF'S ALBUMS.

THE following method of preparing cards, mounts, pictures, &c., and fastening them together into book or album form, has been patented by Mr. J. W. Zaehnsdorf, of York-street, Covent Garden. In the usual method of making up photographic and like mounts into book or album form, the paper of the mount proper is opened or separated along one edge for the reception of a guard or strip of calico or other canvas, or of leather, which when pasted or glued and fixed within the separated portion becomes fixed therein, the flaps of the paper or cardboard being cemented down and made flat. A portion of the canvas is left projecting, and on this a strip of cardboard is pasted corresponding in thickness to that of the mount. This strip of cardboard does not extend to the edge of the canvas, a portion being left in which the back of the leaves are sewn to constitute a book or album for the after application of covers formed of two side boards and a stiff back, so that when the book or album is opened the back part belonging to the side covers remains stiff, the joint being at the edge of the covers only, so that the cover can be folded back and any of the leaves also, so that the mounts appear flat when the album is open. The object of the patentee's invention is to attach two strips of cardboard to the guard to form two distinct folding places beyond the inner edge of the mount, and to make one of the strips, namely, the outer one, of greater width than that of the inner one, and to perforate the larger strip so that any number of such prepared mounts can be arranged in a superposed manner to any desired height. The perforations, all of which correspond in the larger strips, serve for a cord or lace to be passed through to hold all the mounts in that superposed condition, the two folding places permitting the compilation of mounts to be open at any part without interfering with the lacing at the back, the series of mounts so laced or kept together constituting a book or album without a positive cover. In order to preserve the series of mounts as a book, Mr. Zachnsdorf purposes making covers in exactly the same way as that described with regard to the mounts, the covers being of sufficient thickness to resist wear and to form top and bottom pieces. Through the outer strips the cord or lace is also passed to constitute an outer covering and to preserve the inclosed mounts from dust and dirt, at the same time the side covers are slightly larger to prevent the edges of the mounts from being chafed if the album is set up on edge in a bookcase or on a shelf. The front edge, the top edge, and the bottom edge of the covers may be secured in any desired manner, such as by tapes or ribbons.

ARMATURE PROTECTOR.

AN armature protector is a desideratum where the electric-lighting plant is single only, and also to prevent the burning-off of the insulation of the wire, which is a serious accident, especially when there is not a second dynamo to switch on to keep up the supply of current. In the case of small installations delays cause much annoyance to consumers, to say nothing of the financial loss entailed through rebates allowed, and it is to prevent just such destructive accidents that the Electrical Supply Company, of Chicago, have caused to be devised and placed upon the market their instantaneous armature protector. As shown in the figure, the instrument is so arranged that upon an increase of current to any determined percentage above the normal, the magnetism of the field is instantly neutralised, and the machine rendered incapable of generating the least current whatsoever, thereby, the manufacturers of the device claim, absolutely protecting the armature against serious injury in case of a "short circuit," or anything that approaches thereto. The action is instantaneous, leaving no time during which the insulation in the armature may be charred or broken down. The simple return of a lever instantly replaces all parts in their normal position. Different sizes are sent out to correspond with the number of ampères employed and the number of lamps on the circuit.



NAILS FROM TIN-PLATE SCRAP—A USE FOR TIN CANS.*

IT may surprise the learned metallurgists who read this paper to hear that, by a recent discovery, nails of good quality can be made at one operation, directly from the ore, at the rate of say sixty per minute for each operator. It should be stated, however, that the raw material referred to does not answer strictly the ordinary assayer's definition of an ore. It is found, in strata of various thickness, in Harlem, N.Y., and other localities where the debris from restaurants and sheet-metal factories has been dumped. In other words, it is old and new tin scrap, one of the few substances which this generation, mainly occupied in exhausting the accumulated resources of the past, seems to have laid up, by way of atonement, for the benefit of posterity. In speaking of this material as ore, we are simply looking forward, prophetically, to the time when our descendants may dig it up and write learned papers for the American Institute of Mining Engineers upon the best methods of assaying and smelting it.

At least such has seemed to be its destiny hitherto. It may fairly be said that the many attempts which have been made to utilise it by separating, through chemical or electrolytical processes, its two valuable constituents, metallic tin and first-class wrought iron, have failed, either technically or commercially. The reason for such failure need not here be dis-

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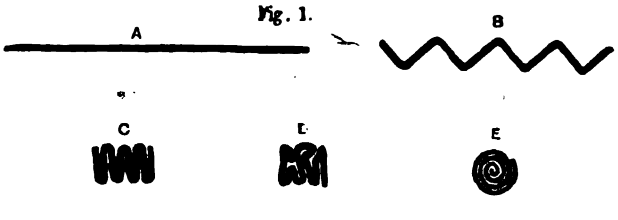
* By OBERLIN SMITH, Bridgeton, N.J. A Paper read before the American Institute of Mining Engineers.

Fig. 1.



cussed. Either the separation has been incomplete, the iron still containing enough tin to spoil it for the sinking fire, or other use short of remelting (perhaps even for that), or the manipulations of the process have been too expensive to make its results profitable, or both. Meanwhile the great tin-scrap deposits have gone on growing faster than any other strata of our post-tertiary psychical era; given up by metallurgists, not yet attacked by geologists, and explored only by that mining engineer of the transitional period, Gulielmus Caper.

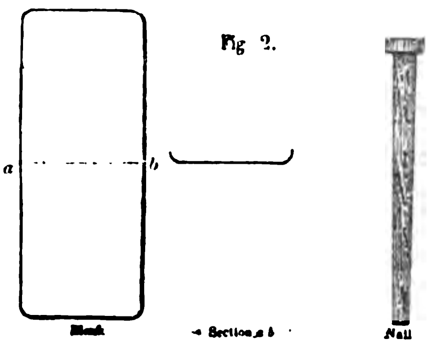
Before leaving these heaps of tin scrap, however, to become mere mineral deposits for future ages, it may be well to consider a novel plan for their immediate utilisation—novel, not only in its means, but in its principle. For it undertakes to use this material just as it is, without trying to separate its constituents at all, and to use it, moreover, for the purpose in which the qualities of both these constituents—namely, the tensile strength and ductility of the iron and the resistance of the tin to corrosion, are directly employed with advantage. I refer to the manufacture, by mechanical pressure, of nails.

This nail was invented, in its original shape, by Mr. George H. Perkins, of Philadelphia, and has been developed, through various forms, until it has almost reached a commercial stage, the machine in which it is to be made in marketable shape being nearly completed. The writer has been associated with Mr. Perkins in its development, and can perhaps make interesting a brief description of the troubles we have gone through in order to produce it quickly, at one operation, in a reasonably manageable and durable machine.

The first scheme tried was to cut "blanks" from ordinary tin plate and sheet-iron scrap, of an approximately rectangular form, and about three-fourths of an inch wide by 1¼in. long, similar to the plan shown in actual size, Fig. 2, but having the end section A, Fig 1 (drawn about twice its real size). This was done in an ordinary press. By a second operation it was corrugated into the form B, Fig. 1, in another press, with a special automatic die, which corrugated the middle grooves first and the side grooves afterwards; much of the metal used not proving strong enough to stand the friction of being pulled into the corrugations of the die without cracking. At a third operation the embryo nail was crushed together into the form C, Fig. 1 (but more tightly closed), something after the manner of closing an accordion bellows. These headless nails were then fed by hands into a revolving dial, to carry them under a heading mechanism, after the operation of which they were ejected from the machine automatically.

Obviously, this series of separate operations made the nails far too expensive for the market; and, moreover, some trouble occurred from their splitting in the tightly-folded corrugations. We afterwards built an automatic machine which performed all the above operations in succession, delivering a complete nail at each stroke. It was, however, far too complicated for practical use, and simply served to show what could not be done.

Fig 2.



Our second nail machine proper, constructed to receive blanks which had been already cut in an ordinary press, worked fairly well. It was likewise an experimental machine, built "piecemeal," and not strong enough for continual hard work; but it served this time to show what could be done. Instead of working upon the principle of regular corrugations, it simply crushed up the blanks edgewise into any form which they chose to assume, the end sections appearing somewhat as shown at D, Fig. 1. The blank and finished nail are shown in Fig. 2.

The machine now under construction has been very much simplified, and is enormously strong and heavy. It is adapted to cutting, crushing, gripping, and heading the nails at one operation, and can be run as fast as an expert operator can feed the material. Its feed probably varies with jagged, irregular scrap, from 30 to 90 nails per minute, although straight strips of sheet metal can easily be fed by hand into a machine running as high as 240 strokes per minute.

During the course of our experiments, various forms of nails have been tried. Among others were straight, cylindrical nails with conical points; straight, square nails with pyramidal, and with wedge-shaped points; hexagonal nails, &c. The most practical form, however, seems to be the square taper nail shown in Fig. 2, which has about the same shape as the ordinary cut nail; but is somewhat stronger and a good deal tougher. It is well adapted for all ordinary purposes; but is especially suitable for a roofing nail, since the tin coating prevents much rusting, and is good to solder to.

Among other processes, we have tried winding the nail blank upon itself, after the manner of a window shade, but minus the mandrel. This makes a very good round nail.

The economy of this system of nail-making is obvious. The scrap can be bought for about 17 cent. per 100lb., and a boy can make, perhaps, 100lb. of nails per day. The most economical system of manufacture will probably be to run one or more nail machines at each large "tin shop," set as close as possible to the presses which produce the scrap, so as to avoid the expense of unnecessary handling, and the extra tangling-up incident thereto.

THE DISCRIMINATION OF THE VARIOUS SPECIES OF SACCHAROMYCETES.*

THIS has been considered hitherto simply a matter of microscopic observation; Reess and others have given descriptions and figures of the various yeast plants; but it has been recently shown by Hansen that each species of yeast is capable of assuming, under varying conditions of cultivation, &c., nearly all the forms which had been assumed as properly belonging to the others. Thus a circular, or nearly circular form, is associated with the Saccharomycetes Cerevisiæ group, an oval one with the Ellipsoideus group, and an elongated or sausage-shape form with the Pastorian group; but as under certain circumstances Sacc. Cerevisiæ forms oval and spindle-shaped cells, and the others in their turn appear as circular cells, any absolute determination of their species by the microscope alone must naturally be futile. As will be seen further on, the ability to differentiate the various species of yeast is likely to become a matter of considerable importance, and one which the analyst ought to be prepared to undertake. Before going into the question of resolving yeast into its various species, it will be well to say a few words about yeast itself.

The true yeasts are simple unicellular plants belonging to the genus Fungi, and as they are capable of developing spores in cells called asci, they belong to the Ascogenous division of that genus. Yeast can reproduce itself under two distinctly different conditions; the ordinary every-day one, where, immersed in a liquid capable of undergoing fermentation, it rapidly increases by a process of budding, never in this case forming spores. The other condition was first brought into notice by Reess in 1869, who found that, by suddenly depriving yeast of all saccharine food, and placing it on the surface of a slice of potato, or other moist porous vegetable root, in a very thin layer, budding still went on for a short time, but eventually ceased, and in a number of the cells spores were formed. Other observers obtained the same results by cultivating yeast on blocks of plaster of Paris kept moist; and this more convenient method is the one now universally employed for this purpose.

To Pasteur we owe our first definite knowledge of the relation of the organised ferments to the process of fermentation. He conclusively proved that fermentation only proceeds when the ferment grows and multiplies; he also taught us that such organised ferments as the acetic, lactic, butyric, &c., together with baccilli, bacteria, &c., frequently contaminated our brewing yeast, and were the causes of what are known now as the diseases of beer—viz., acidity, instability, ropiness, &c. He also very clearly pointed out the way to get rid of these troublesome invaders, and in this way did inestimable service to the brewing industry. He, however, states that when you have thoroughly purified a yeast, so as to be entirely rid of all adventitious organisms, you may yet obtain a yeast which gives the beer a bad flavour. This fact, which Pasteur left unexplained, has been entirely cleared up by the brilliant work of Dr. Hansen, the Principal of the Physiological Laboratory at Carlsberg, Copenhagen. He found that yeast, as ordinarily used in breweries, is an indefinite mixture of yeast plants of various species and varieties; that the species and variety exercise a most marked influence on the flavour and properties of the finished beer, some causing a nauseous, bitter flavour, others producing an article which will not clarify, others an unstable article, &c. He proposed to introduce into practice, and has actually done so, yeasts grown from a single cell, and therefore consisting of one distinct species only. The advantages of this system are obvious; the brewer, provided he takes care to use good materials, can invariably secure a beer of identical flavour and other properties. That this is not a mere matter of laboratory experiment is shown conclusively by the fact that these single-cell yeasts have been used since the year 1884 in the Old and New Carlsberg Breweries, which produce annually over seven million gallons of lager and export beer, with the most marked success. In Denmark and Norway they are successfully used in all the largest breweries, to some extent in Sweden, Finland, Bohemia, and other parts of Austria, in Switzerland, North Italy, Belgium, North America, Russia, Germany, and Holland, in Asia, and Australia. In all these breweries, with the exception of Baartz and Zoon, at Rotterdam, the system of low fermentation is adopted—*i.e.*, the type of yeast used is a bottom fermentation one, the fermentation being conducted at a temperature of 6 to 10° Cent.; the yeast sinking to the bottom of the fermenting vessel. The Rotterdam Brewery employs the high fermentation system, which is the one almost, if not invariably, used in this country. In this system a yeast is employed which, as fermentation proceeds, rises to the surface, the temperature of the fermentation being from 10 to 15° Cent. So far the high or top fermentation yeasts have been very little studied; but as the advantages to be obtained by employing single-cell yeast are sure to be recognised sooner or later in this country, a highly interesting field of practical observation and research is opened out. The preparation of the small samples of the different varieties of single-cell yeast will naturally fall within the province of the chemist; their multiplication to quantities sufficient for practical purposes will take place in properly constructed apparatus in the brewery.

The method devised at first by Hansen to obtain a sample from one cell was as follows: he diluted the yeast with water so that a measured quantity under the field of the microscope contained, say, twenty cells. A quantity of this mixture, equal to that contained in the microscope field, was added to 20c.c. of water and well shaken up. It was now assumed that one c.c. of this mixture would contain a single yeast cell. This quantity was next added to wort contained in a Pasteur or similar flask, and vigorously shaken, the remaining 19c.c. being treated in a similar manner. The flasks were examined in a few days, and if bubbles were seen proceeding from one point only, the experiment was considered successful. If no sign of fermentation appeared, it was evidence that the c.c. of the mixture introduced had not contained a yeast cell; if bubbles arose from two or more points, that more than one yeast cell had been introduced, and naturally such flasks were rejected. This method had considerable elements of chance about it, and I only mention it as the one by which all Dr. Hansen's discoveries were made, particularly as it has been hinted by some of his detractors that his studies had their origin in Koch's gelatine plate cultivation process. This could not be the case, because all Dr. Hansen's facts were published before the latter's gelatine process had been announced.

After the publication of Koch's method, Hansen adopted a modification of it, which leaves nothing to be desired in the way of obtaining cultures from a single yeast cell. He proceeds as follows: A sample of yeast is diluted as before with water until each microscope field shows about 20 or 30 cells; a small drop of this mixture is now mixed thoroughly with 20c.c. of ordinary beer wort containing 10 per cent. of gelatine. In all these processes it is now almost unnecessary to state that apparatus and fluids used must all be thoroughly sterilised. The gelatinised wort must never be allowed to reach a higher temperature than [illegible] Cent. at the time of the addition of the yeast c[illegible] or afterwards, for obvious reasons. A drop of th[illegible] is spread in an even layer on an ordinary microscopic cover glass, placed film side downwards, on a small moisture chamber, containing a small quantity of water. The whole is placed under the microscope, and if the experiment has been sucessful, some half-dozen isolated yeast cells will be bserved in different parts of the field, each of which is destined to form a colony. Those suffiiently apart are chosen from the rest, and a ring narked round them by a small apparatus which crews into the place of the object glass. A number s affixed to each circle with a fine pen, and the igure of each cell and its number noted down in he memorandum book. The moist chamber and ts contents are placed in a warm place for 24 hours nd further examined. Each cell will now be found o have formed a small colony; all the marked olonies are carefully examined, to see that they re not likely to coalesce with adjacent ones, and hat they are perfectly circular, great stress being id upon this latter point by Dr. Hansen. After eing that all is going on right, the moist chamber allowed to stay another 48 or 72 hours, when the olonies will be found so large as to be easily seen y the naked eye. They are each in turn picked f the gelatine film on small pieces of platinum ire, which are dropped, colony and wire, into parate cultivation flasks containing wort. Ferentation and multiplication of yeast cells now mmence, and all that is necessary is the careful riodical changing of the wort, so as to avoid tside contamination. By this means it is possible increase the growth of yeast to any amount. he next question was to establish a method of ifferentiating the species with certainty, and this roblem our indefatigable observer, Dr. Hansen, kewise solved satisfactorily. By observing the currence of spore formation at different temperaures, he discovered that each species only developed ores between certain temperatures, and that at mperatures between these limits each species had s own relation to time and temperature. By taking e times of development as abscissæ, and the temrature as ordinates, a curve may be generated for ch yeast.

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* By Walter J. Sykes, M.D. A Paper read at a meeting of the Society of Public Analysts.

Spore formation is best observed in the following anner: A small truncated cone of plaster of Paris moulded, the upper surface of which must be rfectly flat and smooth. On this surface, the ast to be observed must be spread in a thin layer, e cone is placed base downwards in a vessel, and ater poured in until it reaches half-way up the le of the cone. The whole is loosely covered, so to admit of free aëration, this being absolutely cessary for spore formation, and kept at an even mperature. Small samples are taken off the sure of the cone from time to time and examined der the microscope; the time to be noted is the rliest sign of spore formation. It has been found t only young and vigorous cells sporulate; care st be taken, therefore, to secure these by growing sample for 24 hours in good, well-aërated wort, efully pouring this off, and adding a fresh supply wort. After another 24 hours the wort may be refully poured off the thick layer of yeast at the ttom of the vessel, and the latter spread on the aster block as described above. In this manner ansen has differentiated six species of yeast, Sacaromycetes Cerevisiæ, a top fermentation yeast, ving its times of spore formation as follows:—

Sacc. Cerevisiæ I.

37·5	No spore formation.
36·37	29 hours.
35	25 ,,
33·5	23 ,,
30	20 ,,
25	23 ,,
23	27 ,,
17·5	50 ,,
16·5	65 ,,
11·12	10 days.
9	No development.

S. Pastorianus I., a bottom fermentation yeast, ich frequently occurs in the air of fermenting oms, and gives a strong, bitter taste to beer.

S. Pastoriansus II., feeble top fermentation yeast, es not seem to give rise to any disease in beer.

S. Pastorianus III., top fermentation yeast, causes st turbidity.

S. Ellipsoideus I., bottom fermentation yeast, nd on the surface of grapes.

S. Ellipsoideus II., bottom fermentation yeast, uses great turbidity.

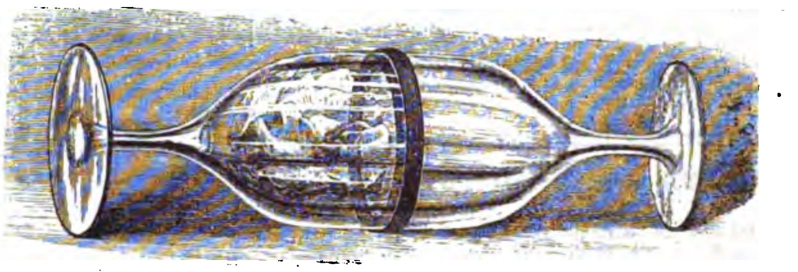
As the whole nomenclature of yeasts is at present state of transition, these names must be looked on as merely provisional.

n addition to the before-mentioned discoveries in re formation, Dr. Hansen observed some curious ts with reference to the formation of yeast films the surface of a yeast cultivation when fermentan had quite ceased. Each yeast seems capable of ming a film, which appears at a longer or shorter iod of time for each species. Temperature effects imilar acceleration or retardation, as in the case pore formation, and consequently the conditions lm formation may be used to corroborate those pore formation.

om the foregoing we conclude that diseases of re not only caused by false ferments, but also charomycetes; that it is possible to distinguish eful from the noxious species of the latter; at it is easy to prepare a yeast which shall consist of one species only, thus affording the brewer an exactitude and certainty in his fermentation results he never possessed before, and at the same time opening out a wide and interesting field for the analyst.

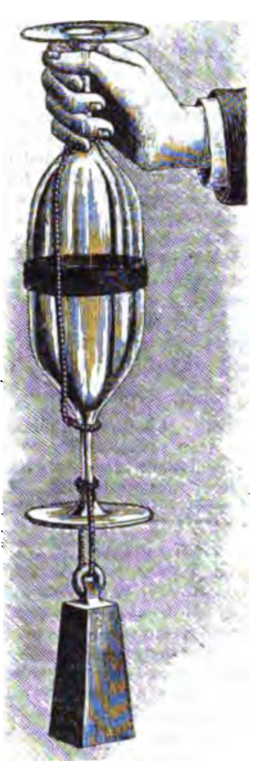
EXPERIMENTS ON THE INEXPANSIBILITY OF WATER AND CONTRACTION OF ICE.*

WHEN ice melts, the water produced is of considerably less volume than was the original ice. This is obvious from the fact that ice floats upon water. The reverse is a fact but too well known to housekeepers, who trace many broken vessels and fractured water-pipes to the expansion of freezing water. The change in volume is a sudden one for the most part. At 39·2° Fahr. water attains its greatest density. If the temperature is lowered it expands slightly, until 32° Fahr. is reached, when it freezes, if there are no causes to prevent. It freezing it suddenly expands about one-eleventh of its bulk with almost irresistible power. A pressure as high as 28,000lb. to the square inch has been estimated as having been exerted by it.



Many other substances in solidifying experience the same change. Thus solid cast iron floats on melted iron as ice does on water, and for the same reason.

This sudden expansion is the more impressive in the case of water because it is ordinarily of comparatively constant volume. Its change of bulk by alterations of temperature or pressure is but slight. It resists compressive or expansive strains, yielding but little to very high pressures.



Both of these phenomena — the reduction in volume experienced by melting ice and the slight expansibility of water—are illustrated by the simple experiments shown in the cuts. Nothing in the way of apparatus is required to perform them, unless a couple of wineglasses or goblets and an indiarubber band can be termed such.

The simplest one may be first described, the illustration of the slight expansibility of water. If two empty wineglasses are placed mouth to mouth, and a rather wide indiarubber band is sprung around the junction, they will resist separation with some force. The glasses in separating slide, like the members of a telescope, through the band, and in doing so cause the air within to be slightly rarefied. A partial vacuum is produced, and some exertion is required to separate them. When they part, a slight report is produced by the inrush of the outer air. It is evident that if the glasses were filled with a non-expansible substance, they would adhere much more strongly. For air, therefore, water may be substituted.

The glasses are immersed in a vessel of water large enough to hold them mouth to mouth. The band is sprung over them, and is worked up as near the lip of one of them as possible. It is important that it should be wet, to facilitate its sliding. The glasses, immersed so as to be filled with water, are next brought mouth to mouth beneath the surface. The band is adjusted by sliding so as to cover the junction as evenly as possible. Care must be taken to exclude all bubbles of air. The glasses are then removed from the water, when they will be found to adhere loosely yet strongly. They can be worked from side to side, but will resist a direct pull with great force. A very heavy weight can be sustained before they come apart. The water contained within them is practically inexpansible, and permits no telescoping of the band and glasses.

The second experiment may now be tried. The glasses are separated and emptied, and the band is sprung around one of the glasses and is brought down below the edge, so that only half of its width surrounds the body. The other half will now spring inward and form a horizontal diaphragm, through which a large aperture extends. It represents a flat perforated washer. The glasses are again immersed in water and filled. A lump of ice as free from air bubbles as possible is introduced into one of them, and they are, as before, brought together under the surface of the water. The ice is, of course, rapidly melting. The instant they touch they adhere strongly. The shrinkage of the water as it changes from the solid into the liquid state produces a vacuum, and the atmospheric pressure forces the glasses strongly together. They are now removed from the vessel. It will be found that they can be laid on their sides and rolled about; that they can be held by the base of one in a horizontal position, and that they will sustain a very heavy weight before pulling apart. They will adhere thus for a number of days, until gradually enough air has leaked in to destroy the vacuum. The other arrangement of band could be used, and is to be advised when the edges of the glasses are not true; but the flat surface of connection makes it much more impressive, and by doing away with any chance of telescoping, restricts the experiment to an illustration of the shrinkage of frozen water on melting.

The glasses should be selected of equal diameter at the mouths, and if ground and polished they are much better. There is no trouble in finding such glasses at any dealer's. Even if the mouths fit poorly, the experiments can be performed by having a wide enough band, and by not attempting to use the flat-washer arrangement.

HEATING RAILWAY COACHES BY ELECTRICITY.

DURING the past few days, says the Richmond, Va., *State*, a series of very interesting tests have been made in heating a railway passenger coach, furnished by the Richmond, Fredericksburg and Potomac Railroad Company, at the Byrd-stree station by means of the Burton electric heaters. These tests have been conducted by Mr. E. W. Trafford, electrical engineer and superintendent of the Virginia Electric Light and Power Company, whose command of the necessary measuring instruments enabled him to get exact figures of the amount of current used in the work. Fourteen heaters, having a radiating surface of 70sq.ft., were placed in the car, one under every other seat, a vacancy on one side being filled by a heater on the opposite side. Wires were run from the power station on Seventh-street into the car through one of its front windows, and a switch was provided for letting on or cutting off the current. The main object of the test was to demonstrate that by the use of a powerful current for a short time only a car could be heated to the desired temperature by means of the Burton electric heaters more quickly than by any other known method; and the next was to show that this temperature could be maintained by the use of a current of much less voltage as cheaply as the present methods of warming railway cars. According to the calculations of Mr. Trafford, the expense, represented in the use of coal, of heating a car with a strong current to a difference of 25° Fahr. above the outside temperature, would be at the rate of 12 cents per hour, or six cents for half an hour, the limit of time it is proposed to take to warm a car before it is attached to a train. He estimates that the cost of maintaining this temperature from a small dynamo, after the car had been put in motion, would be, for coal consumed, 1½ cents per hour. During the progress of these tests a number of well-known railroad officials visited the car, and can bear testimony to the heating capacity of the Burton electric heaters; and it would seem that it only remains for the Burton Electric Company to push this invention into the several positions of usefulness it is destined, at no distant day, to occupy.

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* By T. O'CONOR SLOANE, Ph.D., in the *Scientific American.*

USEFUL AND SCIENTIFIC NOTES.

The Growth of Steamships.—Apart from the question of the relative economy of steam and sailing vessels, there is in the growth of the steamship an interesting national problem. Our merchant navy is less numerous than it was; but it grows in tonnage, in power, and in cost. We are having built fewer small vessels and more steamers of large dimensions, generally coupled with great power and a compartively high rate of speed. The money invested in our steapships enlarges yearly if slight and temporary fluctuations in value be kept out of the question; and as long as shipping is fairly remunerative, that flow of money into the industry will be continued. But it is becoming evident that some attempt must soon be made to bring about economies in the working of steamships if that remunerative character is to be continued which is needed to keep all industries in a state of growth. In steamships wages have of late increased, the cost of fuel has been also increased, and it is probable that slight alterations of the tonnage laws may alter the cost of port charges, so that, as the freight market cannot be expected to move upwards permanently whilst there is so large an addition to the fleet of carrying vessels as is at the present time being made, some economy will be needed to maintain that remunerative character of the trade to which we have referred. In one or two instances this is being effected by the substitution of newer and more economically-working engines, in others the endeavour is to use a cheaper kind of coal. If this can be done, the steam shipping fleet may go on increasing for some time to come, though it is doubtful whether the present rate of construction can be maintained very long unless there be relief to the shipbuilding yards by more of the building berths being devoted to the construction of other class of ships than those for the carriage of passengers and cargo. Some yards under the new scheme of the Government will be so employed as to lessen their powers of constructing merchant ships, and this will reduce the competition for such orders as are in the market. But it will still be essential for the cargo-carrying vessels to be worked with economy, because of the growing international competition with the ships owned by nations having the advantage of very cheap rates of payment for labour, such as the Scandinavian and German nations. It is quite possible that the rate of wages between the foreign and British seamen may be a little more equalised than of late; but until that is the case our fleet work under a rather heavy handicapping in international rivalry.—*Engineer*.

Welding Steel.—According to the *Engineer*, in welding tool steel workmen use a bright yellow heat, and melted and pulverised borax as flux. For ingot iron some prefer fluxing with sand; a temperature between redness and whiteness; a quick fire, and quick work; the steam-hammer gave much better welds than the hand-hammer. The Steel Company of Scotland recommends a bright yellow heat; if any flux, three parts of sand to one of common salt, moistened; a V-weld, which, with the neighbouring parts, is to be lightly hammered during and after welding; and sulphurless coal.

Safety Insulating Staples.—Messrs. Mosses and Mitchell, of Chiswell-street, E.C., have been appointed sole agents for Mason's Safety Insulating Staples, to be used with electric-light leads and wires, telephone and bell wires, &c. The staples are themselves made of insulating material, and are in all ways superior to the common iron staples.

SCIENTIFIC NEWS.

The comet which was telegraphed as having been discovered by Prof. Smith is, it appears, Barnard's of Sept. 2, 1888. Mistakes of the kind may be expected when prizes are offered for the discovery of comets.

In a lecture on Babylonian Astronomy delivered by Mr. G. Bertin at the British Museum, the lecturer stated that many of the allegorical figures representing the constellations were engraved on the boundary-stones as images of protecting divinities, and they show the process by which the Babylonian artists arrived at the creation of the composite animals that still adorn our celestial globes. For instance, the Goat coming after Aquarius was represented as coming out of the water, and the hind part of its body changed into that of a fish. Sometimes three or more constellations were combined to form one figure: the horse, the scorpion, and the bow gave birth to a Centaur, holding a bow, and having a scorpion's tail—our Sagittarius.

The death is announced of Comte Charles de Bouillé, a vice-president of the Société des Agriculteurs and a member of the Société Nationale d'Agriculture. The Comte de Bouillé, who was a large landowner in the neighbourhood of Nevers, was the first to introduce the Southdown sheep into France, and he also had a very fine herd of the white Charolais cattle indigenous to the district. He was a member of the Senate, where he devoted his attention more to purely agricultural topics than to active politics, and he was one of the deputation sent over by the Société des Agriculteurs to the great Kilburn Show in 1879. He was a type of the French country gentleman, and was generally respected, even by his political opponents. Comte de Bouillé was in his 73rd year.

Mr. T. Hudson Beare, Professor of Engineering and Mechanics in Heriot-Watt College, Edinburgh, has been appointed to succeed Prof. A. B. W. Kennedy, F.R.S., at University College, London, as Professor of Engineering and Mechanical Technology.

The correspondent of the *Daily News* at Paris gives an account of a "water railway," or "slide railway," which has been erected at the Exhibition. It seems that it is a "singularly original" contrivance for enabling trains to run, by means of water power, at a speed hitherto undreamt of. The train consisted of four carriages, affording accommodation for about 100 passengers. The carriages had no wheels, being supported at the corners by blocks of iron of a size somewhat larger than a brick, which rested upon a double line of iron girders. In the middle of the line at regular intervals jutted out irregularly-shaped pillars, the use of which was not apparent. The correspondent says: We glided along very gently for the space of a few yards, when suddenly we gathered speed; two or three tugs were felt, and we were flying along at the pace of an ordinary train, but as smoothly as a boat on the river. There was a clicking noise on the rails, due to a defect in the construction of the slides. The absence of any vibration, shaking, or "tail motion" was wonderful. A slight jerk there was at regular intervals; but then, again, it was said that it was due merely to the shortness of the course and the inability to get up a proper pace. In a hydraulic train travelling at full speed—that is to say, at the rate of 144 to 200 kilomètres, or 87 to 124 miles an hour—there would be almost no consciousness of motion. The journey down the length of the Esplanade only occupied a few seconds. The "slide railway" was, it seems, invented by M. Girard some years ago, and it has been improved by his assistant, M. Barre. The slides are, it appears, water-formed, and there is consequently little friction; but the "clicking" noise to which the correspondent refers is caused by the turning-on of the taps as the "train" reaches the irregularly-shaped pillars. The correspondent has evidently been told that a water train "running at one hundred miles an hour could be pulled-up within thirty yards."

Another remarkable statement found in a communication of the "special correspondent" of an American paper published in London, is to the effect that while the *Galatea* was on her way to Spithead her "eccentric straps" became "white hot." When the hose was set to play on them, "in half a minute they snapped into hundreds of pieces." Now, if the straps were "white hot," it would be interesting to know at what temperature was the eccentric itself? That is a problem in—what? Given an eccentric strap at a white heat, what is the temperature of the metal near it?

The Hydrographer to the Admiralty has recently issued an interesting report, containing an account of the operations carried on during 1888. There were two hydrographical surveys at home—one on the east coast of England and one combining the south coast of Ireland and the north coast of Wales. In foreign waters there were surveys going on in the river St. Lawrence, at St. Lucia, in the West Indies, in the Red Sea, and the Mediterranean, on the east coast of Africa, off the coasts of China, in the Pacific Ocean, and on the coasts of the Australasian colonies. In these operations eight of Her Majesty's ships, two hired steam vessels, and one colonial gunboat (lent for the purpose by the Queensland Government), with 72 officers and 703 men, were engaged. One rock in the Red Sea, on which two steamships had foundered in 1887, was found and surveyed by Her Majesty's ship *Stork*. It is astonishing, the Hydrographer says, that so dangerous a rock had not been sighted before, and a subject for congratulation that slightly-manned cargo vessels first struck it and not crowded steamers, troopships, or ironclads, in which case the loss of life might have been appalling.

A deep-sea exploration party, under Prof. Hensen, left Kiel last week in the steamer *National*, with the view of examining the sea bottom and the coast on the east side of Greenland.

It is stated that the "Congress of Hypnotism" will assemble in the hospital of the Hotel Dieu, Paris, on August 8, and will continue until the 12th. Doctors of eminence from every capital in Europe—including Berlin—will attend, and will be initiated into the mysteries of Hypnotism, as practised in Paris by Dr. Charcot and other famous professors of the strange science. The question is, What is really meant by Hypnotism?

The Sims-Edison torpedo is a spindle-shaped shell divided into compartments by bulkheads, the forward compartment containing from 250 to 500 pounds of dynamite, while the length of electric cable which keeps it in touch, so to speak, with the shore or a vessel is as much as from 6,000ft. to 11,000ft. The electromotor is said to be of 40 horse-power, and a speed of over twenty miles per hour has been attained. When the torpedo arrives at its destination it is exploded by a manipulation of the switches on shore or on shipboard.

The best illuminated thoroughfare in the world is said to be the famous Unter den Linden of Berlin. There are three lines of arc lamps separated by two rows of large trees. Two of the lines are on poles located just inside the kerb, and the other runs down the middle of the street on poles planted just inside the line of trees. By "lines" lamps are understood, for the wires are all under ground.

Mr. W. H. Pierce has made for the Chicago, Burlington, and Quincey Railway Company a series of tests on the efficiency of glow lamps during their period of life. The lamps were ordinary commercial lamps, and observations were made on 59. Briefly stated, the results were that a set of lamps consuming 3·54 watts per candle-power when new, required 6·1 watts per candle-power after burning 900 hours, and the mean watts per candle-power during the whole period of life was 5·25. Putting the facts the other way round, it may be stated that the candle-power of the lamps, after burning 900 hours, was but 58½ per cent. of the initial, and the mean candle-power but 67 per cent.

Litigation amongst the electric light patentees, or, rather, the holders of the patents, seems to have been stopped by agreement; while as regards the telephones, the patents will soon expire. In the course of a few years, therefore, we may see not only a great development of the use of electric lights and telephones, but considerable improvements in the apparatus, as competion is sure to bring the best articles to the front.

The Regulation of Railways Bill introduced by Sir M. Hicks-Beach and Baron H. de Worms is apparently intended to give the Board of Trade power to "order" railway companies to do this nd that. As there is little chance of the Bill ecoming an Act this session, it is not worth hile discussing its provisions; but many of hem may be described as "steps in the right irection," and if adopted would, in the long un, benefit the shareholders—especially those lauses relating to the brakes and the block ystem. The clauses relating to passengers and ickets are also commendable, for there is no oubt that railway companies are defrauded to a onsiderable extent by people who travel in rains without having taken tickets, or in classes" superior to those for which they have aid.

The trial of the railway servants, in connection ith the Armagh accident, against whom the rand Jury found true bills, will take place at the ommission Court, Dublin, at the sitting which ommences on the 6th August next. Our corespondent, Mr. Clement E. Stretton, of Leicester, as from the first been engaged in the defence of hese railway servants, and, judging from past xperiences, we may rest assured that he will ave no stone unturned in order to furnish ounsel with facts upon which to build up a efence, showing that the defective system was r more to blame than the men.

The committee appointed by the American ociety of Civil Engineers to report on the roper relation to each other of the sections of ailway wheels and rails, have concluded their bours. They recommend that the rail top hall be struck with a radius of 12in., this form eing preferred by 44 of the engineers to whom ueries were sent, only eight recommending a at top. As to the wheel tires, the committee eport that, whilst few hold that coning has any ensible effect on the curve resistance of a train, e belief is general that coning does diminish scillation, and it is questionable whether it ould be advisable to dispense with it. They lso recommend that the rails shall have a comaratively broad head. Hitherto in America an ttempt has been made to economise material by aking the flange and web of the rail too light proportion to the head, with the result of creasing the difficulties of rolling. The corner dius of the head should, they state, be ½in. r all sections, and the lower corner radius, here the head joins the web, should, they state, $\frac{1}{16}$in. only.

The American Master Mechanics' Association ractically "locomotive engineers") have also ad a committee on the construction of locootive fireboxes, and they have reported that hen the feed water is largely or even moderately harged with foreign matter, the water space on e back and sides of the firebox should be not ss than 4½in., with a distance of 5in. between e front plates. The ordinary American type f locomotive boiler has a water space of 3in., ut on replacing fireboxes, it is stated that many ngineers have increased this space to 4in. or ½in., and obtained very satisfactory results both s to durability of the plates and economy of fuel.

At a recent meeting of the Berlin Physical ociety, Dr. Fröhlich demonstrated experientally his method of recording vibration in the rm of curves. Light from an electric-arc lamp as made to fall upon a small mirror, attached ither to the vibrating plate of a telephone, or to piece of card covered with a thin film of iron, r to a thin indiarubber membrane. From this irror it was reflected on to a polygonal rotating irror, and by this on to a transparent screen, eing thus made visible to the whole audience ither as a spot of light when the rotating mirror as at rest, or as a line of light when it was set motion. On sounding various organ-pipes in ont of the receiver of the telephone, many very retty curves were seen; on singing the vowels to the telephone, very characteristic curves ere seen crossing the screen; so also with the nsonant *r*, whereas on the other hand *s* produced o effect.

At the meeting of the San Francisco Microopical Society on June 26, Dr. Frank L. James, f St. Louis, Mo., gave an interesting account of phenomenal class of crystals produced from alicine by the extreme cold method, as discovered y him several years ago, and exhibited a series f slides with the polariscope, which were proounced by all to be the most beautiful crystalliations ever seen. The process depends on ringing a saturated solution of salicine, made ith distilled water, into contact with cold below he freezing point; and Dr. James's explanation is that the rapid congelation of the water interferes with the usual arrangement of the crystals, producing the wonderful series alluded to, which are entirely unlike any forms resulting from crystallisation at the ordinary temperature. H. M. Whelpley, of the St. Louis Microscopical Club, also addressed the society on the subject of the microscope in its relation to pharmacy, pointout the rapid progress being made in the detection of adulterations, and the interest manifested generally among pharmaceutists in studying the character and acquiring a correct knowledge of the crude constituents of the *materia medica*.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE APSIDES OF THE EARTH'S ORBIT, AND THE DATE OF THE CREATION—ASTRONOMICAL PHOTOGRAPHY—FINDING THE POSITION OF THE MOON OVER THE EARTH'S SURFACE—THE DISTANCE OF THE VISIBLE HORIZON—THE VERNIER—JARGOON—HOUR ANGLE OF THE MOON—THE PLANET JUPITER—CAN WE SEE THE DIRECTION OF LIGHTNING?—DAYLIGHT OBSERVATIONS—SUNLIGHT MEASURER (?)—RED-HOT WATER—AREA OF SPHERICAL ZONE.

[30169.]—IN letter 29977 (on p. 281) I referred to a paper on "Terrestrial Magnetism," by M. C. Lagrange, which had appeared in *Ciel et Terre* for May 16th. Taking this paper, in some sort, for his text, the well-known Belgian savant, M. Ad. de Boë, of Antwerp, contributes an article to the *Précurseur* (Antwerp newspaper) of June 28, which, while containing a considerable amount of sound astronomical information in a popular form, appears to me to break down in a rather important point of detail. All students who have mastered the rudiments of mathematical astronomy are familiar with the fact that the pole of the terrestrial Equator revolves round that of the Ecliptic in 25,800 years, with the result of shifting the point of intersection of the Equator and the Ecliptic (the "First Point of Aries" of the books) a little more than 50″ to the right, or west, every year; and, further, that the line of apsides of the earth's orbit—or, to put it in another form, the positions of perihelion and aphelion (now in Sagittarius and Gemini)—travels in the opposite direction—i.e., from west to east—in some 109,000 years. Now, as one is going one way, and the other the other, this comes to the same thing as the advance of the perihelion about 62″ annually, and it is evident that the most simple arithmetic will enable us to calculate the epoch of the coincidence of perihelion and aphelion with the Equinoxes. Making the calculation, M. de Boë decides that perihelion and the autumnal equinox were coincident in the year 4075 before Christ, and, so far, supplies the beginner with a piece of useful information. But here we must part company, for he goes on to speak of this being the date of the creation of the world in its existing form! My difficulty is this: 100,000 years ago, when as yet the English Channel was not, and what are now Germany and Norfolk were conterminous, the Cave men roamed about here in company with the reindeer, the cave bear, and the hippopotamus. Were these primæval inhabitants of the earth swept from the face of it to make room for a fresh race of men 4075 years B.C.—or what? There is no indication whatever in the strata of the occurrence of any such cataclysm; the sequence of life having been absolutely unbroken on the earth's surface, as far as is observable. The essay on which I am commenting also refers to the secular increase and diminution of the magnetic energy from solar action, in connected with the supposed date of the Deluge—a question which I would rather leave the Deluge-mongers to fight out among themselves.

There is a rumour, well or ill founded, that an English astronomical photographer of world-wide fame has purchased a site on the highest point in the South of England, famous for the purity of its air, and the comparatively large number of fine nights it enjoys during the year; whither he proposes to transfer his observatory, with all its splendid instruments and apparatus, bodily. If this be true, we may look forward to further and increased triumphs in that field in which the gentleman of whom I am speaking has already earned renown, and of valuable additions to our knowledge of the structure of the physical universe.

Apropos of Celestial Photography, the chief value and advantage of Miss Bruce's splendid gift to Harvard College Observatory (to which you refer in your "Scientific News" on p. 434) lies in the fact that the lens of the telescope is a compound one, of the portrait form. It seems almost needless to point out the enormous advantage conferred by so short a focussed lens in photographing very faint stars and nebula, to say nothing of the greatly extended area of the heavens susceptible of being photographed at once. In fact, each 13in. plate would cover 5° square of the sky, on a scale of 1′ to ·0394 of an inch; so that about 2,000 such plates would take in the entire heavens.

The example I worked out for "Ruric" in paragraph four of letter 30115, on p. 413 (the second of two, both, as it happens, computed in a violent hurry), would be more rigidly accurate had I turned the 5h. 4m. of mean solar time into sidereal time, and added 5h. 4m. 49·94s. to the sidereal time at mean noon instead of 5h. 4m. Then the paragraph would read thus: "The sidereal time at Greenwich mean noon, or R.A. of the Greenwich meridian at that hour on August 24th is 10h. 11m. 49·08s., and, of course, 5 hours and 4 minutes later (= 5h. 4m. 49·94s. sidereal time), 15h. 16m. 39·02s. But we have seen that the moon's R.A. is only 8h. 53m. 28·56s., or, in other words, she is then 6h. 23m. 10·46s. west of Greenwich. Hence we see that she must be vertically over a point in the Gulf of Mexico somewhat to the north and east of the town of Vera Cruz." If, as I fancy, "Ruric" proposes to lay down the moon's path round the earth on a globe, my paragraph in its original form could not have led him into any practical error, but I amend it here for theoretical completeness. [Mr. Dixon (letter 30145, p. 435) may see from the above that I noted the slip to which he refers, at least as soon as he did—in fact the moment I opened my copy of the ENGLISH MECHANIC on the morning of the 12th, and have no doubt that my correction must have been in type when his letter arrived. What in the world has the difference between solar and sidereal time to do with terrestrial longitude?]

The gentleman with whom Mr. Hampden is "almost in daily intercourse" (as stated in letter 30138, on p. 416), and who "admits that it is known all over Paris that the top of the Eiffel Tower can be seen for over 90 or 95 miles," undoubtedly lies—under, let us say, some curious mistake. The ENGLISH MECHANIC seemingly penetrates everywhere, and I should like to ask anyone at Abbeville, Dieppe, Auxerre, Troyes, or Chalons whether he or she, with the most powerful telescope procurable, has ever caught the faintest glimpse of the top of the Eiffel Tower? As for Mr. H.'s allegation with reference to the Mediterranean, he is absolutely mistaken about his facts. I happen, myself, to have been in the Mediterranean (which he obviously never has), and can assert categorically, from personal observation, that the statement that "vessels can see each other on the water-level of the Mediterranean at 50 or 55 miles" is the very wildest fiction, and destitute of any foundation whatever. To an eye 20ft. above the surface of the sea the horizon is very little more than six miles off, and vessels thirteen miles or so distant lose sight of each other's hulls entirely, the masts only remaining visible. I cannot conceive what end Mr. Hampden proposes to attain by the promulgation of assertions that are like Mrs. Gamp's "row of bald old curls, that could scarcely be called false: they were so very innocent of anything approaching to deception."

As the principle and method of use of the Vernier is not easily made intelligible without diagrams, I would refer "Orion" (query 69040, p. 421) to Tomlinson's "Natural Philosophy," or to Heather and Walmsley's "Mathematical Instruments," both in "Weale's Series."

I cannot help Mr. Harvey (query 69065, p. 422) about his mixture for preserving botanical and zoological specimens; but Jargoon is a Cingalese mineral—a kind of zircon, colourless specimens of which native dealers often sell to P. and O. passengers and others for diamonds.

I can only answer Mr. Grant (query 69067, p. 422) by saying that I have hunted right through Nos. 34 and 35 of the *Selenographical Journal* for December 1880, in an unsuccessful attempt to find the statement "that the moon's hour-angle is found by subtracting the sidereal time from the moon's Right Ascension"—albeit such statement is accurate enough. My querist should give a reference to the page and line. On p. 91, however, I do find this example.

Time of transit = 7h. 8m.
Time of observation = 10 0

– 2 52 = – 43°,

which is perfectly right, a larger number subtracted from a smaller one, merely as a matter of course leaving, algebraically a – remainder. Mr. Grant will see that Mr. Neison uses the signs + and – conventionally: + when the moon is east of the meridian at the time of observation, – when she has passed, or is to the west of, it. Bearing this in mind, the example on p. 1 of No. 36 of the *Journal* is quite correct. The moon crossed the Greenwich meridian at 6h. 8·2m. (say 6h. 8m.); hence, at 8 o'clock she was 1h. 52m. (or – 28°) to the west of it.

If any justification were needed of the remarks made by Mr. Brett at the June meeting of the Royal Astronomical Society as to the value and importance of faithfully-executed drawings of celestial phenomena, it would assuredly be found in that portion of Vol. XLIX. of the R.A.S. *Memoirs* which has just been issued. It is a monograph by Mr. N. E. Green on the planet Jupiter, and is the outcome of forty years' patient study of the superficial detail of the planet by that distinguished artist and astronomer. The drawings, of which there are twenty-one, extend over the period comprised between the years 1866 and 1886 inclusive; and for beauty and fidelity are unsurpassed by anything that has so far been produced. Everyone engaged in the study of the physical conditions and aspect of the planets should obtain and study this most instructive memoir, where, in addition to a series of most beautiful and truthful views of Jupiter during a period of twenty-one years, he will find a statement of Mr. Green's theoretical deductions as to the constitution of the Jovian atmosphere and subjacent surface, derived from the observations he describes and so ably illustrates. It is in work like this that the amateur observer has a notable advantage over what I may call the professional meridian astronomer.

The perusal of an interesting article in your contemporary, *Knowledge*, for the present month, entitled "How Long does a Flash of Lightning Last?" suggests to me to moot a question here, which, I think, deserves discussion. Some years ago, watching a heavy thunderstorm from an elevation of between 800ft. and 900ft. above the sea level, I saw, as distinctly as I ever saw anything in my life, a flash of lightning strike upwards from the earth into a huge, dark cloud lowering above it. Stating this as a matter of personal experience, the late Mr. R. A. Proctor took exception to my allegation on the ground that it might—or might not be true that the lightning did strike upwards, but that the duration of its entire apparition was so infinitesimally short that the human eye could by no possibility estimate its direction. I was far from being convinced by his reasoning, and shall be glad of the opinion of those of my brother correspondents who take an interest in the matter.

In connection with letter 31047 (p. 435), I will simply say that if Mr. Ingall will regard the sky on the first day on which the sun is struggling through numerous clouds, he will see that those *through* which the sun is shining will appear dark, and those *on* which he is shining brilliantly illuminated. For clouds substitute a stratum of dust, and my meaning will be evident. Need I add that by the word "alike" I did not, of course, mean in a similar manner, but *both ?*

Surely "Experimenter" (query 69096, p. 444) is under some misapprehension as to the instrument he illustrates being a "sunlight measurer." The blackened pieces of tin seem something like a reminiscence of the vanes in Crookes's radiometer; but by no conceivable possibility could a quantitative estimate of sunshine be made by any machine like that in his woodcut.

I have often said here that I religiously eschew any query which seems to me to have been set in an examination, as I absolutely refuse to aid in any shape or form the detestable system of "cram" now rampant. As, however, "the Irish intermediate examinations for 1889" are now over and gone, I will just say this in reply to query 69111, on p. 445, that water boils at a higher and higher temperature as the pressure on its surface increases. Thus, at a pressure of 1 atmosphere it boils at 212° Fahr., at 2 atmospheres at 250° Fahr., at 8 atmospheres at 344° Fahr., and so on. Now, with such apparatus as we can construct, it is quite obvious that, after a certain amount of pressure is reached, the containing vessel must burst with a most violent explosion. If, however, we conceive the water to exist in the bowels of the earth, confined beneath millions of tons of rock, it is quite evident that this may resist the disruptive force until the water is heated up to redness without ebullition taking place at all.

The formula given by "Snow Cap" in query 69116, on p. 445, is quite correct; as is his application of it. What he must particularly note is, that the sines are taken as fractions of the radius (in degrees) of the celestial sphere: such radius being, of course, approximately 57·29578°. It is the *vertical height* between the bounding planes of the zone that enters into the measurement of its area; and this height is measured by the difference of the sines of the peripheries of those planes (which are parallels of Declination).

A Fellow of the Royal Astronomical Society.

VISIBILITY OF THE CRESCENT OF VENUS WITH THE NAKED EYE.

[30170.]—I am much obliged to Mr. Hopkins (letter 30034, p. 326) for his reference to Mr. Stoddard's observations of the crescent of Venus with the naked eye. By the way, his name appears to have been really Stoddard (David), and not Stoddart, as misprinted in the *Leisure Hour.* I cannot, however, share Mr. Hopkins's opinion, that Mr. Stoddard's observations were "conducted with great care." In the first place, such an assertion as the one that the snowy peak of Ararat could be seen "just as bright and beautiful when two hundred miles distant as when we stand near its base" is more worthy of a missionary than of a man of science. Mr. Stoddard gives no indication of the times when his observations were made; he does not even give the years. He begins by stating that in the case of Jupiter he could see no satellites for a considerable time, though Jupiter was examined through a tube, and in various ways so as to cut off the rays. He proceeds: "Some time after I was sitting on the terrace as daylight was fading into darkness, and thought I would watch Jupiter from its first distinct appearance till it shone out in its full splendour. This time I was exceedingly gratified, just as stars of the first and second magnitudes were beginning to appear, to see two extremely faint points of light near the planet, which I felt sure were satellites. On pointing my telescope towards them, my first impressions were confirmed, and I almost leaped for joy. Since that night I have many times, at the same hour of the evening, had a similar view of these telescopic objects, and think I cannot be mistaken as to the fact of their visibility. I must, however, add that none of my associates, who at my request have attended to the subject, are *sure* that they detect them, though the most sharp-sighted individual feels some confidence that he can do so. . . . The time during which these satellites are visible is hardly more than ten minutes. The planet itself soon becomes so bright that they are lost in its rays. I will not stop to discuss the question—in itself a most interesting one—why they are visible at all, when stars of the third and fourth magnitude are not distinguishable. . . ." I must confess that these statements appear to me to be exceedingly vague. I suppose that we must take it for granted that some of the satellites of Jupiter *have* been seen occasionally with the naked eye; but I fail to see how they could have been caught up in bright twilight, of which there cannot be much in a latitude of 37½°, nor do I see how they could have been seen many times at the same hour of the evening. According to Gallé, the radiation of Jupiter is about 6'. Pickering gives the photometric magnitudes of the satellites as I = 5·61, II = 5·75, III = 5·24, IV = 6·37, while their maximum elongations at opposition are about 2¼', 3½', 5¼', 9¼'. Webb says, in the 4th edition of "Celestial Objects," that "the keen eye of Heis could occasionally see two when close together." I do not knew where this is quoted from, for Heis, in a book published in 1852, after mentioning that he could see Jupiter and Mercury with the naked eye in full sunlight ("sæpius conspexi" are his words), and that "omni tempore stellæ mihi apparent tanquam puncta distincté lucentia, quæ radiis omnino carent" (the tailor, Schön, at Breslau, also saw the planets and stars as luminous points having no rays, and I know of at least one modern instance of this), goes on to remark, "Jovis discernere satellites mihi non contigit." Few observations of the satellites with the naked eye have been made by *astronomers*, and I cannot help suspecting an illusion in many cases. Baron von Wrangel mentions that he met a Tartar in Siberia, who observed an eclipse of one of them with the naked eye, which appears to me to be almost incredible. However, to return to Mr. Stoddard. He continues: "I turned next to Saturn. This planet rose so late in the night that I had not seen it while watching Jupiter, and I was very curious to know whether any traces of a ring could be detected by the naked eye. To my surprise and delight, the moment I fixed my eyes on it the elongation was very apparent—not like the satellites of Jupiter, at first suspected, then *guessed* at, and then pretty discernible, but such a view as was most convincing, and raised my wonder that I had never made the discovery before. . . . . Several of my associates whose attention I have since called to the planet at once told me in which direction the longer axis of the ring lay, and that, too, without any previous knowledge of its position, or acquaintance with each other's opinion." Comment is superfluous. Then follows the passage about the crescent of Venus, quoted by Mr. Hopkins in letter 29981, page 281. I have recovered the reference to the Chilian observations alluded to by Mr. Webb. They are of a very [illegible] character to Mr. Stoddard's, and are to be found in the volumes of the U.S. Naval Expedition to Chile for the purpose of determining the solar parallax by observations of Mars and Venus. Lieut. Gilliss says: "Its crescent was more than once seen with the naked eye" during a [illegible] dry fog which occurs late in the season. The observations were made at Santiago de Chile at 2,000ft. above the sea-level. One example will suffice. In the observations for parallax of July [illegible], 1852, "the crescent was plainly visible without the telescope." The measured diameter of Venus that morning was 56·5", Venus having been in inferior conjunction on the morning of July [illegible]th. [illegible] the observations were made by a party of [illegible] astronomers. I have not found Theodore [illegible] but the "observations" of a boy of twelve [illegible] old are not of much importance. I presume Mr. Holmes (letter 29931, page 238) refers to some statements by a M. Léon Guiot in *L'Astronomie* [illegible] May. M. Guiot says he saw the crescent [illegible] 1st, 2nd, 4th, and 11th of April, 1889. The [illegible] gentleman says he could see the phases of [illegible] with a tube one mètre long and a darkened [illegible] in March and April, 1884. On March 1st [illegible] the diameter of Venus was 14¼", about [illegible] the disc being illuminated. On April 1st [illegible] diameter was 18½", about $\frac{7}{10}$ths of the disc being illuminated. On April 30th her diameter [illegible] 23¼", rather more than half the disc being illuminated. Venus did not come into inferior conjunction till July 12th. I cannot attach any value [illegible] M. Guiot's statements.

H. Sadler.

ζ BOOTIS.

[30171.]—The latest published measures of [illegible] binary that I know of are those of Schiaparelli [illegible] the 18½ refractor at Milan.

1886·495	294·12°	0·611"	(2 nights).
1887·495	293·39°	0·509"	(12 nights).

Schiaparelli remarks: "Questa splendida coppia sta per entrare nella sua fase critica; diventerà presto uno degli oggetti più difficili del cielo." [illegible] angle now should be about 291°, and the distance about 0·46".

H. Sadler.

BROOKS' NEW COMET.

[30172.]—While sweeping the heavens with [illegible] 10in. equatorial on the morning of July 6 [illegible] I discovered a new comet in the constellation [illegible] R.A. 23h. 45m., Dec. S. 9° 10'. The comet has been observed on two succeeding mornings, and is [illegible] to be moving very slowly in a north-easterly [illegible] It is faintish, with a very short spreading tail. [illegible] apparent motion is so slow that the comet [illegible] remain several days in the low-power field [illegible] covery.

William R. Brooks.

Smith Observatory, Geneva, N.Y., July 9.

JUPITER.

[30173.]—Je n'ai pas encore remarqué [illegible] année les détails de la tache rouge de Jupiter [illegible] quels M. Stanley Williams fait allusion [illegible] 30142). L'image est toujours trop ondulante [illegible] c'est à force de patience que l'on parvient à [illegible] une observation de quelque utilité. Je vais faire [illegible] plus grande attention à ces détails.

Le 8 Juillet, à 9 heures, j'ai trouvé Gassendi trop peu éclairé pour voir le cratère de M. Ga[illegible] bert; des images sont survenus ensuite; le [illegible] ciel n'a pas été favorable; le 10, de 8h. 45m. [illegible] Gassendi était trop éclairé, le vent trop fort, la [illegible] trop basse. J'espère mieux réussir à la lunaison prochaine.

Voici une observation de ζ Böotis, par M. Schiaparelli, avec le 18 pouces de Milan :—

1887, 495 .... 293·39° .... 0·509".

M. Schiaparelli dit :—"Questa splendida coppia sta per entrare nella sua fase critica; diventerà presto uno degli oggetti più difficili del cielo; fornirà un eccellente criterio di prova sulla [illegible] separazione dei grandi obbiettivi. La minima distanza sarà intorno al 1,900 e discenderà certamente al di sotto di 0·3"."—*Osservazioni sulle Stelle Doppie,* 1888.

F. Terby.

MOON'S POSITION.

[30174.]—"F.R.A.S." (letter 30115) certainly made the slip pointed out by Mr. Dixon [illegible] 30145) in not converting his 5h. 4m. into the corresponding sidereal interval; consequently, his hour-angle of the moon is nearly 50sec. of time in error.

Mr. Dixon makes the much more serious [illegible] because one of fundamental principles, of mistaking the hour-angle for an interval of sidereal time, which is converted into longitude by substituting [illegible] mean time equivalent.

The moon's tabular geocentric hour-angle, at the instant in question—viz., 1889, Aug. 24, 5h. [illegible] G.M.T., is 95°47'34·6", measured from the point where the meridian of Greenwich intersects the Equator (either celestial or terrestrial), along the Equator to the West. The spot on the earth's surface, the fore, which is exactly between the centre of the earth and the point in space corresponding to the moon's tabular geocentric place, is 95° 47′ 34·5″ west of Greenwich, and in North latitude, 20° 5′ 53·3″.

The centre of the moon will not be exactly vertical over this spot at the instant in question, because the true position of the centre cannot be predicted with greater precision than 15 seconds of arc. The fractions of seconds used in this connection have no meaning whatever. **G. L. Tupman.**

SNOW ON THE MOON.

[30175.]—Regarding No. 29953, may I draw the attention of "E. L. G." to the fact that on the lunar poles "solar heat is nil"? (see Neison's "Moon," page 37), and that thus if they are snowed, *solar* heat could not remove these polar caps.

2. Lord Rosse's conclusions *in re* maximum surface temperature at the lunar equator are disputed by Profs. S. P. Langley, Director of the Allegheny Observatory, and C. A. Young, of Princeton.

3. Assuming a sufficiently low temperature, neither ice nor snow will evaporise with us, even in vacuo.

4. I presume "E. L. G." will not deny that the lunar poles may be snowcapped, or that the polar and equatorial surfacing is practically identical.

June 22. **S. E. Peal.**

CHANGE OF THE MOON.

[30176.]—In reply to "F.R.A.S." (letter 29977, p. 281), I beg to refer to the following extracts:—

"The point, and the only point, of importance is whether, regarded as a *matter of fact*, any correspondence between the *changes* of the moon and those of the weather exist, and a short examination of the recorded facts proves *that it does not*."—(Lardner's "Handbook of Astronomy," 1867, p. 151.)

"When she is in the same part of the heavens as the sun, her dark side being turned towards us, she is invisible, and this part of her orbit is called the *change* or time of new moon."—(Norie's "Epitome," 19th edition, 1868, p. 143.)

The comparisons instituted, though not valuable, may not be without interest to some.

Rio de Janeiro, June 29. **G. W. Nicolls.**

DAYLIGHT OBSERVATIONS.

[30177.]—I have taken a good deal of interest in the remarks in your journal as to the falling off of late years in the clearness of the air, notably about the time of the afterglow in 1883 and 1884. Did any of your readers notice the singular clearness of the sky in the early months of the year in 1880 and 1881? I was able frequently to see both Jupiter and Saturn during broad daylight. In the middle of January, 1881, during a sharp frost, I saw, and was able to point out to others, at about 3 p.m., Venus, Jupiter, and Saturn. Since 1883 I have seldom been able to see Saturn by daylight, even when guided by looking along the top of my equatoreal. In the present year, although I was able to follow Venus past her conjunction with the sun, the definition was seldom very good, with, perhaps, the exception of April 29, when I saw both Venus and Mercury very clearly, in spite of their nearness to the sun. I used 2ft. of blackened cardboard tube on to the end of my 6¼in. reflector, which much improved the definition. On May 21 and 23 I saw Mercury between 8 and 9 p.m.; on the former date it was very clear, and I saw it without knowing more than its general direction; on the 23rd only after finding it in the telescope.

Is the sky clearer in the morning hours? I sometimes fancy there is less haze and quivering before the sun gains power. **Lavant.**

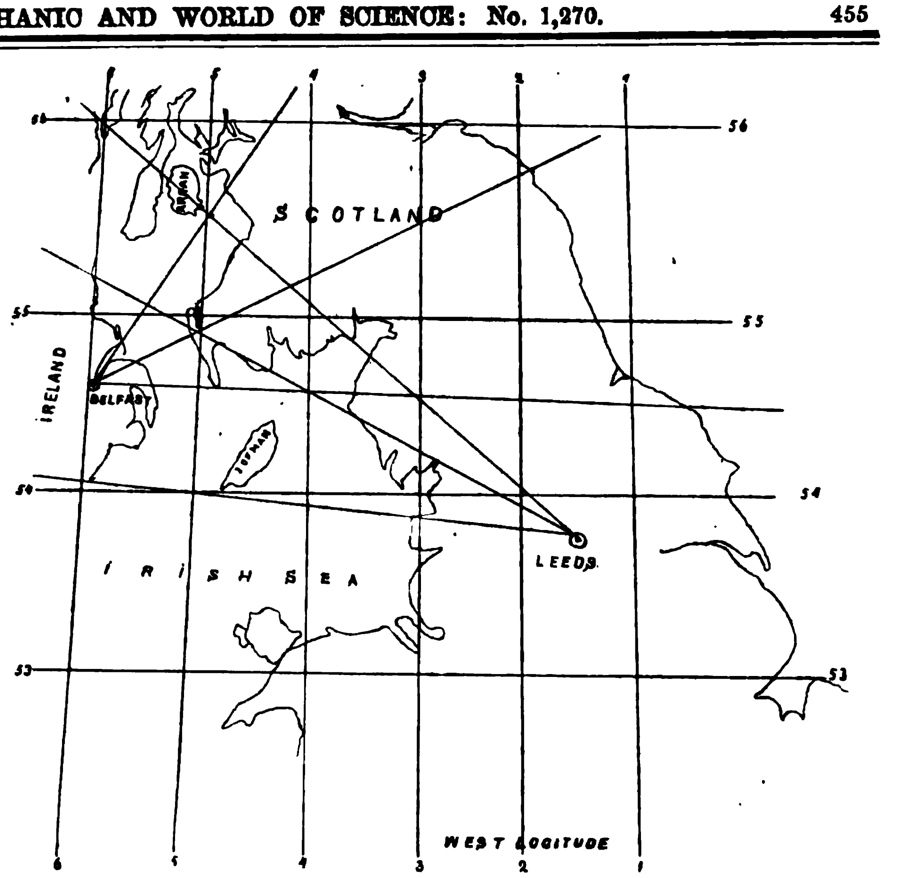
METEOR OF MAY 29.

[30178.]—I forward projection of this meteor over the earth's surface in response to Mr. Chas. Grant (letter 30121, p. 414). He will find every information with reference to the computation of meteor heights in the *Monthly Notices* of the R.A.S. for June, 1865 (Vol. XXV. p. 225), and *Astronomical Register* for November, 1867 (Vol. V. p. 230), and in the appendix to Vol. XIV. of the same publication.

In ascertaining the heights of meteors, it is usual to compute the bearings from the mean meridian of the two stations from which the object was observed. Mr. Grant misquotes my words, and makes me say the meteor was "due W. from Leeds." I should like to know where he finds this statement.

In quoting statements of this kind, it is only fair to give the exact words. What I really did say was that the fireball, when first observed at Leeds, was "*almost* due W. from Leeds," and this is quite correct.

It may be advisable to add that Prof. Herschel and Mr. Denning have computed the heights of this fireball, and their figures corroborate those given in letter 30082. Of course, there is always some little difference in the results obtained by different computers of meteor heights, owing to the various maps used by them, and small errors must always creep into the projections, however great the care taken by the projector.



Neither the observations nor the reductions of this class of phenomena admit of absolute accuracy; we have therefore to be satisfied with a very near approximation.

Leeds, July 15th. **David Booth.**

SIZE OF PLANE FOR NEWTONIAN.

[30179.]—"J. P." is quite right in choosing a 2½in. plane for his 12½in. mirror of 14ft. focus. It is no economy, but the reverse, to cut down to a geometrical minimum the size of the plane for fear of losing light. I have often been thought by clients to use planes too large because the mirrors focus a star to a point.

Where there is no clock to drive the telescope such a theoretical plane is a decided loss. Neither is it true that the *centre* of the mirror is the best part, as someone said. With a good mirror the most valuable and effective part is the margin; the separating and dividing power increase from the centre outwards.

Thus, by a small flat you gain, say, ⅛in. ring of aperture in the centre. What is that compared to the gain by ⅛in. larger flat, the ⅛in. ring of the mirror at its margin? The gain of effective aperture in light and defining power is great.

G. Calver.

LIGHTNING, AND ATMOSPHERIC ELECTRICITY.

[30180.]—I see that in England you are stirring up the subject of lightning photographs, your Royal Meteorological Society having given an exhibition of such specimens as are available. It may interest your readers, therefore, if you can reproduce the following paper by Mr. A. G. McAdie, M.A., which has attracted a good deal of attention here.

Lightning, he remarks, is essentially electricity of high potential. Potential is a convenient term to express a certain force relation. It is not electrical force. That arises when the potential of a body differs from that of another. When the potentials of bodies are the same there is no electrical force; furthermore, the direction of electrical force is always from the place of higher to the place of lower potential, and the rate of variation of the potential measures the component force in that direction. Franklin's famous kite experiment in reality only proved that a difference of potential did exist between the clouds and the ground. This, of all Franklin's experiments, is the most famous, because it was accepted at once as conclusively proving the general identity of lightning and the electricity developed by the friction machines of that time. But we must not forget that other experiments were made by Franklin, and that the famous kite experiment was but one in a series.

The kite experiment, under modern auspices, was tried a few summers ago at the Blue Hill Observatory, near Boston. The summit of the hill has an elevation of 635ft. above sea level, and is the highest point on this section of the Atlantic seaboard. We differed from Franklin in being able to ascertain the value of the potential at each step. Our first step was to ascertain the value of the potential of the air a few feet out from the observatory walls and about 5ft. above the ground. Then, having flown the kite (a large, light, silk-covered kite, the longest axis over 4ft., and tin foiled on the front face) the wired kite-string was connected with the electrometer and direct measurements of the potential made. The moment the kite string, properly insulated, of course, was put in connection with the needle (a technical name for a light disc of aluminium which is free to move between two sets of metallic conductors which have different electrical potentials) of the electrometer, the needle was deflected with a considerable impulse beyond the scale limits, indicating a very high positive potential for the air in the vicinity of the kite. All of one forenoon the sky was covered with a low pallium of dark stratus clouds and the weather threatening, and yet the deflections were just the same as later on, when the weather had cleared up and developed into a clear and pleasant June afternoon. On one morning the wind was quite "puffy," and consequently our kite, after we had succeeded in flying it, was not at all steady, and kept falling and rising. Without exception, when the kite would rise, the needle would indicate an increase in the value of the potential, and the sparks would be longer and more frequent, while, on the other hand, as regularly as the kite fell, the deflection decreased. At another time we made experiments when the sky was without clouds and with the kite about 400ft. above the ground, the sparks we obtained on "grounding" the kite wire were thick and in length about ⅛in.; these under a perfectly cloudless sky.

It is a surprising fact that, with the great number of experiments that were made by the large number of able workers contemporaneous with Franklin, no very marked advance upon his experiments occurred during the 40 years succeeding, and it was not until the beginning of the 19th century that attempts at systematic observations of atmospheric electricity and weather elements were made.

Perhaps the most interesting observations on the character of lightning were some made at the top of the Washington monument, elevation 500ft. above the city streets, during thunderstorms. On July 14, 1886, a thunder squall came up suddenly. Negative deflections indicated a potential difference between the air at the monument and the ground of 3,000 volts, or, in other words, there was the same difference as between the first positive and final negative pole of 3,000 Daniell cells connected in "series." Sparks passed almost continuously between the suspending wire and the case of the electrometer. The "sparking" between the collector and ground ceased, and, as we afterwards found out, when thunder clouds approach the electrometer needle responds to their presence and is very active, and after considerable oscillation begins to move steadily in one direction, as if subject to a steadily increasing pull, and then, when perhaps a potential of several thousand volts is reached, a sudden drop to zero occurs, and with it the flash of lightning. Then the needle begins again to move steadily, and repeats the same operation with every flash of lightning. And it is both possible and not difficult, in this way, to know just when a flash of lightning is going to occur, and to prepare the camera (if we are taking photographs). This, at least, is one feature, we think, entirely new, and brought out by these experiments and observations.

It is a common experience with surveying parties, especially on western mountain peaks, to undergo peculiar sensations during thunderstorms. These effects consist in general of a hissing, crackling sound, accompanying single discharges, or more marked sparks, with a tingling sensation if a finger be presented to any metallic object near by. Now it has been several times observed that a sudden cessation of these distressing electrical effects was experienced whenever there occurred a flash of lightning. We see an explanation for this in what precedes, and our electrometer measurements prove to us without doubt that every lightning flash relieves the electrical tension, besides enabling us to measure the electric strength of the air under ordinary conditions, and the electro-motive force producing the disruptive discharge.

Finally we come to the effects of the electrification of the air upon water, dust, and other particles in it. Whenever our collector was "grounded," the fine stream of water issuing from it would preserve a certain even, rounded character, breaking into drops some 4in. away from the place of exit. Removing the "ground" connection, and the stream being now under the influence of the thunder-clounds, the steadily increasing electrification of the air caused the stream to twist and split into innumerable threads and sprays; but with the flash of lightning the distortion ceased to exist, and the stream resumed its first and proper character, only to be again distorted and to repeat the operation with each flash of lightning. Here is a cheap and easy mode of foretelling the lightning, and the photographer has now at his hand warning for his exposure.

I guess that some of Mr. McAdie's remarks may be useful to any reader who wishes to photograph the lightning, and I shall be pleased to see them in the English Mechanic.

Cambridgeport, Mass. **S. V. Sykes.**

THE EIFFEL TOWER.

[30181.]—In calling attention to what I regarded as an error in the distance of the visible horizon from the summit of this structure as given by the writer of an article in a recent number (in the correction of which I am corroborated by your esteemed correspondent, "F.R.A.S."), I little thought that the act I was committing really amounted to "trailing a [globular] herring" in front of the nose of the distinguished disciple of flat-earth-ism, if I may so designate the fad which has so long exercised the minds of this gentleman and those who think with him.

Not having heard of Mr. Hampden for a considerable time, I had thought that he had come "round" to see and know things as most others see and know them, and I am somewhat regretful that my little innocent, and, as I thought, harmless effusion in your issue of the 5th has produced a similar effect to the proverbial "red rag" upon the masculine member of the bovine species, by affording Mr. Hampden the opportunity of giving vent to another growl at our poor "round-earth men," who, however, somehow undergo the ordeal with commendable fortitude, and appear to suffer no permanent inconvenience from the outbursts.

With regard to the assertions of Mr. Hampden and his friend, with whom he is in almost daily intercourse, as to the range of vision from the top and intermediate platforms of the Eiffel tower, and the distance "that vessels can see each other" (*sic*) on the Mediterranean, I would merely remark (my gentlemanly instincts preclude me from indicating my meaning in an obviously plainer way) that if I saw a procession proceeding down Grey-street in our "canny" city of Newcastle-on-Tyne consisting of Mr. Hampden and his friend in its centre, and Ananias and Sapphira forming the head and tail of it, I should say they were indeed a very nice family party.

Hetton-le-Hole, July 16. **Lyons.**

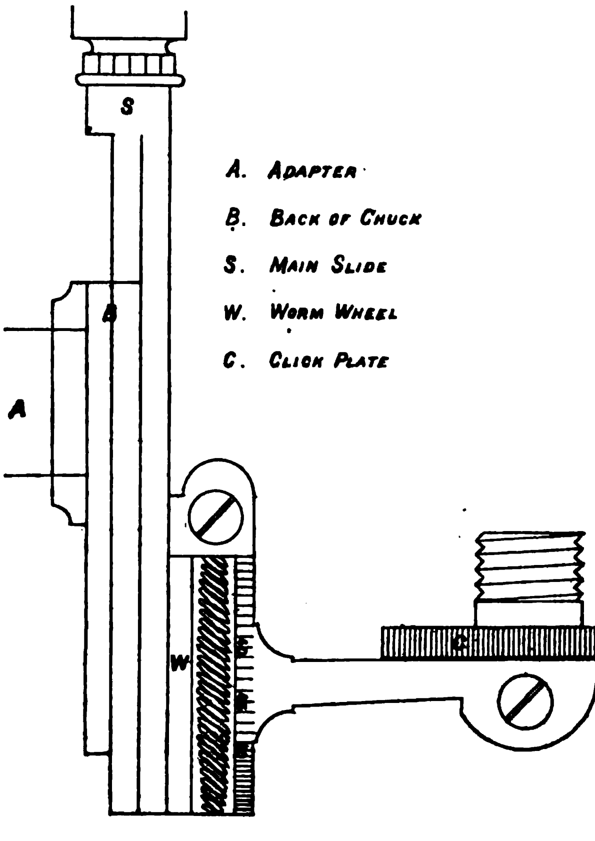
SPHERICAL REST AND DOME CHUCK.

[30182.]—"F. A. M." has (30098, p. 390) concisely described the chief differences between spherical rest and dome chuck. The price of the *best* rest and chuck runs up to £90 and £16, and even £16 does not yield a profit to the maker of the best compound D.C.

The Sp. R. being so much more stable than the D.C., should be used when practicable; but, as the axis of the Sp. R. cannot be brought within some 2½in. of the head-stock, a false nose 2½in. long is usually required to carry the work. The powers of the Sp. R. and D. C. are very similar, and facility alone will often decide which is to be used.

Spirals may be effectively worked on the Sp. R., and also, though not conveniently, squares, polygons, &c. Its curves may begin and terminate with straight lines. Its employment with the oval chuck opens out a wide field of work, and the addition of the rose-engine movements effects some of the boldest and most beautiful shapes; but there are some things readily produced upon the D. C. (and vice versâ), which are impossible with the Sp. R., and, without doubt, the D. C. should be bought first and its capabilities thoroughly investigated before a Sp. R. is though of.

I send a rough drawing, half-size, of the compound D. C., as made by Birch and Co. Having a recess at the back, it can be adapted to any lathe (this will please Dr. Edmunds). Another improvement over the old long slide (so often in the way of the slide-rest) is that the slide is thrown out only when it is wanted. This slide is beautifully fitted with a long steel plate and four adjusting screws; another binds it fast with the utmost rigidity. Its range is such that the click-plate can be brought within ¼in. of the lathe axis, or thrown out 4in. beyond it, thus enabling one to execute hollow and other work, which with the old chuck required the employment of the eccentric chuck, and consequently vastly increased the vibration.



Next, the arm carrying click-plate and work can be rotated on its axis by the worm-wheel. The effect of this is most curious—e.g., convex or concave bands can be worked upon, say, a hemisphere; curves from different centres can be brought into continuity, &c. The click-plate carrying the work has a divided quadrant (not shown), and can be set at any desired angle, either way. This enables one, by crossing the cuts, to form diamond patterns, and to decorate the work in many pleasing ways. An ingenious workman could, I am sure, not only astonish others, but himself also, by the multitude of shapes, patterns, and decorations which he would create by means of this comprehensive tool.

I will not further trespass on your space than to add that the Rose E. may be most effectively employed either with or without the intervention of the oval chuck. **C. C. E.**

P.S.—The above chuck weighs 10lb., taking work up to 7¾in. diameter; the Sp. R. of a 5in. lathe taking only about 5in. diam.

EQUATORIAL MOUNT FOR TELESCOPE.

[30183.]—How to give equatorial motion to a telescope by means of a simple and inexpensive mounting has long occupied the thoughts of the amateur astronomer. Several methods have been devised, and such forms of mounting as Dollond's stand, Smeaton's block, and Smyth's parallactic ladder are well known. On considering the matter lately I set before myself four conditions, which it appeared to me an amateur's mounting should fulfil, if practicable.

1. It should be inexpensive. 2. Capable of being put together by a village joiner. 3. So made as to be proof against the weather without an observatory. 4. So arranged that an object at any altitude can be examined without changing the height of the eye.

I accordingly had a mounting made for a 7in. refractor, focal length 12ft., and I think I may say that it not only fulfils the conditions above named, but is also very convenient in use, and very steady. It is suitable for either a refractor or reflector. The total cost was £12, including models.

I now proceed to describe the mounting. It consists of five principal parts—viz., the Polar axis, the North and South supports, the cradle, and the telescope.

Fig. 1 is a view of the instrument from the west side, and shows the telescope in two positions. Fig. 2 shows it as seen from the south; two blocks of stone support the legs of the trestle at the north end, and a block with its face parallel to the plane of the Equator supports the lower end of the Polar axis. Fig. 3 is a view in plan.

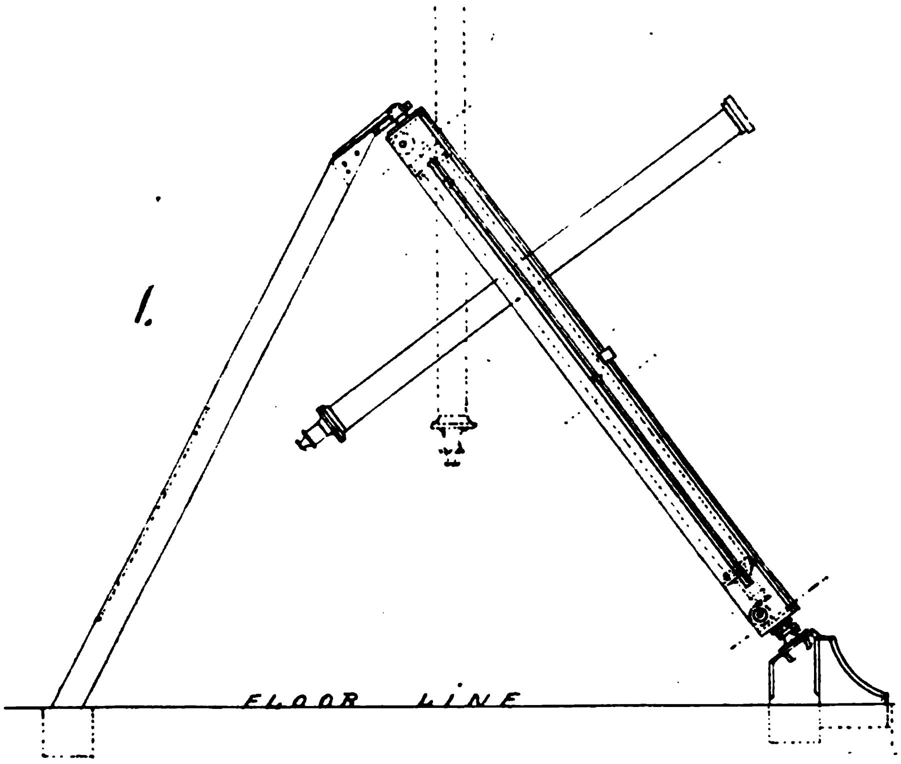
The polar axis is of box form, and is constructed of two parallel planks. Between these the telescope is placed on pivots, and when not in use it lies within them, and one or both of the open sides are covered with shutters to keep out the rain. The telescope is attached to a cradle, which can be moved up and down the axis by means of a wire cord, pulleys, and winch. In this way it can be set at any height, and the observer can observe in comfort, seated in an armchair.

Figs. 4, 5, 6, and 7 are sections of the Polar axis box. Fig. 4 is a section at the upper end, and shows the upper cord pulleys. Fig. 6 is a section through the declination pivots, and shows the tube, cradle, and pulleys for the cord. Fig. 7 shows the telescope and eye-end, the spirally-grooved drums for the cord, and the worm and winch-handle. Fig. 5 is an intermediate section.

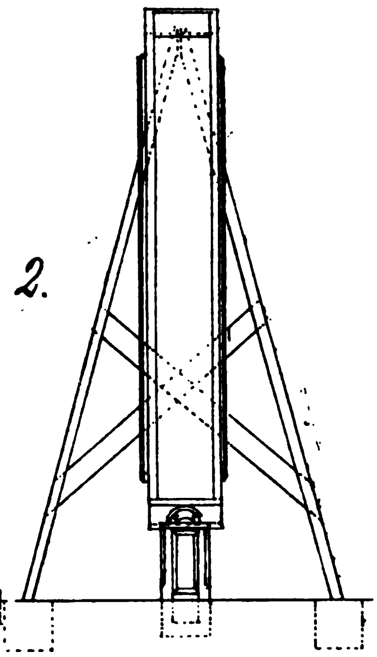
The axis is stiffened with T-iron, and four pieces of angle iron form the slide for the cradle.

The cradle and cord pulleys are seen in Figs. 8 and 9, the former figure being a side, and the latter a top view. The cradle consists of two pieces of hard wood, fastened together at each end by two iron bands of U-shape, one above at one end, and one below at the other. The holes in the centre are for declination pivots. Instead of the cord being rigidly attached to the cradle on each side, it is run through three pulleys, as shown in Figs. 6, 8, and 9.

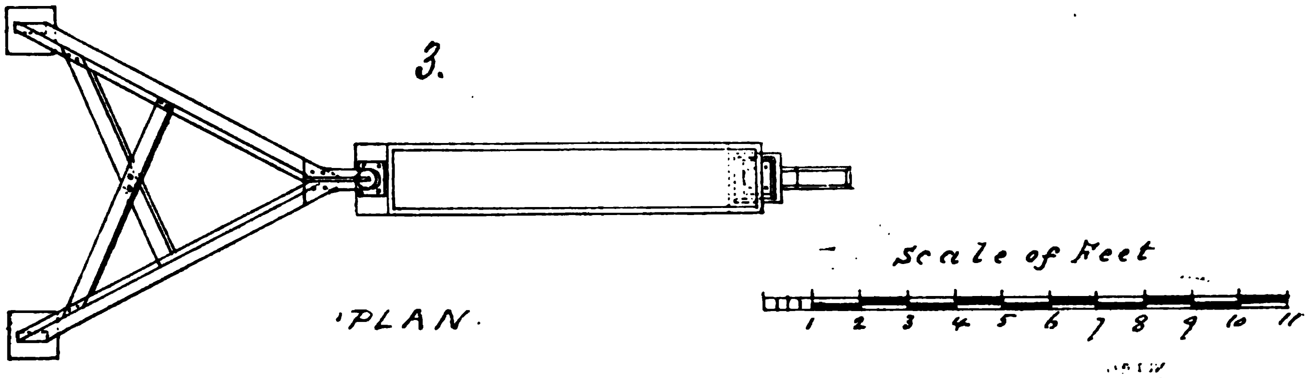
This arrangement enables the cord to draw the



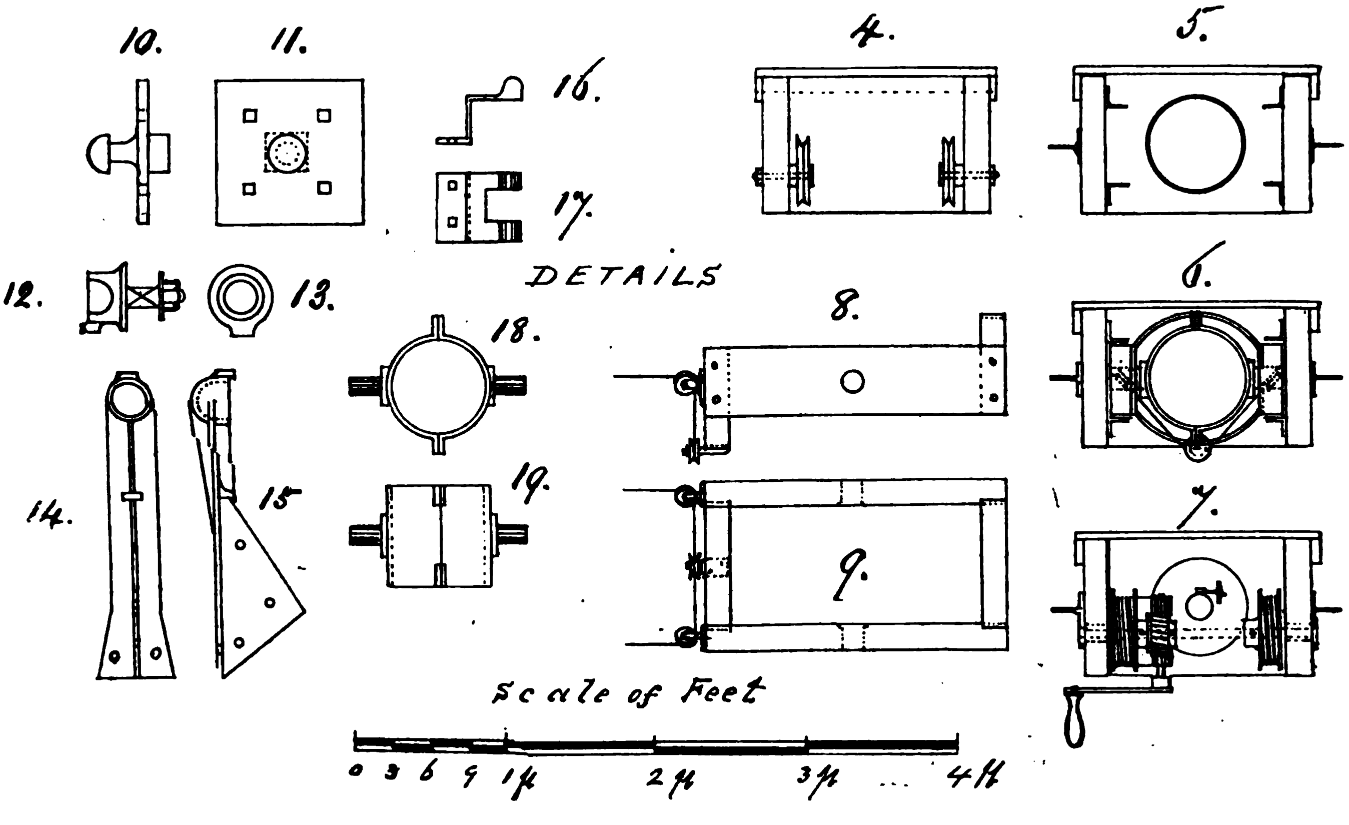
SIDE ELEVATION



FRONT ELEVATION



PLAN



DETAILS

cradle equally without tilt. The cast-iron ball and socket support at the upper end of the axis is seen in Figs. 10, 11, 14, and 15. A set screw passes into the neck of the ball to keep it from slipping out of the socket. Such an accident is also further prevented by the fact that the trestle and axis mutually support each other by their weight and position. The two legs of the trestle simply rest on two blocks of stone.

The ball and socket for the lower end of the axis are shown in Figs. 10, 11, 12, and 13. The bracket which carries the worm is represented in Figs. 16 and 17.

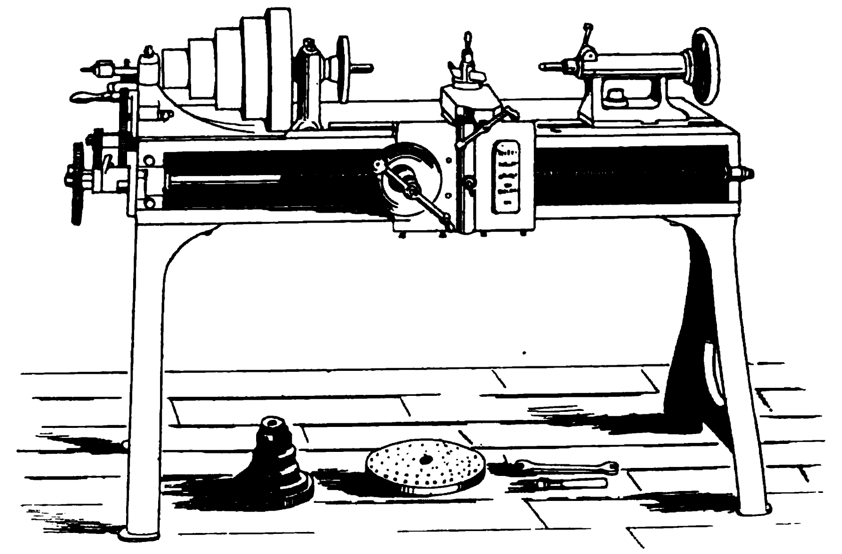
Figs. 18 and 19 show the declination pivots; they consist of two semi-cylindrical castings with flanges bolted together, and firmly embracing the tube of the telescope.

The winch having a worm needs no catch or clamp; the weight of the telescope is sufficient to bring it down when the cord is released. The double cord is passed from the cradle up each side, over the pulleys at the top of the axis, and down to the winch.

To give further protection to the telescope, in addition to the shutters, which make the axis rain-proof, it would be easy to keep the interior warm and dry in damp weather by means of a small jet of gas at the lower end, the products of combustion being carried out at the top through a small copper tube.

It is hardly necessary to add that finding circles might easily be attached to the instrument, one for R.A. at the lower end of the axis, and one for declination either on the declination pivot or at the eye-end of the telescope. **Edward Crossley.**

Bermerside, Halifax, July 13.



Twelve-inch Lathe.

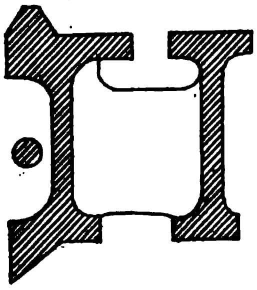
Swings 12in. over slides and clear of rest; driven by cone with five changes for a 2½in. belt: no back-gearing; steel spindle, running in gunmetal boxes; rest carriage slides on front of bed; positive screw feed by gearing, with reverse motion; countershaft, wrenches, &c., intended for turning bolts, screws, studs, and other small work. With 5ft. bed, to turn 2ft. 6in. long.—Wm. B. Bement and Son, Industrial Works, Philadelphia.

WATER-MOTORS—ROSE-ENGINES—FRONT-SLIDE LATHE.

[30184.]—I am very glad to have been the means of drawing attention to Mr. Rigg's water-motor by my question, and was pleased to see the notice you gave of it on p. 342. I have received from the makers some papers descriptive of their invention, of which I had never heard. The method by which the stroke is varied appears to me most ingenious, and when I found that, by reversing, it would both act as a brake and also return water to the supply cistern or accumulator, I thought it about the most perfect mechanical contrivance I had met with.

The discussion on rose-engines following upon the "Extracts from Bergeron" has, I think, been fruitful, and now that Mr. Maclean has returned to us, I hope we may all learn something more of these interesting and little-known machines. I have received from America a capital photograph of an American rose-engine made by Chas. H. Field, of 42, Point-street, Providence, R.I., U.S.A. The rosettes are not upon the mandrel, but upon a second mandrel below the table, carried, as it seems, by the tail of the rocking headstock in such a way that this rosette-mandrel can be lowered or raised higher and nearer to the rocking centre—an arrangement, I suppose, must be intended to increase the depth of the waves; then, too, the two mandrels do not of necessity move turn for turn, but are connected by change-wheels in such a way that any number of waves may be produced upon the work, irrespective of the number upon the rosette. I have heard there is one of these engines in use in Birmingham, and that there is now no one in England making rose-engines for trade or amateur purposes.

Fig. 1



I have also paid a visit to Messrs. Bacon, Machinographists, of 5, Gough-square, Fleet-street, mentioned by Mr. Maclean, and whose address I obtained by a query in the "E.M." They have never allowed anyone to see their apparatus, but they very kindly told me something of their process, and allowed me to buy some of their specimen sheets of beautiful and curious designs. The medallion printing is especially beautiful, and there is an admirable specimen of it on Messrs. Bacon's card.

Having been successful in obtaining *some* information for the public good, I will not despair of more, and hope that we may be able to persuade Messrs. G. Birch and Co. to give us a description of the powers of their new dome-chuck, and Mr. Evans to give us an article (if not a "pamphlet") on the production of spirals upon the sphere.

I have also received from a kind friend in America photos. of a very excellent form of front-slide lathe made by Wm. B. Bement and Son, Industrial Works, Philadelphia. A sketch of the section of their bed I give at Fig. 1; it is not to scale. This is a 6in. centre lathe made 35 years ago, several of them being in use at the present time in their shops. Though very convenient in some ways, they have given up making them, because "the strains are not so evenly distributed as in the ordinary form, and they did not find favour with the machinists." It would not follow because they were not fitted so well for rough shop use that they would not be the best thing for amateurs. I send you a photograph of the 6in. centre size, as I think you will like to reproduce it. The long mandrel and ample belt power with no back-gear pleases me very much. In fact, I begin to think I must go across to the "other side," as that seems to be the right country for rose-engines, front-slide lathes, &c.! I fear, however, the lathe-makers I keep worrying for information, articles, &c., would not grieve much, though some of the smaller lathe men from whom I try to extract information might do so.

F. A. M.

4, Clarence-road, Tunbridge Wells.

CUTTING PITCH.

[30185.]—I have found the following plan of cutting grooves in pitch very convenient, and think it may be useful to some of your readers who are polishing lenses or specula.

I use a common dinner-knife dipped in hot water in which enough soap is dissolved to make it coat the blade; the knife cuts evenly and easily into the pitch, and does not split it. A trial or two will give the best temperature. It should not be too hot, or it presses up the edge of the cut, and the pitch may stick to the blade.

I have also tried simply dipping the blade in hot water, and rubbing it lightly on a piece of wet soap; but prefer the former plan as most convenient.

It is as well to give the knife a rub on a whetstone, though great sharpness does not appear necessary, as the warmth increases the cutting-power. The knife should have a dip before taking each cut. **Lavant.**

CENTRIFUGAL FORCE, SO-CALLED.

[30186.]—This subject is one that has, perhaps, been more confused than any other in the history of mathematics.

For a general discussion of the subject I would refer my readers to Clerk Maxwell's excellent little book, "Matter and Motion," in which the main errors are most clearly pointed out; but the case before us seems to me worthy of special attention.

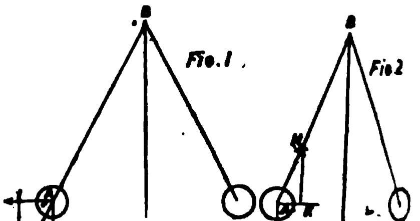
An article on page 293 of the English Mechanic, June 7th, 1889, treating of the conical pendulum, made use of the following statement about the forces acting on the pendulum in motion. Suppose the pendulum to rotate about a vertical axis. Let af = the intensity of the gravitation, and ai = that of the centrifugal force. Complete the parallelogram $aihf$, then there will be three forces in *equilibrium* acting at the point a, these three being the vertical gravitative force af, the horizontal centrifugal force ai, and the tensile resistance of the arm ab, which latter will equal the resultant ah of the other two forces, and act in the same straight line with it. Now the two most obvious objections to this statement are:—

1. The forces are not in equilibrium, but are producing uniform motion *in a circle*.

2. It is a law that if a body be describing a circular path with uniform velocity, it is acted on by a force in the direction of the centre of the circle, whereas in the above the force is represented as acting away from the centre.

These errors are very common, and arise (1) from a misconception of the above law about uniform motion in a circle; and (2) from the notion that the forces, acting on a body moving uniformly in a *circle*, are in equilibrium.

With regard to 1, what is the meaning of the law? Clearly this:—A body cannot move uniformly *in a circle* unless it has some external force or forces acting on it, and the resultant of the resolved parts of these forces in the direction of the line from the body to the centre of the circle is not zero, and acts towards the centre of the circle; in fact, this force is not another external force arising somehow of itself, but is *the effective force in the direction of* the centre of the circle—i.e., the resultant of the resolved parts of all the external forces in the direction of the centre of the circle.



The second point is more obvious. The forces acting on a body moving with uniform velocity in a circle, unlike those acting on a body moving uniformly in a straight line, are not in equilibrium, but are producing a constant acceleration in the direction of the centre of the circle. The conical pendulum should, therefore, with accuracy be treated as follows:—The forces acting on the bob are—the weight acting vertically downwards and completely represented by af, the tension of the rod ab completely represented by ah; the resultant of these is a force acting horizontally inwards towards the centre of the circle in which the bob is moving. Therefore, if we drop hk perpendicular on the horizontal through a $hk = cf$, and ak represents the centripetal force.

If the pendulum is performing N revolutions per second, we know therefore that $ak = 4\pi^2N^2r$ where m is t[illegible] the radius of the circle, and $hk = mg$. Therefore, if H be the height of b vertically above ak $\frac{H}{r} = \frac{hk}{ak}$ $= \frac{mg}{4\pi^2 N^2 mr}$. $\therefore H = \frac{g}{4\pi^2 N^2}$.

This result of course requires to be modified, when we consider the weight of the rod ab. We have thus arrived at the same result as the article in question, and though the method may seem to some of small importance in this case, it should be remembered that the immense amount of confusion that such methods have led to, requires a careful avoidance of even the semblance of error; for this reason I have avoided D'Alembert's principle, which often simplifies problems on centripetal force, but has a dangerous resemblance to the erroneous method pointed out above; the principle I refer to is that "the reversed effective force is in equilibrium with the external forces," and is very useful if care be taken to point out the method employed.

Marlborough, July 13. **H. D. Carey.**

A DEADLY DISEASE.

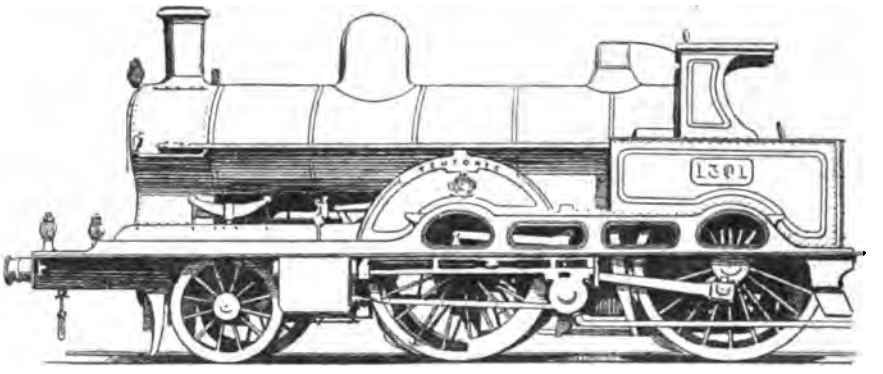
[30187.]—The Garo Hills have ever been noted for the most deadly form of malarial fever. When they were first visited by a party of English military officers over half a century ago, every one of them, except one individual, died. The climate is hot and humid. The soil consists of decaying vegetable strata. Perhaps arsenical treatment (as in my own case, when attacked by serious complications of spleen and liver congestions during the course of an epidemic fever peculiar to Central India) may be found effective.

A Calcutta paper writes:—"The deadly malarial fever known as 'Kala-azar,' which was first heard of in the Garo Hills, and has since made its way up the Assam Valley, is now raging with great virulence in the Gauhati and Barpeta districts. The disease is almost invariably fatal, although its victims may linger in some cases for months, or even for years, before they finally succumb. Many remedies have been tried, but all alike seem useless. A correspondent who has seen much of 'Kala-azar' informs us that he has never known of a genuine cure. The first symptoms, he says, are slight fever and an enlargement of the spleen and liver. Subsequently there is an extraordinary change in the complexion of the person attacked, who turns either black or yellow, and is then past hope. Our correspondent, who has little doubt that the disease is contagious, ascribes its spread to the influx of coolies from the Garo Hills and Goalpara into Kamroop on their way to Upper Assam. Whether this is so or not, the population of the affected districts is likely to show a considerable diminution within the next few years unless a cure for 'Kala-azar' can be found, and unusual interest attaches to the efforts which, by direction of the Chief Commissioner, are now being made to discover a successful method of treatment." **Eos.**

AMERICAN ORGAN v. HARMONIUM.

[30188.]—This subject becomes positively amusing when "998," p. 437, tells us he takes off his boots in order to get expression out of the harmonium. May I repeat the question I put to Mr. Casson, and ask "998" to explain why "expression" cannot be obtained on the A. O.? The expression stop, a mere mechanical device, can be fitted to the A. O. as well as to the harmonium, so that all that "998's" letter amounts to is this—that he prefers the harmonium, or does not understand how to get expression out of the A. O. Tell us *why*, Messieurs Critics, if you please? It is purely a mechanical affair, or it is something mysterious. If the latter, what is it? **Organon.**

THE L. AND N.W. RAILWAY'S NEW COMPOUND LOCOMOTIVE "TEUTONIC."



[30189.]—I send you an illustration of the latest type of compound passenger traffic locomotive constructed from Mr. F. W. Webb's designs, for the London and North-Western Railway Company. The "Teutonic" is the first of a class of engines which have been constructed for working the general express service of the line, and not, as some people seem to believe, for the Scotch traffic. This class, or the Teutonic class, of locomotive is one of the three-cylinder compounds built on Mr. Webb's system, and embodies all the improvements which have suggested themselves during the running of the earlier compound engines. The leading particulars are the same as in the "Dreadnought," built some five years ago, and which commenced running in September, 1884. The resemblance, however, ceases in this respect—that in the "Teutonic" the driving-wheels are 7ft. 1in. in diameter, instead of 6ft. 3in., while the leading wheels are 4ft. 1½in. instead of 3ft. 9in. A rumour has been extensively circulated as to the probability of the North-Western Company starting this summer what will henceforth be known in the railway world as the railway race to Scotland, and some colour seemed to be given to this report from the fact that several of the daily papers gave forth to the public that there were several engines being built in Crewe works of such enormous strength, together with the facility of running at a high rate of speed, that the rival company would have no chance if the keen competition which existed last summer were renewed. I hear, however, that the North-Western Company will not be the first to start this insane race to the North, and that any reports to the contrary are utterly devoid of foundation. The only new compound engines which have been built in Crewe are those forming the type we now illustrate. The "Teutonic" first began to run in April, and has done, and is doing, duty between London and Crewe, and between Crewe and Carlisle, drawing heavy trains at a speed which gives the utmost satisfaction. **E. T.**

RAILWAY SIGNAL RETURNS.

[30190.]—The annual return relating to the signal arrangments has recently been published for the year, ending 31st December, 1888, from which I have compiled the summary relating to

THE ABSOLUTE BLOCK SYSTEM.

—	Total length of railway opened for passenger traffic.		Distance worked on the absolute block system.	
	Double.	Single.	Double.	Single.
	Miles.	Miles.	Miles.	Miles.
England and Wales	8,801¾	4,348¼	8,572	3,583¼
Scotland	1,192¾	1,627½	1,184¾	1,120½
Ireland........................	592¼	2,124½	184¼	380¼
United Kingdom	10,586¾	8,100¼	9,941	5,084
Grand total..............	18,687		15,025	

It will thus be seen that the total length of line open for passenger traffic at the close of last year was 18,687 miles, of which 15,025 miles are returned as worked on the block system. There are 411 miles of single railway upon which only one engine at one time, or two coupled together, are allowed; thus leaving a balance of 3,251 miles which are still worked upon inefficient principles, and requiring the introduction of the absolute block system.

With regard to interlocking, the following table shows that the requirements of the Board of Trade have been complied with to a large extent, but still the levers require "concentration" in 4,173 cases, and "interlocking" in 3,861 instances; also, that no fewer than 2,482 pairs of "safety points" are required.

INTERLOCKING OF SIGNALS.

—	Number of cases in which any passenger line is connected with or crossed on a level by—				Number of cases in which the usual requirements of the Inspecting Officers of the Board of Trade have or have not been complied with in the following respects:—					
	Any other passenger line.	Any goods line.	Any siding.	Any cross-over road.	Concentration of signal and point levers.		Interlocking of signal and point levers.		Addition of safety points in cases of goods lines and sidings.	
					Have.	Have not.	Have.	Have not.	Have.	Have not.
England and Wales......	4,391	1,490	18,298	7,079	28,954	2,304	29,224	2,034	18,426	1,362
Scotland......	786	246	3,219	1,103	4,416	938	4,402	952	2,983	483
Ireland	434	100	1,335	284	1,222	931	1,278	875	798	637
Total: United Kingdom ..	5,611	1,836	22,852	8,466	34,592	4,173	34,904	3,861	22,207	2,482

Clement E. Stretton,
Consulting Engineer Asso. Soc. of
Leicester, July 20. Enginemen and Firemen.

STEEP GRADIENTS: EARLY LOCOMOTIVES.

[30191.]—In reply to "A. S. L.," the steepest gradient I know of in the North of England is on that portion of the North Eastern Railway known as the Hartlepool and Ferryhill branch, near to Coxhoe Bridge Station, where the trains have to be assisted by a stationary engine and rope, with frequently two locomotives working.

The locos. with bell-crank motion were designed by Mr. Richard Roberts (Sharp, Roberts, and Co.), and built for the Dublin and Kingstown Railway, Ireland. They were, however, soon laid aside. (See Colburn's "Locomotive" for particulars.)

Will "A. S. L." supply a sketch giving a fairly correct outline of the engine he mentions with vertical cylinders. I knew several on the Stockton and Darlington, and Stockton and Hartlepool Railways, coal engines, and in nearly every case the valve gear differed in some respects as improvements crept in. These engines were for the most part rebuilt, but some were sold, and others went to the scrap heap. A fairly clear outline, carefully drawn, might lead me to identify the engine if it belonged to any of the above. **Geo. Hunter.**

WHAT DO WE SEE?

[30192.]—The above question may have sufficient interest for your readers to justify a few more remarks on the subject.

I think your able correspondent "F.R.A.S." confounds the act of seeing with the thing seen. The picture on the retina is not seen when the optic nerve is cut; but then nothing at all is seen. When the picture is connected with the brain, something very like the picture is seen. Break the connection, and we see nothing. Does not this go some distance to prove that what we see is the picture?

"F.R.A.S." seems to adopt the popular view that we see the external object. Does the external object then change when we use a glass which alters its colour or its shape, or turns one object into a dozen? Perhaps, however, he attaches some other meaning to the phrase "we become conscious of the presence" of the object. What object? and how is it present?

A great part of the practical work of the optician turns on the principle that every change in the picture on the retina makes a corresponding change in the thing seen. A simple explanation of this fact would be afforded if the thing seen turned out to be the picture.

Buxton, July 16. **W. H. S. Monck.**

PIPE WRENCHES.

[30193.]—I see amongst other things in your valuable paper last week an account of a pipe wrench recently patented by Frayn and Goodyear, of Plymouth. Where there is anything new or to patent in these I am at a loss to see, as I have used three pairs exactly the same for the last *nine years*. There were formerly four pairs made by one of the smiths here about 14 years since, but one pair were left down in Yorkshire about five years ago; the others are in use almost every day.

W. Davison, Fitter and Turner.
114, Browney Colliery, near Durham,
July 22.

BRUCINE.

[30194.]—Many thanks to those gentlemen who so *kindly* answered my query. I am perfectly aware of the antiquity of the test, and also am aware that it is well known; but what I wanted to know is whether or not any reader was *practically acquainted* with it. There is a difference between practical work and theoretical work: it is one thing to know how to work a process, but it is another matter to be able to *work* that process. Perhaps also some of the same gentlemen would like to know that *this chemist* has been engaged in some of the other colour reactions to do with nitric acid for years past. **F. W. Mason, F.S.S.,**
Consulting Electrician and Chemist.

THE DANGER OF WATER-FILTERS.

[30195.]—In your issue of the 12th inst. you give an interesting report by Dr. G. T. Swarts on the above; similar results being certified to by most scientific observers of the day.

I, like the majority of persons who object to drinking dirty-looking water, tried the regular filters of the trade; but gave them up as unsatisfactory. I now use a common glass funnel of large capacity, and in it the ordinary filter-papers used by analytical chemists, which are changed every other day. The result is most satisfactory, as the water appears bright and clear, is pleasant to the taste, and the danger of swallowing unnecessary tens of thousands of microbes is reduced to a minimum. This filter has also the merit of being very cheap. **C. E. B.**

BLOWPIPE ANALYSIS.

[30196.]—Col. W. A. Ross wants to know what I shall say as to the publication of details of manufacture of my blowers and furnace. It does not matter in the slightest degree, except that it has the advantage of being a very good advertisement to us, all free gratis. As a matter of fact, we hold our own only so long as we make apparatus better than others, and people learn in time that it does not pay them to spend time attempting to manufacture apparatus. As an example, although I myself am accustomed to small metal-work, and we have workmen quite capable of making a microscope stand, I should not think of attempting to make one, as I know I could neither make it so cheaply nor so well as those who make this class of work their special study. **Thos. Fletcher.**

BOTTONE'S DEPOLARISER.

[30197.]—I notice that "F.R.Met.Soc.," in replying to a correspondent, says:—"Bottone's (?) depolariser is chromic acid." This is not correct; my depolariser contains chromic acid, along with chlorate of potash. On the addition of sulphuric acid to this mixture, chloric acid is set free, and this wonderfully increases the "staying" powers of the chromic acid, and gives off no noxious fumes. But it must be used according to the instructions sent out with it to obtain the best results.

S. Bottone.

BALLOON ACCIDENTS.

[30198.]—Two similar balloon accidents have lately happened at Leicester and Manchester. As some of your readers are interested in aëronautics, I send the following particulars of the fatal one at Manchester:—

The balloon was made of cambric cloth, and reported to contain 34,000c.ft. of gas. It was filled in nine hours, with about 28,000c.ft., losing some of its lifting power in being carried three-quarters of a mile to the place from which it ascended on the racecourse.

Two persons ascended, one in charge of the balloon, and the other for the purpose of making a parachute descent.

The parachutist left the balloon when about 8,000ft. high, the sun shining and the sky clear and calm. After the parachute dropped the balloon ascended rapidly, with a wavy motion, to a great height—much over two miles—and then descended in a steady manner, carried by the wind towards the village of Burnage. During this time, by means of a telescope, the man was seen to leave the car and do something in the hoop of the balloon, leaving the mouth apparently secured to the hoop after he had returned to the car. When the balloon descended to about three-quarters of a mile, it seemed only half-full of gas, and was coming down at a great speed, revolving once a minute. At a quarter of a mile high the top seemed to have a slight depression, and the balloon suddenly elongated and fell like a stone, the unfortunate aëronaut being killed on the spot.

No ballast was found in the car, and the only explanation of the collapse given at the inquest, supposed that the mouth of the balloon was forced against the network by the air and torn during the descent.

As I cannot reconcile this with the fact that in the Leicester accident the balloon was intact, and that the valves and line were in working condition in both cases, I should like to know if any of your readers can give a more satisfactory cause for these rapid descents.

My own opinion is that the unfortunate man miscalculated the quantity of gas that he ought to have kept in the balloon, for the Manchester gas is heavy, and only lifts 28lb. for 1,000cub.ft. Therefore, the balloon half-full of gas would not carry much more than four hundredweight, and as the balloon and aëronaut could not be less, there would be no ballast to check a too rapid descent.

In a rapid descent the wedge form obtained by fastening the mouth to the hoop would compress the gas, and it would therefore pass out through the mouth at a speed in proportion to the rapidity of the descent. In the Leicester accident the quick descent was attributed to meeting with a cold current; but the gas must have got out of the balloon someway, as the amount left in the envelope was too small to be due to condensation. The statement I saw was 500ft., but it may be a misprint for 5,000. Even then, with heavy gas the quantity is too small. **J. Sutcliffe.**

Testing Filtering Paper.—In testing filtering paper, one feature, among others, should be specially paid attention to—namely, the rapidity with which liquid will spread over a given surface. This may be ascertained by fastening to a frame a series of equal strips of various filtering papers, and then immersing them simultaneously in water. The exact time of immersion being noticed, it only remains to wait until upward diffusion stops, and then to read off, on the scale to which each strip is fastened, the degree or mark to which diffusion extended.

At a recent meeting of the Verein für Eisenbahnkunde in Berlin, the rail sections in use in Germany and America were discussed. Herr Zimmermann stated that in Germany the rail heads have, without exception, either vertical, or in many cases converging—heads narrower at the bottom than at the top—sides. In America, the *Railroad Gazette* says, on the contrary, the heads are flaring, wider at the bottom than at the top, the object sought by this form of head being a large bearing for the angle plates. The usual amount of bearing surface under the head with them—*i.e.*, the Germans—appears too small, and in America it is increased by flaring the sides of the rail head. Herr Stambke said that in case a change in the form of the rails at present in use on the Continent should be had in view, not only would the widening of the bearing surfaces for the joint splices according to the American model come into consideration, but above all things the widening of the bearing surface for the wheels, and the increase of the stiffness of the rail section. The rapid hollow wearing of the treads of the wheels, requiring a frequent turning, necessarily calls for increase in the bearing surface. An increase in the depth of the rail head for increasing the durability of the rail he did not consider necessary or effective. When steel came into use the weight of the rails was reduced, because of the greater resistance of the steel, and of the greater first cost of the material. The stiffness of the rail has, however, suffered considerably thereby. The new rails spring more from the passage of heavy and rapid trains, and the permanent way is not rigid enough. The ideal for a permanent way is to so construct it that the pressure due to the loads upon it may be distributed over the greatest possible surface of the road bed. A stiff, heavy rail distributes the pressure over a greater number of ties, and consequently a greater surface than a more flexible rail. The ties lying directly under the wheels are, with light rails, heavily loaded, while those lying between the wheels may be subjected to no load at all.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[68191.]—**Wounds.**—I promised to tell you, on my return from my visit to the Paris Exhibition, what I and my sister Millie had done in the matter of having our nipples pierced and having rings inserted in them. We stayed in Paris much longer than we had intended, and only arrived at home a few days ago. I should very much have liked to hear again from "Fanny," whose answer appeared in your number for May 10th, and to know what are the inconveniences she has experienced during her five years continuous wear of the rings. I think the troubles cannot have been very serious, or she would not have continued to endure them. I was fortunate enough to obtain in Paris all the information which I could have desired. Soon after our arrival there we made the acquaintance of an American lady, who had taken her degree in medicine, and was staying in Paris in order to study a special subject at one of the hospitals. I consulted her as to any danger likely to arise from having the nipples pierced. She could not give me any opinion from her own knowledge, but offered to make inquiry of the surgeon at her hospital. He told her that he did not think any danger would arise from the operation if care were taken not to injure the breast. He knew personally one lady, and had heard of others, who had undergone the operation. He kindly gave us an introduction to the lady mentioned, and we visited her. We found her very obliging, and she gave us all the particulars we wanted to know. She had been wearing the rings more than three years, and during that time had had two children; the younger of which she was at the time nursing herself, which is, I am told, not a common custom with Parisian mothers. She did not find any inconvenience from wearing the rings, neither did they seem to incommode the child, who seemed in very good health. This lady told us that she had first worn the rings a few months after her marriage, at her husband's desire, and that they had been inserted by a certain Madame Beaumont, who made the performance of the operation a part of her business. We obtained her address, and made an appointment to visit her. We found her occupying an elegantly-furnished apartment in a street leading from the Rue de Rivoli. She is a nice, pleasant, middle-aged lady, and along with her was one of her daughters, a fine girl of about eighteen. Madame B.'s business is to minister to the little wants and requirements of ladies, such as hair-dyeing, enamelling, corn doctoring, piercing their ears, and occasionally also their nipples. She has quite an assortment of large gold rings made expressly for this purpose, and she showed us that both herself and her daughter were at the time wearing them. They were rather larger, but thinner, than our own rings which we had brought along with us. Madame B. has invented an instrument for the purpose of insuring that the perforation is made in the proper direction through the nipple, and without any chance of failure. It is something like a sugar tongs in form, but instead of the spoons at the ends of the legs there is a pair of small tubes about 1in. long, and in a straight line with each other, so that when the nipple is grasped between the inner ends of the tubes by means of a screw in the handle, a piercer can be passed through the whole without any chance of deviating from its proper course. Our own rings being rather too thick, we purchased two pairs from Mdme. B., and I, being eldest, was to be first operated on. I must confess I felt very qualmish, and almost repented having consented to it. However, I could not now retreat, and I had to make the best of it. Mdme. B. assured me that the pain would not be great, so I partially undressed and seated myself on a couch by the side of Mdme. B., who passed her arm round my neck and held me steadily. Mdme. B. then bathed my right breast for a few minutes with something which smelt like benzoline, and seemed almost to freeze it. She then adjusted the instrument to the nipple, and screwed it up securely, and then, almost before I was aware of her intention, she plunged the piercer through the tubes. I scarcely felt its passage through my nipple, which seemed almost insensitive. She then unscrewed and removed the tongs, leaving the piercer still sticking through the nipple, the point of a ring being then put into a hollow in the base of the piercer, the ring was passed through the nipple and closed. The whole operation, excepting the bathing, did not, I believe, occupy a minute. I felt scarcely any pain, and only a drop or two of blood flowed, which was at once absorbed by a little styptic wool. My other nipple was then pierced in like manner. I am sure I was not ten minutes under Mdme. B.'s hands, and should never have imagined that the operation could have been so quickly and neatly performed. My sister Millie then had her turn. She seemed to feel it a little more than I had done, for what the piercer went through her nipple the first time she uttered a little scream; but I think she was more frightened than hurt, as she did not scream at the second piercing. Mdme. B. charged us 10 francs each for performing the operation, and 30 francs per pair for the gold rings. She told us that we were the first English ladies who had visited her for the purpose of having their nipples pierced, but that she had had several American ladies visit her, and many from France and other parts of the Continent. On the whole, we were much pleased with our visit to her, and glad that we had found the facility for carrying out our wishes much more conveniently than we could have hoped for in London. Some little time after we had quitted Mdme. B.'s I began to feel sensation returning in my breasts, and before long I could have fancied that the rings were red hot, the irritation was so intense. Fortunately we were soon back at our hotel, and, hurrying to our chamber, we spent the next few hours in bathing our breasts with camphorated water, which Mdme. B. had recommended us to use. After a time the pain subsided, and we were able to dress and go about. We continued to use the camphor water for some days, as occasion served, but had no recurrence of the pain. I wore a pad made of several thicknesses of wadding, over the breasts, to prevent the edge of my corset from rubbing the rings, and this I still wear for the present. It is now about seven weeks since we had the rings inserted, and the wounds in our nipples are fast healing. The perforations are made directly through the centres of the nipples, but so that the rings do not quite touch the breasts. CONSTANCE.

[68612.]—**Flattening Wood for Fretwork.**—I have just noticed this query, and suggest hot water for straightening. I have cut out a large quantity of fretwork, and my plan was, when my pattern was cut out, to remove the design by soaking it in boiling water. My pieces have at times been so large that I had to resort to a large tea-tray as a holder for the hot water, and I do not think a single piece of work has not passed through this process, and I may say the pieces have been thick and thin—less than ¼in. up to nearly ½in.—and I do not know what a warped piece is. There is only one care to be taken—that is, keep your wood turned so that the turning over should keep the wood straight, and then to stand the wood on end—that is, the grain of the wood to run upright. Some will, I know, object to this soaking, as it brings out the grain, &c., but have not found any objection in that shape myself, and the work will bear any amount of inspection. J. C.

[68639.]—**Megascope.**—Many thanks to F. W. Mason for his detailed sketch of a megascope, but why it should be so difficult to construct I cannot see. Provided the lens is the right one, and the light is strong, a good picture must surely result? Will F. W. M. kindly say what kind, size, and focus of lens is required to throw a 10ft. disc? Is there more than one lens? E. C. OWEN.

[68722.]—**Methods of Studying Organic Chemistry (U.Q.)**—May I be allowed to express my most thorough agreement with "Young Analyst" in his protest against the "so-called 'Practical Organic Analysis' being confounded with the truly magnificent science of organic chemistry"? It was to avoid as much as possible the abortion he complains of that my query was presented. At the same time, I think he somewhat overlooks the real point at issue. Organic chemistry is certainly fascinating and interesting, to say nothing of its importance; but unfortunately, what is called by that name in the examination room (University of London, e.g.) seems to be the veriest dry bones of the real thing, without either interest or fascination. Now, however much we may wish to study the subject for its own sake and its practical utility, one counts for nothing without going through an examination; and what I am anxious to get opinions upon is as to how the examination chemistry may be done without "cram," and without sacrificing any more than can be helped of what is really useful in practical life, and always remembering, too, that other subjects have to be taken up besides organic chemistry. In mathematics a process of reasoning may recall a forgotten formula, and in languages the various declensions, &c., are arranged so as to simplify things, and assist the memory; but, so far as I am aware, no attempt has been made to reduce chemistry to any corresponding order for the learner, except in Tilden's "Chemical Philosophy." Unfortunately, I do not know the books "Young Analyst" kindly recommends (which I shall make acquaintance with as soon as I can), but an ordinary "Chemistry" is the veriest *olla podrida* of chemical facts. I open Roscoe and Schorlemmer's "Carbon Compounds" anywhere, and all I find is short articles on the various bodies, giving the preparation and formula, and then some account of properties, and some reactions, selected pretty much at random apparently. For instance, opening the book at hazard, "Tolylene di-iodide . . crystallises in small rhomboidal plates, which are decomposed by heat." Now, what I want to insist upon is this—that to try to store one's brain with facts bearing any relation to this is cram of the very worst kind. At the same time, a man who can descend to it gets "distinguished" or takes "Honours" in chemistry. To put it in a nutshell, and use a simile which may be somewhat crude, our way of doing chemistry seems like learning a language by the aid of a dictionary alone, without a grammar. I am well aware that there must be much difficulty in making a grammar of organic chemistry; but the existence of Tilden's "Chemical Philosophy," and its rapid sale, shows that what I feel is a generally-felt want, if not generally expressed, and I hoped that some of the readers of the "E. M." would be able to offer some suggestions on the matter. I should have liked to say a word on the so-called "analysis," but fear I have already trespassed on space too far. AURORA.

[68756.]—**Gas-Engine.**—I agree with some of the remarks of "One in a Fix," especially when he says that he thinks it the "duty of every reader" to carefully read the queries, and if it lays in his power, to help another; but I also think, in connection with that, that it is the duty of every querist seeking information to put his questions into a definite form. There is no paper in the world (I speak with some knowledge) that contains so much valuable information as the ENGLISH MECHANIC, and I am quite sure that its readers (or some of them, for I do not remember any information given by "One in a Fix") will willingly help when they can: they cannot be expected to belabour their brains to discover what a querist means. 90 per cent. of the queries which go into the "Unanswered" list get there because they are so vague and indefinite: hence the signature appended means "Jack Empty"—a reference to the emptiness of the query. J. M. T.

[68775.]—**Piebald Snails (U.Q.)**—The slug (not "snail") distinguished by a black upper surface and white foot is not a "piebald" in the usual acceptation of the term, any more than is a brown weasel with a white belly. As a rule, the foot or locomotory disc of all snails and slugs is uncoloured, and this, again, is only a special case of a still more general rule—viz., that the underside of all animals whose mode of locomotion is such as to cause the same part of the body to be always in shade, is less highly coloured than the upper side. There are exceptions, some real, some apparent, some partial, and it is these exceptions that require explanation rather than the case alluded to by "R." The foot of the great black slug (*Arion ater, L.*) is very variable in this respect, not unfrequently whitish, very often dusky grey, sometimes very dark, but even in the last case is sensibly a shade or two less black than the dorsal region, and so conforms to the rule. On second thoughts, "R." will see that a peculiarity so widespread cannot be explained by the accidental and rare union of a full-coloured individual with an albino. LIMAX.

[68819.]—**Magnet.**—Cell (square), 8in. high, 4in. broad, 5in. across. The elements consist of a piece of zinc plate about ¼in. thick, joined by an insulated wire to one terminal (see p. 418). This is suspended in the liquid. I prefer to use here a piece of brass rod thoroughly insulated with gutta-percha to hold the zinc, as it requires something strong. The zinc plate should be 3in. by 4in.; this should not be fixed in the cell till last. For the copper plate (see p. 418), use a piece of copper about the same size; this copper should have an insulated wire similar to the zinc. The ends of these two wires are the terminals. At the bottom of the cell put a layer of sawdust; on this put the copper plate, and connect its wire up to one terminal. Over this, to half-way up the cell, put a mixture of sawdust and copper sulphate. I prefer for this to make up a solution of copper sulphate ½lb., sulphuric acid 1oz., water 3 pints. Put the sawdust in the cell, and then pour the solution on it; then fill up the cell with water, and then hang the zinc in, and connect that up to the other terminal (see p. 418. H_2O = water, Zn = zinc, $CuSO_4$ = copper sulphate). I have myself used one of these (similar work to what you require) for three or four months. Two or three cells are quite sufficient, providing you have not got a great external resistance. F. W. MASON.

[68855.] — **Steel Bronze.**—I fancy "Brass Finisher" will find suitable recipes in back volumes; but of course he knows the bronzes are really coloured lacquers which he can buy cheaper than he can make them. See also p. 54, No. 1147. S. M.

[68857.]—**Beaters.**—Will this querist say what material is to be scutched? The three-bladed beater gives more blows as a rule, but the two-bladed beater gives the strongest blow as a rule.

Belfast. G.

[68866.]—**Opening Pipes.**—These pipes can be cut open by means of a circular saw, or by a tool in the planer cutting a groove. J. M. T.

[68867.]—**Amber Varnish.**—Amber is fused by placing it in an iron ladle over a clear fire. It is coloured with dragon's blood, gamboge, &c., according to tint required. Take, say, 3lb. of pale amber; fuse, and add 1 gallon of clarified linseed oil; boil until it "strings"; add the colour, and when it has cooled a bit, 2 gallons of best turpentine. But it is always cheaper to buy such things, unless large quantities are wanted. NUN. DOR.

[68876.]—**Horse - Power of Engines and Boilers.**—I do not understand what it is that Mr. Snowden wishes to know. Surely, as chief engineer, he knows how to calculate the horse-power of both engines and boilers, the data necessary being given in all the textbooks dealing with the subject. The best way of getting at the horse-power developed by any given engine is to put the indicator on; but as to boiler power, so much depends on their condition, on their construction, and on the quality of the fuel used, that only empirical data are available. As to locomotives, engineers do not calculate in horse-power, but in tractive power—that is, the ability to haul given weights at given speeds. M. R.

[68878.]—**Lightning Conductors.**—As no one else has come forward to help "Joiner," I will try to do so. If I wanted to test his conductor I should satisfy myself by examination if it was in good order down to the ground, and test earth res. with a bridge and coils. However, replying to his last query, 1lb. of 20 B.W.G. copper wire has a res. of 2·137 ohms, and he will find directions for making and using a bridge in "E.M.," Aug. 5, 1887. He must put his standard res. on one side of bridge, on the other side a wire from bridge to water-main which he mentions, another wire from conductor back to bridge. These wires must be thick and well connected, and if he has to move slider more towards one end than the other of stretched wire to get a balance, that is the side of lowest resistance in the two things he is testing.

Cambridge. A. J. DEW.

[68878.]—**Lightning Conductors.**—Your job is a rather difficult one, on account of the main conductor branching into two branches, each with a separate earth. Take a wire and solder it on to the pinnacle, taking it to the testing situation. Above the place where the conductor branches into two solder another wire. Test this, then find a separate earth to that used by the conductor, and disconnect one of the branched conductors at the point; test between point of wire and the free end of the branch. This should be of hardly any resistance (at least to speak of); if it is, test the resistance between point and end of wire above fork. The fault will sometimes be found in the joint, due to the weather acting on the lead-filling in the joint, and it is, in nine cases out of 10, that it will be found so. Now test the resistance of the earth, using the earth connection of the branch you have cut. This should be under, say, 2ohms; if it is not, test between subsidiary earth, and each conductor earth in succession. One will be of higher resistance than the other. The fault lies in this. You then have to remedy it. There is no need for me to give particulars how to do this; this depends upon circumstances, according to the fault. Next re-make the joint in the branch you have cut, and then test it. You cannot make a good test (taken on the whole) unless you proceed this way, as, if you test without cutting the joint, you have no guarantee that both earths are correct. Of course you must allow for resistance in the leads to testing instrument. The bell and battery in the present instance are rather a bad dodge. You should do the testing with a direct reading bridge; it should have a scale one mètre long. divided to mm. might be calibrated to read from 0·01 to 10 ohms by steps of 0·01 ohm. This is quite near enough for lightning-conductors. F. W. MASON.

[68883.]—**Bath Enamel Paint.**—These enamel paints are, I believe, very carefully ground and strained, and are then mixed with fine copal varnish and a good deal of terebene; but I do not think that for baths many paints will stand hot water unless the coating of japan or paint is "stoved." C.

[68885.]—**Metallic Durability.**—For all rubbing surfaces in machinery there is, I believe, nothing more durable than polished steel running in gunmetal. For durability the aim is to so support the journal or moving part that it always runs on the lubricant, not on the metal. J. K. C.

[68915.]—**Auxiliary Screw.**—May I venture to inquire whether any of the correspondents who have written on this subject as recently exploited in these columns ever tried the method of fixing a screw-propeller as suggested. It seems to me that more speed could be obtained with a pair of sculls than with all these curious propellers combined. Some of those who have replied do not seem to have any idea of what a thrust-block is for. S. P.

[68933.]—**Electrical.**—If your case was mine, I should proceed as follows:—1oz. of phos. to 15oz. bisulphuret, and paint the wax well with this (or dip it in), and then immerse the mould into a solution of silver nitrate (3dwt. to 2 pints of distilled water). I should keep the mould there till it is black all over. I should then place it in cold water for a few minutes, and then immerse it in a solution of chloride of gold, wash again, and allow to dry and then it is ready for the deposit—copper sulphate 1lb., sulphuric acid 2oz., water 3 pints. Sometimes I prefer to mix the bisulphuret and phos. with my mould. The mould I always use consists of wax 1lb., spt. turpentine 1 pint, indiarubber 2oz., asphalte 1lb. Melt the wax, dissolve the rubber and asphalte in spt. of turpentine; now add the wax, stir well, and then add phosphorus 1lb., bisulphuret of carbon 15lb. Any further information shall be pleased to give.

F. W. Mason.

[68948.]—**Gaiffe's Chloride of Silver Cell.**—I have never had to fuse my silver wire to the AgCl; simple immersion has been quite sufficient. You also could use your solution. F. W. Mason.

[68954.]—**Cleaning Brass Clock Dials.**—Take the corner-pieces from the dial-plate, and also the ring on which hours, &c., are engraved. Remove all the old lacquer with hot solution of potash. Use a scratch-brush to get into the crevices of the corner-pieces. When clean, brush them up successively with flour emery, bath brick, and then rottenstone, using a dry brush for the finish. They may then be dipped in hot soda-water, and then cold water; this will render them free from grease. Warm them slightly, and lacquer with "deep gold lacquer." The main-plate may be treated in the same way, but instead of using a scratch-brush, take fine emery cloth, and finally flour emery cloth, taking care to give the surface a uniform series of up and down strokes, so as to secure a uniform "grain." When quite clean this plate may be lacquered with pale gold lacquer. The hour-ring is best done in the lathe. A piece of finest glass-cloth applied by hand will lay the grain on in a circular form, and give the dial that radial reflection often seen on barometer and other work. The whitening or silvering may be done as follows:—Take a small quantity (say ½oz.) of nitrate silver crystals, and, say, 1oz. of common salt; powder them, and add enough water to them to make a fluid paste. Revolve the circle slowly in the lathe, and apply the paste with a piece of old linen rag made up into a ball. The whitening will gradually come out, and the plate can then be well washed under a water-tap. It may then be warmed and lacquered (by preference in the lathe) with white or colourless lacquer. In carrying out the above instructions observe three points: 1. Finish nothing to an absolute polish, but whatever surface you arrive at let it be free from grease. 2. Don't finger any of the surfaces which are to be lacquered or whitened. 3. See that whatever treatment you give to each portion of the dial is uniform, or failing that, the final effect will not be good. To clean the hands, prepare them on a finer emery bob, without oil or grease, till they are a thoroughly uniform white colour. Make a sand-bath and place the hands in it—in a few minutes they will begin to get a straw or yellow colour; move them about to a cooler or hotter part of the bath, as the shade on one portion of it deepens too quickly, or not quick enough. When the required colour is reached, take them up with the pliers, draw a candle down them, and finally clean off with an old leather, &c. A few experiments, both in the silvering and bluing, will of course be advantageous, if not necessary.

Birmingham. Hall.

[68958.]—**Pumps.**—"Water" has, like other querists, forgotten an element in the inquiry he makes. He does not say the time occupied in lifting a given number of gallons, nor does he give the length of the stroke. Without these particulars it would be rather a difficult matter to give a "plain rule."

Birmingham. Hall.

[68963.]—**Filter for Waste Oil.**—I have used Price's gas-engine oil many times over, by filtering through flannel, and then strong, but rather open, canvas. This latter straining holds the short wool which comes from the flannel itself.

Birmingham. Hall.

[69003.]—**Piano Keys—Woodwork.**—It is not the dry-rot; but, from description, it will be that insect pest—Anobium domesticum—and I fear, from the mention of the "fine dust," that it has gone too far for carbolic acid or other chemicals to be of any use. The best advice that I can give is to get rid of all the articles infested with the Anobia at once. This is hard, I know; but I have had to do a similar thing myself. In June and July the perfect insect (a small brown beetle of singular appearance) comes out of the holes, and it might attack the other furniture, or, worse than all, the joists or flooring of the room. They seem to start underneath the furniture—for instance, on the under part of the chairs and tables, and not so soon in painted wood. They can be dealt with, if taken in time, with carbolic acid; but as they burrow with the grain far up the wood, the difficulty is how to get at them when well established, and they will eat away the wood until there is left but a mere shell. Perhaps the best plan when the circular holes first appear, is to take out the piece of infested wood, and replace with new. Sometimes when I see a hole, say under a chair, I thrust in a red-hot wire, which seems very effectual. The larvæ are whitish-looking grubs, but these never leave the burrows. If anyone else can give a better way of dealing with this alarming insect, I shall be only too glad. The only good thing about them that I can see is that they seem to prefer old wood to new. In the summer, by looking over the infested furniture early in the morning, great numbers of the Anobia may be killed issuing from fresh holes. I have slain many this month. You might try benzoline, paraffin, or any strong insect destroyer, and a syringe is handy; but unless you cut into the wood you cannot tell if the grubs are really killed. A. E. B. M.

[69033.]—**Engine for Sewing-machine.**—I am just finishing an engine that would, perhaps, suit you, the dimensions of which are: Cylinder bore 1⅜in., length of stroke 2in., steam ports 1¼in. by $\frac{3}{16}$in., exhaust port 1¼in. by ⅜in.; diameter of valve and piston-rods $\frac{3}{16}$in. and $\frac{5}{16}$in. respectively; flywheel about 8in. diam. A vertical boiler 20in. high and 9in. diam. would, I should think, be suitable for the above engine. Major.

[69034.]—**Dynamo.**—For series wound I expect you mean as in Fig. 1, and your connected platinum wire to terminals A B. This is all right for circuits of very small resistance; but in the case of lamps there is too much resistance, and so no current can go to excite field magnets. If you want to light lamps, connect it as in Fig. 2 to terminals A B, putting proportionate resistances between A C to the resistance in the outer circuit—viz., between A B. Small dynamos, series wound, are no use for lighting purposes, especially incandescent lighting.

R. H. Craven.

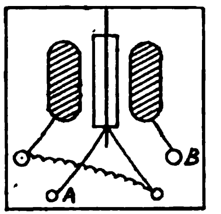


Fig. 1.

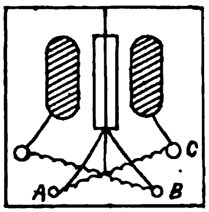


Fig. 2.

[69036.] — **Platinum Contacts becoming Oxidised.**—The rubbing contact is far the best; you could use the alloy of platinum-iridium. You had best advertise your address; I fancy I may be able to help you. F. W. Mason.

[69037.]—**Navigation and Seamanship.**—The textbooks for this are the Epitomes of Rossier and Norie. These are the standard books, and ones that all officers are supposed to be provided with (either one or the other). Full regulations may be obtained from the Board of Trade. Second officer: Log arithmetic; day's work; time by chronometer; lat. by sun's mean alt.; parallel sailing; to find course and distance by Mercator's sailing; to find time of high water; cor. and dev. of compass by amplitude. Additional for first officer: Dev. of compass by an azimuth; finding lat. by reduction to the meridian. Additional for master: Lat. by sun's, mean alt., and dev. of compass. Any particulars that "Alpha" may require regarding solutions to the problems I shall be very pleased to give, as I have had considerable experience in these problems up to the grade of master.

F. W. Mason.

[69039.]—**B.C. Battery.**—As a rule, these carbons are coppered before being soldered. This is done by the electro-deposition process. Use one Bunsen and solution of copper sulphate 4oz., sulphuric acid 1oz., water 1 pint. Make carbon the cathode, and a copper plate the anode of the bath.

F. W. Mason.

[69042.]—**Electric Bells.**—I expect you have dropped spirits of salts on them or salammoniac solution. Wires should be thoroughly insulated and run in tin tubes. F. W. Mason.

[69042.]—**Electric Bells.** — The situation of your wires is damp, and the class of wire used by you is not suited to withstand the damp. I expect the wire is "paraffin" served with one wrapping of sheet guttapercha. This wire will not stand in damp places, as when the covering of the wires gets damp, leakage takes place between the wires themselves or to "earth," the electrolytic action of the current eating the wire away. Use wire served with a thick covering of guttapercha and then cotton covered, or, if the situation of your wire is very damp, taped and tarred. F. C. Allsop.

[69042.]—**Electric Bell-wire Failing.**—Your wires have been perhaps badly insulated, and damp has found it out. Everything electrical demands work to be thoroughly well done, and material to be of the best, or you may depend upon it, sooner or later, these shortcomings will make themselves known.

Birmingham. Hall.

[69044.]—**Dynamo.**—If you had put more wire on F.M. it would have been better: but still it should light a 2c.p. lamp. You must have got the connections wrong; try connecting like Fig. 2, query 69034; it should go right then.

R. H. C.

[69047.]—**Soldering to Amalgamated Zinc.**—I find I am in error in my reply to this query under the heading of "Paraffining Carbons." It is "Niaudet" in his unequalled book on "Batteries," who says, page 159: "Some persons solder to the amalgamated zinc a strip of copper, which constitutes the negative connection of the cell; but the two must be riveted together by means of a copper rivet: otherwise the mercury will finally detach one from the other." I know from experience soldering a broken amalgamated zinc plate was a failure. The mercury seems to permeate the solder and keep it always soft, something similar to lead when just setting after casting.

F.R.Met.Soc.

[69053.] — **Incandescent Lighting with Leclanches.**—You are quite correct. What you gain in the brilliancy of your light you gain at the cost of breaking down the filament more quickly. Six volts signifies that the lamp requires six volts E.M.F. to light it. I thoroughly hold with Mr. Bottone. The use of the word "volts" in connection with lamps is entirely misleading. The resistance of the Leclanché is rather too high for lighting. As you only require it for intermediate work, you can use it. Use nine cells. F. W. Mason.

[69053.] — **Incandescent Lighting with Leclanches.**—Leclanché batteries have about 1½ volt E.M.F., and about 1·4 ampère current. Now if your lamp takes 6 volts you will want four batteries in series to get the required E.M.F., and if your lamp requires 1 ampère, four will be enough; but if your lamp took 2 ampères, then you would want eight batteries—two fours in series, and then these two fours in parallel. But I think it would pay you to use Bunsens or chromic-acid cells. Leclanchés soon become polarised.

R. H. Craven.

[69053.] — **Incandescent Lighting with Leclanches.**—The total E.M.F. of a battery and the E.M.F. available for outside working (usually called its terminal potential difference—P.D.) are two very different quantities. The total E.M.F. has first to force current through the internal resistance of the battery, and is thereby proportionally reduced. Certainly, if you apply six volts to the terminals of a six-volt lamp, that lamp will light; but though batteries of three Fullers, four Leclanchés, or six Daniells have each six volts total E.M.F., neither would light the lamp, for the reasons above stated. May I direct "A. R. B.'s" attention to his evidently hurried reply?

W. Perren Maycock.

[69055.]—**Blue Salt.**—$CuSO_4$ and NH_3 give a splendid blue solution; salts of Ni are also the same, but in a much less degree. F. W. Mason.

[69064.]—**Varicose Veins.**— Cause: impeded condition of the venous circulation resulting in, or giving evidence of its existence in, a local congestion of the veins, now become increased in calibre, the valves of the said veins having ceased to be efficient in passing on the blood, &c. Amongst the many valuable drugs introduced into medicine by the American homœopaths is the witch hazel (Hamamelis Virginica) so called from its popular use in discovering springs of water. Dr. Hering proved it to possess vast power on various conditions of the human body, notably in controlling hæmorrhages, and in certain varicose disorders. Hamamelis is now used both as a local application and as a medicine. Dr. Ruddock, in the cheap, popular edition (price 5s.) of his "Vade Mecum," devotes a page in his section on "Diseases of the Circulatory System" to Varicose Veins, also six pages to "Hœmorrhoids," another phase of Varices, for which we are again indebted to American homœopaths for a most valuable drug, the horse-chestnut —Æsculus hippocastaneum; in fact, when I am tormented with such anal troubles, I go to one of my trees, peel off a bit of the young bark, chew it for a few minutes, and lose my said annoyance often there and then.

The Lydney Dispenser.

[69073.]—**Tar-water** is very well in its place, and that is where nothing better can be obtained. It owes its efficacy to the presence of small quantities of carbolic acid, naphthaline, and some of the hydrocarbons of the tar, which the water dissolves. It used to be greatly prized as a stomach disinfectant, and as a preventive of consumption and scrofula. It certainly should not be taken by persons in health. I never heard that it produced gravel or renal complaints. It is slightly diuretic.

S. Bottone.

[69074.]—**Children's Teeth.**—Dr. Ringer has (I think) shown in his very popular "Handbook of Therapeutics" (the early editions of which can be bought very cheap from the second-hand book-booksellers) cl[illegible] enough that no alkali—and magnesia is one [illegible] taken as a drug [illegible] running a risk of serious damage to the teeth, owing probably to the said alkali having an affinity for the phosphorus present in the teeth as well as in other parts of the body. In its form of Epsom salts, one of the most popular of domestic medicines in Great Britain, magnesia has, I believe, done a vast amount of harm. That scarcely any notice of magnesia has been taken by homœopathy is probably due to the fact of Epsom salts having been almost unknown in Germany. One of the faculties peculiar to many drugs being the *causing* of toothache, homœopathy applies the said faculty *curatively*. If "Pater" will send a stamped addressed envelope and one penny stamp inclosed to E. Laurie, Esq., 6, Blandford-square, London, N.W., for a copy of No. 22 of the Homœopathic League Tracts, he may then see how drugs in the small doses of the science can have such curative power.

THE LYDNEY DISPENSER.

[69078.]—**Paper-Making.**—"S. S." would not have sufficient power with his "small stream of water," and so little fall, to do much paper-making. Of course if steam power was used, his "small stream" could be used for boiling, washing, and thinning his materials. I think that he had better not attempt paper-making, if the quantity of water and height of fall stated in his query is all the power he has. May I suggest that if he has sufficient room above the "fall" to store up the water by night, and use it (the water) by day, he would have double the power when at work, and might perhaps make a few millboards or leather-boards, and make it pay—the necessary plant for this purpose costing nothing like so much as for paper-making. What does "S. S." mean by "and straw-boards?" They can't be made with flax waste.

MILLBOARD.

[69078.]—**Paper-Making.**—One of the consequences of that act of the nation through its Parliament, the limited liability of co-partners in joint-stock enterprises, was the abandonment of individual responsibility in favour of much reckless trading. It is not many years since the great Anglo-Saxon orator, the late John Bright, announced to the House that the half-yearly balance sheet of a long list of paper-making companies he then held in his hand showed in every case no dividend. Since then, although the price of paper has continued steadily to decline, yet the time, probably, has not been reached, even while the paper on which I now write, thin and strong as a Bank of England note, costs but a fraction over 5d. per pound. That great changes in the materials used in the trade are still in progress, ocular demonstration close at hand tells

THE LYDNEY DISPENSER.

[69081.]—**Permanganate of Potash Cells.**—I would much rather "Wari" excused me from giving my opinion on Mr. Gardner's cell just for the present, as I am engaged with an investigation regarding it. In a few weeks I hope to communicate to "E. M." on it. The bromine in the cell seems to intensify and accelerate the action of the cell. In such a case as yours I should invent a suitable apparatus, and use another set of cells. This apparatus would act as follows:—After one person had had a shock from one set of batteries, the apparatus would then bring into action the other set of cells, and thus allow the other set to regenerate themselves. If "Wari" likes to advertise his address, I will write him with reference to such an apparatus. F. W. MASON.

[69082.]—**Agriculture.** — Within some thirty miles of London—notably around Grays, Essex—thousands of acres of the best corn-growing land in England are either unoccupied or bearing no rent. Close to me, in Gloucestershire, a farm which a few years back was rented at £1 15s. per acre was recently sold for about £15 per acre. After these items, comment *in re* the agriculturists "not being obliged (in Great Britain) to work like slaves for a living" is rather superfluous. I will, however, add that in no other one commercial pursuit can money be sunk (and lost) more easily and more imperceptibly at the time than in farming. A farm of, say, 300 acres, good land, would require at least £10 per acre to stock and to work it. As to the scientific aspect of the question of agriculture, a curriculum at either Downton or Cirencester is suitable, provided always that the pupil has the energy to educate himself when there, and to apply what he can learn there profitably; but the adage amongst old horsey men "that no man can know much about a horse until he has paid dearly for his experience" applies to farming throughout the whole of its procedure. An advertisement in *The Field*, *The Farmer*, the *Mark Lane Express*, &c., would bring a plethora of choice from respectable men open to receive agricultural pupils, and from whom the desired information as to cost, &c., may be obtained. THE LYDNEY DISPENSER.

[69082.]—**Agriculture.**—I should advise "K." to let his son have two years at an agricultural college, and after that let him live with farmers, assisting them in their business, until he is old enough to be his own master. But before doing this, by all means let "K." and his son make themselves well acquainted with farmers and the circumstances with which they are surrounded, and if this does not alter their views, then decide whether to go in for butter, cheese, or corn farming. For butter farming I should recommend Devonshire, for cheese Somersetshire, and for corn Norfolk. I am a Devonshire farmer's son, and have passed sixty years of my life among the farmers of the above-named counties. I have also been among the farmers of the North of France, and know how unfounded are the English farmers' ideas of their own superiority over their Gallic neighbours, which their landlords, for their own ends, have instilled into their minds. The best fields of wheat and the best methods of butter-making and cow management I have ever seen have been within twenty miles of Havre. A Normandy farmer would graze three cows where an English farmer would graze two, and I should say he grows bushels more of wheat per acre. We shall never get men back from the cities and large towns into the country until we get rid of the landlord curse.

UN CAMPAGUARD.

[69083.]—**Painting or Colouring Photos.**—To remove the gloss you complain of, give the photos. a good rubbing down with a piece of india-rubber. You can then tint them as you please with special water colours sold by photographic dealers. Ordinary colours will do, if good.

F. W. CANNON.

[69083.]—**Painting or Colouring Photographs.**—There are several modes of causing a photograph on albuminised paper to take the colour. The first and commonest is to lick the photo, and apply the colour before the surface gets bone dry. This does not remove the glaze, but causes the surface to take the colours, which must be good, transparent ones, applied lightly. The second mode is to wipe over the surface with a flannel dipped in ox gall. A third mode is to rub in, with the tip of a clean finger, a drop of thin gelatine water until the surface is nearly dry. This takes the colour very well, but the colours require to be rubbed up with gelatine water. A fourth mode is to abrade the surface of the photograph by rubbing it very lightly with the tip of the finger, and a little finest pumice powder. S. BOTTONE.

[69084.]—**Making Accumulator Cells.**—To MR. MASON.—Allow the cells to soak for 15 or 20 minutes in the boiling wax. Be careful the wax does not burn. F. W. MASON.

[69085.]—**Electric Alarm Clock.**—See my answer, 64496, in No. 1,197, or please advertise address, when shall be pleased to help.

F. W. MASON.

[69085.]—**Electric Alarm Clock.**—This has been described and figured in the pages of "Ours" over and over again. Here is a novel and simple mode by which you can cause a clock to ring a bell, which, if you are anything of a mechanic, you can rig up yourself in less than half an hour. Procure two pieces of old watch-spring about 4in. long and ⅛ wide. Tie these one on each side of a block of wood about 1in. square, leaving ½in. free ends on the one side and 2½in. on the other. Bend the long ends towards each other, thus: (|, so that they almost, but not quite, touch. Now glue, screw, or otherwise attach the block carrying the springs on or near the clock-face, at such a point that the springs are in the path of the hour-hand when it reaches the desired hour of ringing. When the hour hand reaches the upper spring it will cause it to touch the lower; and if one of the short ends has been connected with one battery wire, and the other short end is in connection with the bell, while the other battery wire is connected up to the bell, the bell will ring when the two springs are thus pressed into contact. S. BOTTONE.

[69086.]—**Dynamo, Angular Velocity.**—Angular velocity means really the rate at which a point on the periphery of a circle travels. Thus, for instance, suppose we had an armature 1 yard in circumference, and we drove this at 400 revs. per minute, the angular velocity would be 400 yards, or 1,200ft. per minute. In other words, multiplying the circumference of the rotating body, in feet, by the number of revs. per minute, we get the angular velocity in feet per minute. With regard to the space embraced by the pole-pieces, in dynamos of the ring armature type each pole-piece should embrace one-third of the armature.

S. BOTTONE.

[69087.]—**Pump Valves.**—In a properly designed pump the correct lift is one-fourth the dia. of valve orifice. In your case, as the valve is larger than the ram, and the speed is slow, $\frac{3}{16}$ths lift for the foot and a ¼in. for the head is ample. Do this at once, as the thumping of the valve in its seat may split the chamber. Any knocking of the pump can be prevented by fitting air-valves.

F. W. CANNON.

[69088.]—**Prevention of Rust.**—There is a kind of fine colourless lacquer called "lustrine," which, I think, will answer the purpose required. The maker is Hartley, of Birmingham.

PRINCIPIA.

[69088.]—**Prevention of Rust.**—You can make a lacquer by dissolving shellac in methylated spirits, or you could obtain it ready made from lacquer manufacturers. The quality known as pale gold is best suited for your purpose, it being hardly noticeable on iron or steel, which it thoroughly protects, even from salt water. T. W. CANNON.

[69090.]—**Brighton Engines.**—I append any names I know of the engines "P. H. N." mentions. 78 Hailsham, 80 Bookham, 99 Bordeaux, 136 Brindisi, 172 Chichester, 198 Sheffield, 451 Lancing, 452 Worthing, 484 Solent (now Glynde), 486 Portsmouth. W. E. C. B.

[69090.]—**Brighton Engines.**—38 Millwall, 42 Tulse Hill, 45 Merton, 48 Leadenhall, 65 Tooting, 66 Hatcham, 77 Wonersh, 78 Knowle, 79 Minories, 80 Bookham, 83 Earlswood, 99 Bordeaux, 107 Alderney, 109 Strasbourg, 114 Trouville, 118 Trocadero, 122 Leghorn, 127 Poitiers, 135 Foligno, 136 Brindisi, 157 Barcelona, 161 Havant,* 186 De La Warr, 187 Philip Rose, 188 Allen Sarle, 189 Edward Blount, 190 Arthur Otway, 191 Gordon-Lennox, 192 Jacomb-Hood, 193 Fremantle, 197 Jonas Levy, 198 Sheffield, 234 Rottingdean, 268 Baynards, 282 Rowfont, 293 Norbury, 324 Abergavenny, 484 Glynde,* 485 Pevensey,* 486 Portsmouth,* 490 Dieppe,* 496 Bognor.* Those marked (*) are old engines; the rest are Mr. Stroudley's.

C. F. DENDY MARSHALL.

[69095.]—**South-Western Engines.**—12 Jupiter (built 1871), 26 Gazelle, 37 Arab, 39 Wizard, 40 Windsor, 41 Ajax, 43 Milo (built 1875), 44 Pluto, 50 Buffalo, 83 Siren (built 1866), 120 Hecla 151, Montrose (built 1878) 221 Scotia, 222 Cambria, 223 Colossus, 225 Hibernia, 226 Aurora, Mina (no number), Sambo (no number). W. E. C. B.

[69096.]—**Sunlight Measurer.**—The instrument as figured is probably a modification of the radiometer. A mixture of fine glue and vegetable or lampblack, will answer, and the suspension is effected by metallic (platinum or aluminium) wires on glass centres. There is another form of sunshine recorder in which the sunshine, passing through a glass ball, is focussed on a semi-circular strip of paper, so that when the sun shines it leaves a black back, and when covered by clouds leaves the paper blank. PRINCIPIA.

[69099.]—**Glaze for Pottery.**—By using fretted glazes, and giving the ware plenty of fire in biscuit. It is only the easy-fired biscuit ware that crazes. You will find two good glazes in answer to query 69012. POTTER.

[69101.]—**Defective Sight.**—In reply to "W. F. P.," it is obvious that he is suffering from paresis of some of his ocular muscles, which dislocates the image, so that it does not fall on corresponding portions of his retina, and hence appears double. His only course is to consult an oculist; but it is often irremediable. The false image finally gets ignored. In reply to "Edwards" (69112), he can easily distinguish "pebbles" from glass by means of the polariscope. The usual form for this purpose is the "Tourmaline forceps," which is simply two plates of tourmaline made to revolve, and mounted in a spring clip of wire. Turn to light, and rotate one plate until the field is quite dark. Insert lens between the plates, when, if glass, no effect is produced, but, if quartz, the light is restored. If the "pebble" is cut in the wrong direction, a series of coloured bands make their appearance, which change as the tourmaline is revolved. Periscopic glasses are menisci. They are of no advantage over ordinary lenses, and are only puffed by advertising opticians. As the lens of the eye gets flatter, and accommodation is lost with advancing years, the strength of the lens must be increased from time to time. The proper amount should be worked out for each individual case; but if otherwise intelligent persons will either choose their own glasses or go to a mere salesman and take his advice on a difficult subject, of which he probably knows really nothing, they must, and do not rarely, suffer. G. C. K.

[69101.]—**Defective Sight.**—Sir Astley Cooper, that heroic surgeon, &c., at Guy's Hospital, London, during the early part of the present century, having a bad-leg patient in hand, for experiment ordered a plaister of belladonna. The said patient becoming blind during the course of the ensuing day or so taught Sir Astley a useful lesson, for he cautioned his pupils against that drug—as a plaister at least. The sentence of "W. F. P.," "ever since then I have experienced this illusion of vision," is suggestive. During the discussion which took place in these columns some four or five years ago on the merits and demerits of homœopathy, a letter appeared from me on the action of the Japanese belladonna (*Scopolia Japonica*), supplied to me for experimental purposes by the importers, Messrs. Christy, of Fenchurch-street, the causative symptoms of which, in doses so minute as 1,000th part of one grain of the dried root, were most remarkable on the vision. Out of the leading 70 of the, say, 700 medicines of homœopathy, Farington's "Materia Medica" describes 65 as having certain affinity for and various actions on the eye, diplopia—i.e., single objects appearing double, being a symptom in several of the 65. Now, seeing that in disease, notably in the eruptive fevers of scarlet fever, measles, small-pox, also in scrofula, disordered vision is often present (or follows), it is to be regretted that some clever M.D., who is fortunate enough to be blessed with income from private property sufficient to enable him to devote his whole time, energy, and talent to the study of the action of drugs on the eye, has not hitherto done so, for my humble experience has again and again told me that there is a grand future in store for such a man. Angel, in America, has done a little; but, alas! wealth, inclination, self-denial, and talent form a quartette rarely combined. Accident, years ago, directed my attention to the possible fact that one only of the eyes, generally the right, sees the object (or the main of it) gazed at. Seat yourself, say, three or four yards from a window; gaze at one of its vertical stiles; at arm's length erect the thumb, bringing it in such a position as to cover (part of) the stile, you can still see the stile—that part covered by the thumb; but this is with the left eye, in proof of which close the left eye, then you do not see behind the thumb. Now close the right eye, then with the left eye the thumb seems to have moved some inches to the right. Of course, any work on optics explains the above. Owing to practice I see two thumbs; this, however, is from command of his vision acquired by

The Lydney Dispenser.

[69103.]—**Water-Gas.**—Steam is decomposed by passing it through incandescent carbonaceous matter. A fixed gas results. It is then passed away to a scrubber, and treated in a similar manner to coal-gas. After leaving the scrubber, it passes to the gas-holder for heating and welding purposes. For indoor lighting, it is purified by means of oxide of iron; it gives an intensely hot flame, of a bluish colour, similar to that of a Bunsen burner, but gives very little light. By introducing a magnesian comb into the flame, a light similar to an electric arc is given. The intense heat and absence of smoke and smell make it valuable for cooking purposes. I should not, however, recommend it for house lighting, as a leak can only be detected by the application of a light, which, in the event of an accumulation, would cause an explosion.

F. W. Cannon.

[69104.]—**Leclanche.**—Should use agglomerate blocks, or Mr. Gardner's cell. F. W. Mason.

[69104.] — **Leclanche.** — The agglomerate Leclanché recovers more slowly than the old form on account of the density of the blocks, which do not allow the absorbed gases to escape quickly. If you are going to work for very long at a stretch, I should advise you to use some more constant cell than the Leclanché, for an intermittent current of 5 per sec. is very nearly equivalent to a continuous current. W. Perren Maycock.

[69104.] — **Leclanche.** — The ordinary form recovers itself more quickly than the agglomerate, probably because the fluid penetrates more freely among the loose particles of manganese dioxide than through the compressed and shellac-bound block. But no Leclanché will give satisfactory results if current is taken from it at the rate of five times per second, if the work is continuous; unless, indeed, the current taken is extremely minute, that is to say, through a very high resistance.

S. Bottone.

[69105.]—**Electric Battery.**—Scrub the zinc with a mixture of dilute sulphuric acid (one of acid, five of water) and sand, by means of an old tooth-brush; then pour on a globule of mercury, and work it about with the sand and acid. By this method I have perfectly amalgamated the oldest and dirtiest of zincs. I usually use the fingers instead of a brush, but some do not care for this way, especially if they have a cut finger.

Principia.

[69105.]—**Electric Battery.**—To Mr. F. W. Mason.—The mercury and sulphuric acid has to be rubbed on it, not simply immersing them in it. Use the following—it is much the best:—Mercury 1lb.; nitric acid ¾lb., hydrochloric acid 2¼lb. (Beware of the stench.) Simply immersion in this liquid is quite sufficient, and it is much to be preferred to the old method. There is also another method of amalgamation, but as this is my own invention I do not feel justified just at present making it public; but if you will advertise your address, I will write you with reference to letting you have a sample.

F. W. Mason.

[69106.]—**Electric Bells.**—Could be used.

F. W. Mason.

[69106.]—**Electric Bells.**— Your surmises are perfectly correct; but it would be better in every way to use shunt bells. W. Perren Maycock.

[69106.]—**Electric Bells.**—It is perfectly practicable to ring the bells in parallel in the mode described. Be careful to insulate the overhead wire, and to make a good "earth" for return. You will require several cells to work eight bells through half a mile—say 10 or 12 at least.

S. Bottone.

[69109.] — **Steam and Tide.** — The distance travelled would be the speed of the ship plus that of the tide. F. W. Cannon.

[69111.]—**Red-hot Water.**—Water at 212° Fahr. commences to expand into steam. No doubt, if a container could be made strong enough to resist its expansion, water could be easily made red hot.

F. W. Cannon.

[69116.]—**Area of Spherical Zone.** — Denoting by S the surface of the zone, of which r is the radius, and h the height measured along the axis, we have, by applying the operations of the calculus to the equation to the generating circle of the sphere—

$$S = 2\pi r h.$$

This is the usual formula given in books on mensuration. But, evidently—

$$h = r\,(\sin.\,\theta - \sin.\,\phi).$$

Hence, the formula obtained by "Snow Cap" is perfectly correct.

Charing. J. R. C.

[69116.]—**Area of Spherical Zone.**—I think "Snowcap" is in error. The circumference of a circle is $2\pi r$, where 2π is the circular measure of the angle corresponding to the arc. This expression for the length of a circular arc is true when 2π is any other angle. Therefore the length of the arc which bounds the zone is $r\,(\theta_1 - \phi_1)$, where $\theta_1\ \phi_1$ are the circular measures of $\theta\,\phi$. Turning $\theta_1\ \phi_1$ into angular measure, we have

$$r(\theta_1 \phi_1) = r.\,\frac{2\pi r}{360^\circ}\,[\theta - .\phi].$$

Multiplying this by the circumference of the zone $2\pi r$, we have, for the area of the zone—

$$\frac{4\pi^2 r^2}{360^\circ}\,[\theta - \phi].$$

Now $2\pi r$ in angular measure is $= 360^\circ$, and therefore $\frac{4\pi^2 r^2}{360^\circ} = 20626{\cdot}5$. Hence area of zone in square degrees is $20626{\cdot}5\ [\theta - \phi]$, $\theta\,\phi$ being the angular limit of the zone.

Camberwell. A. H. G.

[69117.]—**Rats.**—I have heard that a substance called "oil of rhodium" will attract rats; but, although I have tried at several druggists (wholesale and retail), I never could obtain it. Perhaps some of "Ours" could say what it is.

Principia.

[69117.]—**Rats.**—Rats are passionately fond of the oil of rhodium and oil of aniseed. We have sometimes put a drop or two of the former on a piece of meat, and the rats would come again and again to the same trap. It is a capital plan if you want to catch them. A. E. B. M.

[69117.]—**Rats.**—About two years ago I successfully exterminated a plague of rats from a cottage by catching a few, giving them a coat of tar, and then letting them go again down their own runs. I subsequently stopped all holes and runs with tar and broken glass; since then no rats have made their appearance. W. J. B.

[69117.]—**Rats.**—These vermin, like human beings, have their likes and dislikes, especially as regards odours. They abominate the smell of tar, while certain aromatic oils, as is well known, will attract them from long distances. So you can either repel or attract them as desired. Find their holes and smear them with tar, and in twenty-four hours there will not be a sign of them, nor will they return while the hateful scent salutes their olfactories. On the other hand, the potent attractive influence of rhodium, or to a less extent of oil of aniseed, has long been known, though it has been found possible to produce a compound scent which is not only more attractive, but cheaper. I have supplied this form to many of "ours," who are turning their knowledge to practical account. They mix the oil with meal to a paste, lay the pellets about on farm, &c., for a few nights till the vermin has been well attracted, and then, with the usual perfidy of the genus *homo* in dealing with the lower creatures, the next night mix arsenic with the paste, and "their guests no more depart." Quite a number are now making a good living in agricultural districts by this simple plan. If any of your readers think this information to compound the above oils would be of service, I shall be glad to send formula free—provided, of course, a stamp be sent for reply up to August.

Percy W. Stanley.

5, Billson-street, Poplar, London.

[69117.]—**Rats.**—I have had large dealings with these pestilent rodents in many lands, and will give you a few hints. *Poisoning.*—In outbuildings, at a distance from an inhabited house, feed them regularly with kitchen grease, suspending a large tin pot of the same near the rafters; daily examine it, and on finding that they consume it, replenish the contents, feeding them into confidence; then prepare a pot full of warm grease, stirring in thoroughly some finely-powdered white arsenic. Another plan. Get a very small old packing-case, break a few rough holes in the sides; get some phosphorus paste from a chemist. Rub some thin slices of bread with hot kitchen grease, when cold, smear them with the paste, and scatter the slices about inside the case. This is a very safe mode of laying poison, as nothing but rats or mice can touch it; leave a pan of water near the case, as they drink and then die rapidly. *Shooting.*—In a back yard, where rats are numerous, feed them on kitchen refuse strewed in a pig or poultry trough; set this so as to be raked by a gun; have a screen, or hole in a door, giving a good line of aim at 20 yards, feed them up till they congregate readily, then, on a moonlight night, have a peep at the marauders, and give them two ounces of No. 5 from a musket. One of my relatives picked up forty odd rats after a shot. *Preventive Treatment.*—Coal tar is very obnoxious to these vermin; after filling up all holes in walls and floors with broken glass and cement, watch for fresh intrusions, and with a brush kept ready in the tar-pot smear every hole and opening: a bunch of old rags dipped in tar can be put in the mouths of drains. When I did this, rats came out on the roofs in twos and threes, and could be shot by daylight. *Catching them Alive.*—The professional ratcatchers keep some tamed female rats; one of these, when in season, is placed in a wire cage near a suitable trap, into which the eager males enter and cannot return. In that amusing book, "London Labour and the London Poor," the ratcatcher's narratives of his profession much interested me. In Siam, where there is a large floating population, a huge male rat is kept in every boat with a bell hung to his neck, the pampered creature drives away all intruders of his own species. Smearing a live rat's fur with coal tar is used by sailors as a searching brush. Eos.

[69120.]—**Chamber Organ.**—There is hardly scope enough for great diversity of stops in "Prorsum Celere's" scheme; but if he insists upon a "stopped diapason" in the Swell, and a "dulciana" on the Great, he can select perhaps from the following as filling up:—

First Scheme.

Great.	Swell.
Open Diapason	Violin Diapason
Claribel	Stopped Diapason
Dulciana	Gemshorn, 4ft.
	Oboe

Second Scheme.

Open Diapason	Salicional
Dulciana	Vox Celeste
Flute, 4ft.	Stopped Diapason
	Dulciana Principal, 4ft.

Third Scheme.

Open Diapason	Gamba
Dulciana	Stopped Diapason
Flute Harmonic, 4ft.	Lieblich Flute, 4ft.
	Oboe

Fourth Scheme.

Open Diapason	Horn Diapason
Dulciana	Stopped Diapason
Wald Flute, 4ft.	Dulciana Principal, 4ft.
	Oboe

The couplers would be Unison Swell to Great, and Sub and Super-Swell to Great; Great to Pedals, and Swell to Pedals. The bourdon on the Pedals to break into a violoncello at the middle or 8ft. C, and have an octave coupler to use the violoncello independently; three compositions to the Great and Swell combined; no separate pedals to be used; the bellows to have parallel feeders.

Wm. Robinson.

In an article on "Reasons why Iron Water-mains Corrode if not Tarred," Mr. G. Weissmann—*Chem. Zeit.*—states that even if iron water-mains contain only traces of sulphur and phosphorus, they are readily corroded if not tarred. This is especially the case if the soil in which they lie be rich in organic substances such as humic acid, contain nitrates and ammonia compounds, or [illegible] saturated with water containing carbonic acid. Access of air is equally detrimental. It is a well-known fact that brine has no corroding action on iron tubes which are tarred, so long as the tubes are kept full. This applies equally to pure water.

Coloured Fires.—According to *Suàd. Apothek-Ztg.* the following mixtures produce lights [illegible] brilliancy equal to that of electricity. The cost [illegible] some of the ingredients would be objectionable, a [illegible] the usual precautions against explosions sho [illegible] be taken. The ingredients must always [illegible] pulverised separately, and only mixed by car sifting together. White fire.—Equal parts sulfonal and potassium chlorate in fine powder carefully mixed. Two grams furnish an int light. Lilac fire. — Lithium carbonate 5 p 20 parts each of sulfonal and potassium chlor each in very fine powder carefully mixed. V fire. — Magnesium metal, powdered, 8 p potassium bichromate 10 parts, and pota permanganate 16 parts, carefully mixed.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unan- ered for five weeks are inserted in this list, and if still answered are repeated four weeks afterwards. We trust r readers will look over the list, and send what information y can for the benefit of their fellow contributors.

Since our last, "Aurora" has replied to 68722; "Limax" 775.

632. To Mr. Stretton, p. 248.
641. Brick Arches, 248.
648. Setting up Watch and Clock Springs, 248.
650. Pivots and Pivot Turning, 248.
665. Weighing Water, 249.
666. Chloride of Lime, 249.
668. Surface Condenser, 249.
678. Foot Lathe, 249.
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860. Astronomical, p. 334.
868. Immersion Objective, 334.
871. Telescopes, 335.
872. Guarnerius and Amati Violins, 335.
880. Gramme, 335.
889. Curious Railway Management at Birkenhead, 335

QUERIES.

[69121.]—**Footpaths.**—"Nemo" will feel obliged if y of our legal contributors will answer the following estion. Can a local board or local authority legally pair or put in order or make a stiled footpath which as not been adopted by order of magistrates as a public ath, but which has been used as such from time immemorial?—JOHN PRESTON.

[69122.]—**Dynamo to Light ⅜ Arc Lamp.**—To R. BOTTONE.—Will you kindly give particulars for ynamo (please give both laminated, Paccinotti, and iemens H shape, saying how many laminations) to light arc lamp, ⅜in. carbons, about 4in. long. Is it necessary insulate each half of H armature, seeing they will be lready insulated by air space; but will be in connection t points where they are strung on? You can use wooden pindle, I suppose?—LIVERPOOL.

[69123.]—**Commutator.**—I have a dynamo to repair. s the insulation of the commutator is burnt out, could nyone tell me how to insulate it again, and what to use? -A. A.

[69124.]—**Pendulum.**—Will "F.R.A.S." kindly inrm me the length of a pendulum to beat sidereal seconds? ean-time seconds I have as 39·139in.; also whether the near expansion of steel is the same as iron, the coefficient f which I have as 0·00001225, and that of zinc as 0·00002944. -TEMPUS.

[69125.]—**Fur Cloak with Bad Smell.**—Will some ne kindly inform me of a remedy to prevent the evil odour rising from a fur (skunk) lined cloak? It seems as if the kins had not been well cured. I returned it to the erchant for him to prevent the smell; but I think he nly well soaked it with camphor, which, for a time, eutralised the smell; but it is now as bad as ever.—TOCKTON.

[69126.]—**Electric Bell Fixing.**—Will any practical lectric bell fitter inform me if it is necessary to solder the oints of the tubing enclosing the wires, or should they nly overlap? Should the wires be put in tubes when the atter are fixed, or after plaster is on the walls? Are the wires covered with indiarubber or guttapercha best to se inside tubes; and can any number be placed within without interfering with the insulation or currents?—TUBINO.

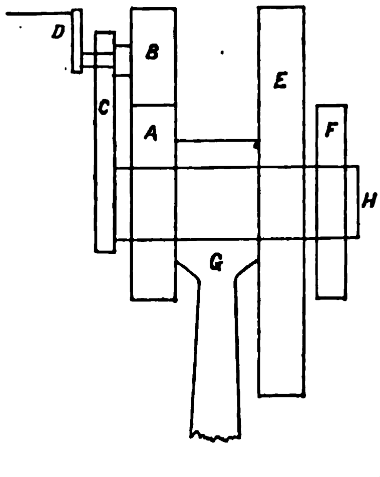
[69127.]—**Model Hydraulic Press.**—Will a brother reader oblige me with instructions how to make a model ydraulic press or jack similar in pattern to Tangye's 100-on lift worked by one man? I have searched back numbers, but fail to find any information on the subject. I wish the ram to be about ⅜in. in diameter. What is the mallest bore I may have for force pump to make model s powerful as possible? Any diagrams or information will be much esteemed.—T. W.

[69128.]—**Red Forehead.**—I am interested in a young lady who, when a child of nine years, fell down stairs, striking her forehead and bringing on brain fever. On recovering from the fever a swelling formed above her left temple, which did not break, but discharged through her left ear a little almost colourless matter. She completely regained her general health about three months after her fall; but her forehead becomes very red whenever she is heated or excited. She is now twenty-two, and is not subject to headache. I think if the capillary arteries and veins had a kind of contraction or impediment in them, such as we find in varicose veins, that might account for it, or it might show a tendency to some scrofulous disease. If there is any cure for it, I should be much obliged for advice from any scientific reader.—J. E. S.

[69129.]—**Geneva Watch Repairs.**—Will some of our brother readers kindly inform me the following? First, how to make and fit brass holes in Geneva watch-plates where jewel-holes have been broken. Second, I have had a clock to clean and repair, and there were three teeth out of one of the wheels, and I fitted the teeth in, and when I came to solder them in, the solder would not hold. Would some brother give me a few hints on soft and hard soldering; also, what is the best material for cleaning clocks and watches?—YOUNG WATCHMAKER.

[69130.]—**Domestic Silk Working.**—I have a quantity of Chinese cocoons, the silk of which I should be very glad to put to some use myself. Is there any domestic manufacture, the appliances for which would be easily made, in which one could utilise the silk, either for use or ornament? If there is, I should be glad to know the whole procedure, and no doubt others would besides, for the silk one gets by keeping silkworms might surely be made into some small thing at home. If I am advised to sell my cocoons, what is the probable value per pound?—VER A SOIE.

[69131.]—**Sun and Planet Motion.**—Will "T. C., Bristol," or any other reader of "ours" kindly inform me what pressure would have to be applied to the crank (reference to sketch) to give one horse-power off the pulley? A is a fixed tooth-wheel, having 80 teeth, and 8in. diameter; B is another toothed-wheel with 40, and 4in. diameter of pitch line; C is a crank fixed to shaft, H, which is 2in. diameter; D is another crank or handle, its centres being 2in.; E is a flywheel 16in. diameter, and 56lb. weight; F is a pulley 8in. diameter; G is a support, and forms a bearing, and is a fixture to the wheel, A H is the shaft 2in. diameter, on which is fixed the crank C, the wheel E and the pulley F. The crank D goes 200 revolutions per minute, giving 100 revolutions to the pulley F; the crank D receives pressure half a revolution twice during its one revolution round the wheel A. What pressure would have to be applied to the crank pin or handle D to give one horse-power from the pulley F at the speed mentioned?—LUMSIE.

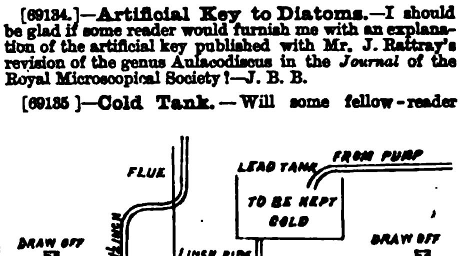


[69132.]—**Cripple's Carriage.**—I am writing to ask for help in a matter in which I am sure every English Mechanic would be glad to help. It is to build a carriage in which a young man of 26, from birth without the use of his legs, but healthy in other respects, might propel himself, or, if necessary, be propelled by others. I have seen in London a man with such a vehicle, evidently of amateur make, and I think I could design one myself, but my experiment might not be successful, and I should be glad to avail myself of the experience and assistance of others. Of course, if anyone had such a thing they could give out and out, I would thank them heartily; but if not, I should be glad of such ideas as a pattern-maker could use. The machine would be used by a poor man, and therefore I cannot entertain expensive plans.—PARISH PRIEST.

[69133.]—**Heating Apparatus.**—Will some reader kindly state the best means of heating a greenhouse (10ft. by 5ft.), and probable cost? Is there not an oil lamp made that would generate sufficient heat to warm a greenhouse of the size named?—W. H. L.

[69134.]—**Artificial Key to Diatoms.**—I should be glad if some reader would furnish me with an explanation of the artificial key published with Mr. J. Rattray's revision of the genus Aulacodiscus in the *Journal* of the Royal Microscopical Society?—J. B. B.

[69135.]—**Cold Tank.**—Will some fellow-reader kindly advise me what to do to keep water in tank from boiling?—CROFT.



[69136.]—**Drilling Machine.**—I want to make a simple and strong bench drilling machine. Will some reader please give me plan and information?—A COUNTRY SMITH.

[69137.]—**To Mr. Nelson.**—I have recently purchased an apochromatic ⅙ of Zeiss, and am not altogether satisfied with it. I have compared it with regard to its colour correctness with an old 1-5th of 100 aperture of Beck's. With this latter glass the secondary spectrum manifests itself as a pale straw colour and dark blue outline on an object, such as Arachnoidiscus Ehr. With the new glass the straw colour is replaced by a bluish-white, and the blue colour by a reddish-brown, which becomes offensive if the aperture of the achr. condenser is contracted. I have tested its resolving power with a D.D. of ·86 N.A., and find the two about equal. I come to the conclusion that the reputed superiority of these new glasses is hardly commensurate with their greatly increased cost. I also fail to discern any improvement in definition with the compensating eyepieces, though I think they are easier for the eye. I should like to know how far this experience is in accord with your own.—F. PAINE.

[69138.]—**Series v. Shunt.**—Would you kindly say what dynamo, shunt or series, is best suited for electric light on small scale, and why? I believe the series is the cheapest and easiest, is it not? Is it possible to have laminated F.M.'s, à la Jamin, only of soft iron instead of steel? It would not be so heavy. In a recent answer by Mr. S. Bottone he advises short thick F.M.'s, whereas in all Edison's dynamos they are of enormous length, and every dynamo that has been constructed invariably has more than two field-magnets. How is this? —J. T. F.

[69139.]—**Chromic-Acid Battery.**—I am about making a six-cell battery as above to work an induction coil. Is there any objection in having a single open tray instead of separate cells? I should make up same as for separate cells, two zincs, two carbons, ranged along the tray.—F. G.

[69140.]—**Leclanche Battery Construction.**—To MR. BOTTONE.—Will you kindly inform me if the carbon plates should undergo any preparation before lead cap is cast on them? Also what quantity of antimony should be used to 1lb. lead to insure contraction to the carbon plates?—CARBON PLATE.

[69141.]—**Analysis of Products of Combustion of Petroleum Lamps.**—Can any of your numerous readers oblige me with the analysis of the products of combustion of the ordinary petroleum lamp?—NAWS.

[69142.]—**Distillery.**—Can anyone recommend a good practical work on the arrangement of distillery buildings and plant, &c., giving detail as to costs?—WORM.

[69143.]—**Polishing on Lathe.**—How are small hardwood articles polished on lathe? I have seen a professional turner make a box, and polish it in about ten minutes. The polish was applied with a rag while the lathe revolved rapidly. I have tried French polish, but it won't stand more than a day or two. Have looked up what back numbers I have without success. At Portsmouth dockyard I have seen lignum pulleys polished with a mixture of beeswax and rosin, but I want something better than that.—IGNORAMUS.

[69144.]—**Battery.**—Can anyone inform what electric batteries there are that are acted upon by light? I made up one according to instructions some years ago, consisting of two sheets of tinfoil in pure alcohol, but could not get it to act at all on a galvanometer, which, by the bye, was not very sensitive.—TIME FUZE.

[69145.]—**G.W.R. Engines.**—Can anyone explain the following peculiar arrangement of numbers of G.W.R. engines? I see Nos. 3202-3209 just made at Swindon in the early months of this year, and No. 3,548 made at Swindon last November, and a number of goods engines between 2360-2380 made in 1886-88. Why do they number engines made earliest with higher numbers than those made later, as in 3548 and 3209? Have they made upwards of 1,100 new engines between 1886-89? I have never seen a G.W.R. engine with a number between 2529-3201. Is it possible that this erratic company skips over 500 numbers without making any engines to them? Perhaps anything out of the common is possible with the G.W.R.—W. E. C. B.

[69146.]—**G.W.R. Named Narrow-Gauge Engines.**—Can any reader give me numbers and names of narrow-gauge G.W.R. named engines besides the following?—55 Queen, 378 Sir Daniel, 381 Morning Star, 999 Sir Alexander, 1122 Beaconsfield, 1123 Salisbury, 1385 John Owen, and 1391 Fox?—W. E. C. B.

[69147.]—**To Mr. S. R. Bottone.**—I wish to convert the motor, described by you in § 26 of "Electro-Motors: How Made and How Used," into a shunt dynamo. What size and quantity of wire should I use on F.M. and armature? What power would it develop? What would be the size of an engine to drive the dynamo described in your book, "The Dynamo: How Made and How Used"? Would you kindly describe a method by which it could be driven (for at least one or two hours) by means of weight and pulleys? In what respect does the electricity of an induction coil differ from that of the Wimshurt machine? Why are not Fizeau's condensers used in connection with the induction machines? They are handy, and occupy less space than Leyden jars. How many square feet of the surface of a Leyden jar would make a man senseless, and how many would deprive him of his life?—J. SERRVAI.

[69148.]—**To "F.R.A.S."**—What is the history of the conception of the earth's motion round the sun? Ghias uddin Abul Fath Omar bin Ibrahim al Khayyam, otherwise known as Omar Khayyam, the poet-astronomer of Nishapur, died in 517 A.H.—i.e., 1123 A.D. No. 310 of his "Quatrains" is translated by Whinfield as follows:—

> "The wheel of Heaven, which makes us all afraid,
> I liken to a lamp's revolving shade,
> The sun the candlestick, the earth the shade,
> And men the trembling forms thereon portrayed.

Poetic license translates *fánus i khiyal* a Chinese or magic lantern by "revolving shade." But in any case the shade surrounds the light. This seems to me to bear distinct reference to revolution of the earth round the sun.—SHAIKH UL JABAL.

[69149.]—**Observatory Roof.**—Can any astronomical friends advise as to whether there is anything better for covering the roof of an observatory, which I am at present erecting, than well painted sail canvas? The framework is timber. Willesden cardboard buckles, and gets out of shape. Has the Willesden canvas any advantage over ordinary canvas when painted?—B. O. S.

[69150.]—**Sensitive Sound Alarum.**—I want to make a sensitive sounding instrument that will sound under a gentle pressure of steam. An ordinary whistle is not sensitive enough; the reeds of a mouth-organ would do; but the steam condenses on the metal, and the sound ceases. Can someone assist me?—CHAS. TURNER.

[69151.]—**Incandescent Lamp (Edison's).**—Some time ago a friend sent me one of these used in the installation at Paddington station. He said it was 20 candle-power. I have connected it with my 30 candle-power shunt-wound dynamo; but cannot get the filament even a dull red, yet the filament and connections are quite perfect. Is it possible to tell the voltage from the resistance it measures? What I mean is this. Suppose upon measurement the resistance is 100 ohms, would the voltage of same be 40 volts? Should I be able to measure the resistance in ohms. with ten No. 2 Leclanchés? How many chromic-acid cells, with zinc plates 8 by 2½in., would light it properly? Any assistance will oblige.—F.R.Met.Soc.

[69152.]—**Electric Light.**—Will some reader kindly help me? I have a steam-engine, 2in. cylinder, 4½in. stroke. Would it be large enough to supply power for lighting up shop with electricity, which has now seven ordinary gas-lights. What size boiler would it require? Some idea of the cost of dynamo, and about five small lamps for same.—Desirous.

[69153.]—**Aquarium.**—I have made wooden framework for an aquarium 2ft. long, 1ft. wide, 1ft. deep. Is it best to have slate back and sides, and glass front, or would glass all round be best? Please give recipe for cement that will stand water for putting up the corners, &c. Will 21oz. glass be strong enough for sides? If not, what glass will do? It will hold ten gallons. Any hints will be thankfully received by—C. A. W.

[69154.]—**Photographic.**—When I place my prints in water before toning there is not the slightest milkiness. What is the reason? Have used Lancaster's and the Edgware paper; but both are the same. Is the water too hard? I use spring water. Will a single combination lens take instantaneous portraits if the special extra rapid Ilford plates are used?—C. A. W.

[69155.]—**Sun Dial.**—Will "F.R.A.S." or other correspondent give an answer to the following problem? A vertical dial is to be fixed on the east side of a wall, bearing 87° 30′ E. (true), lat. 50° 48′, long. 1° 48′. Query: Angle of gnomon, and how many degrees the latter should incline to the south from the perpendicular, supposing the twelve o'clock line to be vertical. Should this line also incline? Dials out of the meridian do not appear to be referred to in textbooks.—F. C.

[69156.]—**Relaxed Throat.**—To "Eos."—There is frequently difficulty in swallowing solid food. The muscles engaged in gulping the food refuse to act for an instant of time, as if paralysed. The obstruction occurs sometimes before the act of gulping, and at others in the middle of it. In the latter case the sensation is very disagreeable, the food remains in the throat until the action is resumed, and the swallowing complete. Have had this difficulty for about two years; but very frequently of late. Medical adviser says it is owing to relaxed throat, and will disappear. In no case is there any pain: am thirty-one years old, very stout, and otherwise in robust health. Have been smoking for twelve years. Would "Eos" oblige by suggesting cure?—Ned.

[69157.]—**Deodorising Sewage.**—Can one of your correspondents advise as to the best and most economical means of deodorising the sewage of our house-drains? I reside on a deep clay, where the water which runs into the cesspool cannot percolate away. This is allowed to overflow into an adjoining ditch, creates a nuisance, and I desire before doing so to deodorise it. I may mention that I propose to keep back all the solid matter by filtering the water through a layer of gravel before deodorising it; and that fresh lime is not procurable readily and regularly where I reside.—A. D. R.

[69158.]—**Painting Lead Roof.**—I have lately covered a glass roof with 2lb. sheet lead. Will a good coat of white paint make it more lasting, and check the power of the heat upon it, and stop the oxidisation?—Quandary.

[69159.]—**Model Engine.**—To "T. C., Bristol."—I have a steam-engine, cylinder 1in. bore, 2in. stroke, flywheel 5¾in. diam., which I work with a boiler 6in. long, 2¾in. diam., speed 160 per minute, cut off ¾ stroke. Will you kindly tell me the probable power, and if it would drive a model dynamo; power required 1-10H.P.; also if flywheel and boiler are right size?—A. R. B., Meran.

[69160.]—**Jewelry.**—I have hard-soldered a gold catch on a gold brooch with silver solder; the brooch is fine gold, and the catch is 9ct. gold. I want now to colour it, to bring it to its bright colour again. What should I colour it in, and would any reader tell me how to make gold solder?—Three Legs.

[69161.]—**Waste Tin.**—Can any one tell me how to get the tin from waste tin plates? There are people who make it their business; but I have been unable to obtain any information as to the process?—Herbert W. Wilson.

[69162.]—**Engine Query.**—Will some reader kindly tell me what sized pair of cylinders (working at a pressure of 30lb. to the square inch) it would take to work a 4½in. screw-cutting lathe? I shall be very glad of a sketch of an upright copper boiler, showing size and thickness of top and sides, shape of firebox, number of tubes, and place of water gauge, and place of manhole. I shall be very glad if you could name a place where I could get proper copper rivets for small boiler making.—W. A. H.

[69163.]—**Dynamo.**—To Mr. Bottone.—Am I asking too much of you to furnish me with particulars for a small Brush dynamo to light twelve 16c.p. 100v. lamps in series? Would this be a very difficult machine to make? Please state size of A., also F.M. and wire for shunt. Would 22c.c. do. for A., as I have a lot by me? Say best mode of fixing ring. A sketch would be a great help.—Mc.S.

[69164.]—**Damp Cellar.**—Being compelled to use such a place for my workshop, I am desirous of knowing what way I may exclude the damp. Already I have covered the sides and ceiling with match-boarding, and closely boarded the floor, but my tools go as rusty as ever. Any information will be gratefully accepted by—A. B.

[69165.]—**Bunsen Cells.**—I have three Bunsen cells, which I charge with aquafortis for the inner solution. On connecting it up with a six-volt lamp I can run it for a space of five or six hours; but owing to the objectionable smell, I wish to dispense with nitric acid and use chromic instead. I have used sulphuric and water about half and half, and then added as much chromic as it appeared to take up, but I cannot get the lamp to run for above a minute. I should be glad if some one would help me out of my difficulty.—Bunsen Cell.

[69166.]—**Brewing.**—Would any gentleman kindly inform me how to brew 10gal. of light bitter beer, similar to lager? Should prefer it brewed from sugar. Please say if German yeast will do to ferment. I have saccharometer (glass one), thermometer, earthenware cask, and fermenting mug.—W. Timpson.

[69167.]—**Insulation Resistance.**—I am in charge of an installation of over 300 16c.p. incandescent lamps. The wires have been in six years, and I am afraid, through position of wires and quality of covering, we have not a fancy insulation resistance. As near as I can get at it—I can't get all lamps off and test leads separately—we have an insulation resistance of about 600 ohms between leads. My object in writing is, we are at present using an alternating machine giving 110 volts. If we were to put in a direct-current machine giving same E.M.F., would there be any danger of our wires being eaten away by electrolytic action?—Practical.

[69168.]—**Enamelling Oven.**—Can any of "ours" give me the particulars how to make an enamelling oven, about 6ft. square, for the purpose of enamelling iron castings black? The size of them are about 48in. by 36in. by ⅛in. thick. Details of the processes will also be acceptable.—Enamelled.

[69169.]—**Telephone.**—To Mr. Bottone.—I wish to make and fit up a telephone on the same principle as the "E. M." telephone. Would you kindly tell me how I could connect transmitters and receivers at each end of the line—distance about 100yds.? Could I use an ordinary electric bell at each end of line to call attention, and could they both be worked on the same wire, as I wish, if possible, to make one wire do, making a good earth connection at each end? I should feel obliged if you will show me how to make the connections. Could I use anything in place of parchment or goldbeater's skin for the diaphragms, as I find it a difficult job to get and keep them tight enough? Should the magnets be hard steel and magnetised, or soft iron rod? How many Leclanché cells should I require to work it? Any useful hints will oblige.—J. R.

[69170.]—**Telegraph.**—I have made a small telegraph and am not able to connect up so as to work both needles at once from one transmitter. Will any reader kindly explain this?—E. E. B.

[69171.]—**Speed Regulators.**—In the "E. M.," June 7, 1889, p. 293, is a very valuable article on speed regulators, &c., by "F. C."; but I cannot understand from where he gets his figures, unless he assumes the values of some of the letters in his mind. Will "F. C.," or one of "ours" kindly answer the following? In the middle of second column is found "and $v^2 = 0{\cdot}010966\,.\,N^3\,.\,(a\,.\,c)^2$." 1. What does 0·010966 represent? "Replacing v^2 by its value in previous expression $b\,c = \frac{g\,.\,(a\,.\,c)^2}{v^2} = \frac{2935{\cdot}55}{N^3}$." 2. What does 2935·55 represent? "And $H = 12\,.\,b\,c = \frac{35226}{N^3}$." 3. How are 12 and 35236 produced?—Georgetown.

[69172.]—**Electrical.**—Will Mr. Bottone or other electrical readers inform me the proper way to connect an 8 volt 5c.p. lamp to a 5-cell battery of the double-carbon single-zinc type, elements 5 by 3in. in cells, 5 by 3¼ inside. I have about one yard of No. 15 copper wire connected to terminals of battery. To try the lamp I hooked on to one of the platinum lamps the wire from one pole, and on to the other loop the wire from other pole of battery. The light I gave was certainly not the light of five candles, not more than 2½c.p., I should think. There appears to be a good current, as it drives an electro-motor with 1in. armature, Siemens type, first rate. Would the current waste by being connected so badly to lamp? Also what would be about the resistance in ohms of the 5 cells.—L. J. G.

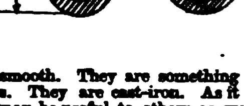
[69173.]—**Dynamo.**—To Mr. Bottone.—Please give dimensions for a 20c.p. dynamo, after the pattern given in reply [67760]; also the quantity of wire and gauge?—H. Ely.

[69174.]—**Cocaine.**—Would some reader give the exact directions for making and taking the solution of cocaine as recommended in "Ours" for sea-sickness. I wish to make a quantity, so that I can try the effect on myself or anyone willing to take it.—A Jersey Man.

[69175.]—**Camera Stand.**—I shall be obliged if some kind reader of "Ours" will give me dimensions and diagrams of a ¼-plate camera stand. One folding up into small compass for carrying about.—J. K. Byron.

[69176.]—**Delta Cygni.**—I should be much obliged if Mr. Sadler or other kind friend would state the present measurement and position angle of the companion to Delta Cygni? Webb gives the angle as 30·9°, but quotes "K 348·3°," and "De 330·1°." Surely a very wide discrepancy!—Beta.

[69177.]—**Turning.**—Can any reader give me practical instructions how to turn and chuck in a lathe an object similar to sketch? I have three to turn out. They must be exact and smooth. They are something like tops of large eggcups. They are cast-iron. As it is an uncommon job, it may be useful to others as well as myself. I am much pleased with article on "Making Model Locomotive" in your paper, and would like to suggest similar papers on, say, carpentry, &c.—La Franck.



[A good series on Carpentry is now appearing in the *Building News.*—Ed.]

Holloway's Pills are especially recommended to all annoyed by tender bowels. A source of constant weakness if not indicative of danger. Diarrhœa, flatulency, nausea, spasms, and distention yield to the extraordinary power this purifying medicine exerts over digestion and those subservient functions which extract the food's nutriment for the body's maintenance.

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for illustrations on separate pieces of paper. 2.
to queries, and when answering queries put the
as well as the titles of the queries to which the
refer. 3. No charge is made for inserting letters,
or replies. 4. Letters or queries asking for
manufacturers or correspondents, or where
articles can be purchased, or replies giving such
tion, cannot be inserted except as advertisements.
question asking for educational or scientific
is answered through the post. 6. Letters sent
spondents, under cover to the Editor, are not
and the names of correspondents are not
quirers.

*** Attention is especially drawn to Hint
space devoted to letters, queries, and replies is
the general good, and it is not fair to occupy it
tions such as are indicated above, which are
vidual interest, and which, if not advertisements
selves, lead to replies which are. The "
Column" offers a cheap means of obtaining
tion, and we trust our readers will avail them

The following are the initials, &c., of letters
to Wednesday evening, July 24, and
elsewhere:—

W. P. Thompson and Co.—Medical Battery
Cornwall Polytechnic Society.—C. C. E.—F
W. H. F.—W. A. Ross.—Raymond.—E.
Baker.—Laundry.—Holland Reader.—T. S.
—G. Cowper.—J. L.—Meteor.—C. F. D.

Column. (The query has been answered many
the two columns are to be of the same
solid one will obviously be the stronger.
columns are to have the same weight of
hollow one will then be the stronger; but
will then have a greater diameter than a
containing as much metal.)—Subscriber.
of filling barometer tubes has been frequently
The tube must be thoroughly clean, and in the
the bent tube, such as is used in the wheel
the mercury must be jerked over the bend
long leg is filled. It may be necessary then
tube to drive out air-bubbles; but that can
carefully warming in the flame of a spirit
Cousin. (If you refer to "Firework
Amateurs," by W. H. Browne (London:
Gill, 170, Strand, W.C.), you may find what
Apparently it is a sort of grenade; but as
to "fire" by merely striking some substance,
necessary to use a fulminate, and no
needs to ask such a question should
attempt the construction of such "fireworks."
neer. (Most of the textbooks of Chemistry
For instance, Miller's "Elements of
Part I., Chemical Physics. There is, so far as
no special textbook dealing with the subject
(We have frequently explained that any one
patented article for the purposes of experiment
it is used for beneficial purposes—to save time,
or money — such user becomes infringement
patentee's rights. You can use a mechanical
or that form of Bell's which is known as the
Mechanic telephone.)—Sophocles. (You can
ably obtain the information required from
6, Dowgate-hill, London, E.C.; but please
above, especially No. 4.)—W. C. (Several
in back numbers. The only effectual remedy
electric needle.)—Leicestershire. (Very likely
this paper, as the volumes contain about
useful in connection with the lathe.)—A.
Bennett, or tinpot, battery was fully described
XXXV., soon after it was patented. A
will be found in No. 895, and many notes about
volume mentioned.)—Novice. (No one can
seeing the telescope. Surely in Leeds there
optician who can show you how to use the
and as to your friends and "nothing under
miles," you may tell them there are few
objects that are not more than a million miles
earth, and that "coming within its focus" has
to do with it. Look up your back numbers and
book which treats on Optics.)—Gena. (Does
description referred to answer? If not, there
of information about electro-motors, which
may be electro-locomotives, in back volumes.
diagrams in back volumes, and compare
nections with them.)—Enquirer. (Blake's
used—that and the Gower-Bell. All have been
See indices and a series of articles commenced
1201.)—Photographer. (If you mean large
see p. 433, No. 1163. For details of the process
indices; several processes have been given
(You will find the register of the Company at
House; the rest of the information you had
from the secretary—it is no business of
(When you give your name and address, and
in support of your story, we will publish it.
this kind, based on "I was told," &c., &c., and
anonymously, will not upset the Darwinian
—L. J. G. (All the preparations and drugs you
are, in our opinion, harmful. Only quacks
and irregular—believe that you can dose the
body with phosphates after such a fashion
The physician of the future will use few
Chas. P. Bols. (We fear the makers of the
houses referred to were a bad lot; at any
advise you not to trouble to hunt them up.
(We do not insert questions of the kind; you
to a good patent agent or lawyer for an
to what you may manufacture without
United Telephone Co. down on you.)

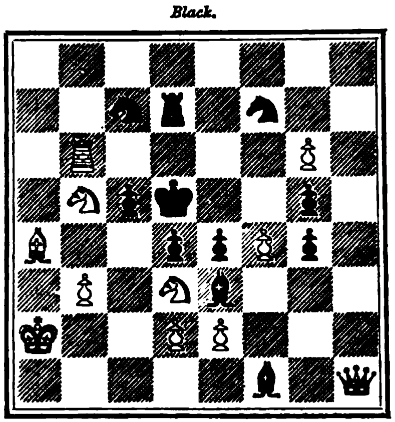
Every Nerve and Muscle of the
strengthened by wearing HARNESS' ELECTROPATHIC
has restored thousands of sufferers to perfect health
known cure for Nervousness, Debility, Rheumatism,
Liver and Kidney Diseases, Ladies' Ailments, &c.
advice free on application to the MEDICAL BATTERY
52, OXFORD-STREET, LONDON, W. (corner of Rathbone
These who cannot call should write at once for

CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLIX.—By J. C. Bremner.

Black.



White. [11 + 11

White to play and mate in three moves.

Solution to 1,157.

White.	*Black.*
1. B-Q sq.	1. K-Q 2 (a).
2. Kt-K 5 (double ch)	2. K moves.
3. Q or B mates.	
	(a) 1. K-Q 4 (b).
2. Kt-K 5 (dis ch), &c.	
	(b) 1. B-K B 5 (ch), or Kt-K B 5, or Q B 5, or Kt-Kt 6, or B 7.
2. Kt takes B (ch), or Kt-Q B 5 (ch), &c.	

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,157 by W. Gleave (triple and two duals: these spoil an otherwise grand problem), J. Bryden (ditto), J. Ough (ditto), T. A. Pringle (two duals), W. L. Martin (ditto), H. C. Haycraft and Fr. Fernando; to 1,156 by J. Kistruck, J. H. Vickers (Newcastle), J. G. Hankin, Othello, H. Warren, Retchford (Penzance), J. E. J. Smith, R. T. Hood, Bernard Green, J. W. Read, and H. G. Walsh.

H. C. Haycraft.—Your problem has a second solution, 1 Q-Kt 5. The white force is too strong. Try again, and next time send the position on a diagram.

J. G. Hankin.—In your attempt at 1,157 how do you proceed if 1. B-B 5 (ch) ?

The Art of Eating.—There is little if any doubt that cooking has been employed by man in the preparation of food from the remotest ages. It is probable also that empirical ideas of what conduces to comfort in diet early formed the basis of a gastronomic art not without some relation to physiological truth. It has been reserved for later times, however, and for civilised man, to discover and formulate a regular method of dining. By a process of natural selection, the work of elaborating this system has in great measure passed into the hands of our French neighbours, who have thus been able to develop an art characteristically their own. Our simpler national customs relating to the table have, in common with those of most other peoples, attracted less attention, though it is not likely that they will ever disappear. It is needless here, however, to discuss in detail each local peculiarity. We should rather aim at understanding those common principles which underlie all rightly constituted systems, and give to each its value as an aid to wholesome nutrition. The time of eating is a matter of no small consequence. This is, to some extent, subject to individual convenience; but we may take it that, as a general rule, not less than five hours should separate one meal from another. The short interval of rest usual after meals will commend itself as being in strict accordance with physiological necessity. The quantity and quality of food taken also require careful attention, and these again must be regulated by reference to the work to be done by a given person. Some difference of opinion has always existed as to the proper daily allowance of meat. We shall probably do justice to the digestive powers of most persons, however, by advising that only one substantial meat meal be taken daily. More than this would tend, if continued, to overload the tissues with digestive products, and less would hardly suffice for full nutrition. Drink, if alcoholic, should be sparingly taken, or not used at all. Cookery has in these days been elaborated almost to excess. Variety and delicacy are carried to an extreme, and we should probably gain rather than lose if plainness, combined with care, were adopted as our rule of practice in such matters.—*Lancet.*

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Yes, the Ruptured will still find Dr. SHERMAN at his London Office, 64, Chancery-lane, where his wonderful success draws the afflicted from all parts of England, and where you and all others should go who entertain the hope of ever being cured. Send for his books, English and American, post free, 6d., and inform yourselves.—[Advt.]

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Important.—All kinds of **Scientific Properties**, Apparatus, Instruments received for others or cash by A. Caplatzi Chenies-street, Tottenham Court-road.

Wanted, Portable Forge, Anvil, Surface Plate, 1H.P. Vertical Boiler, for new Domestic Machine or Oil.—Monkhouse, 7a, East-street, Bromley, Kent.

I offer 40in. Ellis **Facile** or **Knitting Machine** in exchange for Lathe.—Wellesley House, Colchester.

I offer 40in. Ellis **Facile** or 52in. **Roadster** in exchange for second-hand Circular Treadle Saw.—Wellesley House, Colchester.

Wanted, Model Hot Air Engine. Will give exchange, Electrical and Mechanical.—E. Thornton, Stafford-street, Barrow-in-Furness.

Printing Press and Type, &c. What offers? Bicycle, Harmonium, or Drapery.—*Eagle* Office, Daventry.

Bicycle, 56in., double roller bearings, worth £2, for Rocking Horse, moderate size, or C Clarionette, anything useful.—Wm. Knott, Chadwick-street, Marple, near Stockport.

Exchange offers wanted for **Galvanic Machine**, 6 Musical Instruments, 12 Medical Works, &c., &c. List, stamped envelope.—43, Shirley-street, West Brighton.

Wanted, small Hand Barrel Organ, secular tunes. Exchange.—H. Penn, Watton, Herts.

Pair of 6in. **Iron Rolls**, screws, frame complete. Exchange old lead to value 30s.—K., 41, Latimer-road, London, W.

Pair of strong 6in. **Lathe Heads**, T-rest, 20ft. leather strap, chuck screws, &c. Exchange old lead to value 25s.—K., 41, Latimer-road, London, W.

Wanted, Campbell's Favourite Melodeon, fair condition, in exchange for splendid Electric Bell Set, value 10s. 6d., new.—Address, Thales, 31, Carlisle-place, Manningham, Bradford, Yorks.

Double **Vertical Engine**, 3in. stroke, 2in. bore, pistons fitted with rings. Exchange to value of £3.—G. Walker, Diggle, near Oldham.

What offers for **Dulcimer and Case?** Wants a few new wires, full size, mahogany frame, very good-toned instrument.—C. Wooding, Grendon, Northampton.

Medical Coil, very powerful, six powers, regulating tube, switch, handles, improved bichromate battery, complete, quite new, highly finished. Offers to 50s. value.—Address below.

Wimshurst (pretty) **Machine**, new, 17in. discs, 4 jars, latest pattern. Photo. and particulars, 4 stamps. Exchange to £4 value.—Randle, Melton-street, Kettering.

Horizontal Engine, 1½ bore, splendid make. Also powerful Induction Coil, Battery, and Appliances. Exchange for Astronomical or Mathematical Instruments value £4.—Cattell, Hill-top, West Bromwich.

Boiler, 3H.P., complete with all fittings. Will exchange above for Drilling Machine or Screwing Machine, or Engineer's Tools.—Kellett, 21, Thornton-street, Brixton, S.W.

Tricycle, Humber, front steerer, 40in. wheels, balls all over, suit lady or gentleman. Above has hollow rims. What offers?—Kellett, 21, Thornton-street, Brixton, S.W.

Exchange the following:—2 Daniell **Batteries**, Coil, 10 Carbon Plates, "Spon's Workshop Receipts." In want of Bunsen's or Pint Bottle Bichromate Batteries for lighting.—Address, George Barrass, 37, Bromley-street, Hull.

Silver Geneva, silver dome, jewelled, excellent order, suitable for youth. Exchange Cloth (trousering), anything.—W. D., 56, King-street, Dudley.

Self-acting **Fountain**. Exchange for Waterbury Watch or Tools.—C. R., 54, George-street, Reading.

2 cast-iron 20in. **Pulleys**, with four hangers, and g.m. bearings. Wanted, Square Glass Jars, Indicators.—23, Parade, Acton Vale, W.

Set Billiard Balls, new, Lathe Flywheel, and Crank, "Popular Educator," complete, miscellaneous books. Wanted, Air Gun, Cricket Sundries, Umbrella, anything useful.—80, Netherwood-road, Hammersmith.

Wanted old foreign and colonial **Postage Stamps**. Will give good exchange. No recent issues excepting high values required.—Collector, 125, Coltman-street, Hull.

Offers in exchange for **Book on Furniture**, House-Fittings, and Decorations, 1,200 engravings, cost 3 guineas, as new.—Baker, Ringwood Houses, Coalville.

Wanted, strong Tricycle, in exchange for 6 gold-plated Watch Key Pendants, 4 Albert Chains, and part cash.—Mills, 14, Bostock-street, London, E.

Saloon Pistol, by Reilly, of Oxford-street, with cartridges, for a good Lathe Wheel.—Turner, 13, Harman-street, Kingsland-road, London.

10-light **Dynamo**, by Jones, Lambeth, perfect order, ¼-view Lens, by Ross, 200c.p. Sunbeam Lamp. Offers invited.—Braun, 1, Kilburn-square, N.W.

Bicycle, 52in. quite new, silver-plated, by Coventry Co. Useful exchange to £5.—Pearce, Kent House, Crystal Palace-road, S.E.

Lathe, 4in. centre, 3ft. bed, iron frame, 5-speed turned wheel, various chucks. Exchange to £6.—Pearce, Kent House, Crystal Palace-road, S.E.

Locomotive Model, with two cylinders and lamp, copper and brass boiler. Exchange offers wanted.—Pearce, Kent House, Crystal Palace-road, S.E.

Whitworth-thread **Stocks and Dies**, for 1in., ⅝in., and ⅜in., plug and taper taps to each. Useful offer wanted.—Pearce, as above.

Screw-cutting Lathe, bed 5ft. long, with gap, planed up, quite new. Exchange to 50s.—Pearce, as above.

Telescope, by Curragh, London, 30in. long, night or day; also Opera Glass, very good. Useful offers for either.—Pearce, as above.

Microscopic Object.—New pine Cabinet, containing 72 best mounted microscopic objects, all popular subjects. Offers requested.—W. White, 17, York-street, Nottingham.

Boiler wanted, 1H.P., vertical. Will exchange a Book Case, full of splendid books, as good as when new. Over 100 in number.—C. Tarr, 5, Providence-place, Aycliff-street, New Kent-road, S.E.

Banjos, two, nickel-plated, German-silver keys, with all the latest improvements, inlaid handles, one five string and seven; cost £2 5s. each, value 35s. each; also two half-horse Horizontal Engine, quite new. Exchange for small lathe, any article. Six inch Lathe, value £3, bargain. Exchange.—F. Sopwe, No. 1, Russell-grove, Vassal-road, Brixton, London.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

New Illustrated Price List of **Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

Billiards or Bagatelle, or Requisites for ditto, or Billiard Work.—Hennig Bros., High-street, London W.C.

Manchester Electrical Stores.—Medical Coils, Magnetos, Bells, Cells, Wires, Fittings, Chemicals. Best terms.—J. Bentley, 7, Newton-street.

Electric Depot, 14, Deansgate, Manchester.—Handiest shop in the trade. Largest stock. Greatest variety. Lowest price.

Microscopy.—Instructive list of really high-class botanical preparations, with sample, 2d.—Walter White, Litcham, Swaffham.

Cyclists.—Use "Graphine" on your chains; no grease, will not hold dust, 8 stamps, free.—Wolff and Son, Falcon Pencil Works, Battersea, S.W.

"**The Amateur.**" A paper for Fretworkers, Carvers, Inlayers, Painters. Sixpence monthly. Lists of latest designs free on application.—Henry Zilles and Co., 24 and 26, Wilson-street, Finsbury, London, E.C.

Safety Bicycles, superior make, warranted all ball bearings, from £10. Catalogue free.—Hanson Brothers, Settle.

Lard Oil, 3s. per gallon.—69, Commercial-street, E.

G.M. Fittings, cheapest house in London.—69, Commercial-street, E.

Cyclists.—Anti-vibration Safeties, Tandem Safeties, and Tricycles. Send for list.—Bradford Cycle Co., Ltd., Bradford, Yorkshire.

Bellows for Cameras, all kinds. Price list, 1d.—J. Thomson, Camera Maker, Portgordon.

Write for **King, Mendham and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

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6d. prepays three insertions of a 20-word advertisement in *Morning News*, Belfast. Established 1855. Specimen free.

Hats made easy. Braces made perfect. Fits all sizes. Six stamps,—T. Rawson, Heaton-lane, Stockport.

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The **Above** contains all information, and is illustrated from photographs of the finished engines.

Two New Features introduced.—Triple-expansion Engines and Bent Steel Crankshafts are entirely original novelties.

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We Court Comparison for novelty of design, finish of engines, and quality of castings.

Models of every description repaired and put in working order.

Lucas and Davies, Mechanical and Scientific Model Makers, 21, Charles-street, Hatton-garden, London, E.C.

Who is Hilsdon? The cheapest Gun manufacturer in the world. For catalogues address, Sparkbrook-buildings, Folkestone, Kent.

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Smoke Knight's Herb Tobacco.—Splendid flavour, delightfully fragrant. Neither injurious (like ordinary tobacco) nor expensive. Quarter pound (nearly), 7d. post free.—Knight, Druggist, Portsmouth.

Rack and Wheel-cutting, in steel or brass, correct work only.—Oppermann, 55, Spencer-street, Clerkenwell.

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Boilers, from one-horse-power upwards.—Vertical, Portable, Cornish.—Crank and Iron Company, Limited, Grantham.

Unbleached **Violin Strings,** tone pure, strength marvellous; six for 12 stamps.—Craven, 39, Jamaica-road, S.E.

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Make your own Ink.—No trouble. All colours. 1s. per oz., posted.—Ashton, 14, Market-place, Manchester.

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Model Engines.—Finished Parts, Castings. New Catalogue, with illustrations, post free, 6d.—Mills, Tintern-street, Sunderland.

Lathe Castings. New illustrated catalogue of plain and screwcutting, post free, 3d.—Mills, Tintern-street, Sunderland.

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Note this.—Cheap **Cycle Fittings and Frames.** Quick despatch. Illustrated catalogue.—Pentagon Cycle Company, Holloway-road, London.

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Photographic Sets, Magic Lanterns, and other Apparatus supplied. State requirements.—Henry Ebbage, 344, Caledonian-road, London.

Launch Engines, 6in., 4½, and 3in. bore. Boilers, Lathes, all kinds of Machinery at reduced prices.—S. Smith.

Propellers, improved pattern, 12in. to 30in., in stock. Stuffing Boxes and Shafts.—S. Smith, 11, West-street, Soho, W.C.

£20 **Competition,** easy for all, cash prizes guaranteed. Full particulars one stamp.—Marshall, Plynlimmon-road, Hastings.

Strong back-geared **Headstocks,** bored, planed, 3in. 12s. 6d.; 5in., 21s. Particulars, stamp.—Jarratt, Queen-street, Leicester.

Notice.—An Engine without flywheel or connecting rod, three-horse, £30.

Above new Patent **Engine** only occupies space 24in. by 12in. by 12in.

A Six-horse **Engine** to occupy space of 28 by 15 by 15, price £44.

Above may be driven by any ordinary boiler. On view.—Britannia Co., 100, Houndsditch, London.

Special **Steam Boilers** heated by gas burners at less cost than a gas engine.

A first-class **Gas Engine,** nearly one-horse, on brake, £35. Call.—Britannia Co., 100, Houndsditch, London. All letters to Britannia Works, Colchester.

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Malleable Iron Castings, by new process, clean, sound, and tough as steel.—Dronfield Casting Co., Sheffield.

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Large **Magneto Machine,** in mahogany box, all complete, but wants adjusting, 6s.—See below.

Horizontal Engine, cost 52s. 6d., good as new, ⅜in. bore, 1in. stroke, reversing gear, splendid condition, take 30s.—118, Broad-street, Reading.

Astronomical Telescope.—Apparatus and parts made to order.—A. Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

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Palmer's Renowned Prescriptions, 2s. 6d. Cure quickly Urethral Diseases, &c. Thirty years' celebrity. Blood purifying pills included.—Above.

Amalgamating Brushes, Scratch Brushes, Polishing Sand, Calico Mops, Rouge, and Lime Compositions, Nickel Salts, and Anodes.—Henric.

Gold, Silver, Copper, and Nickel-plating **Solutions.** Practical Hints, 1 stamp.—Henric, 234, Great Colmore-street, Birmingham.

Cut Your Own Clothing Systematically.—Enormous saving.—Particulars, James Hopkins, Practical Cutter, 3a, Chestnut-road, Tottenham.

Scientific Draughts enable anyone to cut any size or style guaranteed. Full printed instructions.—Above.

S. Bottone, Carshalton, supplies the following Electrical Books and Apparatus. Invaluable to Electrical Amateurs and Engineers.

"**Electric Bells and All About Them.**" Bottone's new book, post free, 3s. Indispensable to bell fitters.

"**The Dynamo: How Made and How Used,**" 2s. 6d., post free. Fully explained, illustrated, fifth edition.

"**Electrical Instrument Making** for Amateurs," with 60 illustrations, post free, 3s. Third edition now ready.

Dynamos of the Highest Efficiency, from 15s. to £20; for lighting, plating, cauterising, and experimental work.

A beautiful little **Dynamo** that lights easily two six-volt lamps, post free in box, 15s. 9d.

Castings and Parts of all the Motors and Dynamos recently described in the English Mechanic supplied.

Wimshurst Machines from £1. Accumulators, 5s. per cell. Box Batteries, £1. Sample tin Chromic Acid, 1s.

Dynamo Castings.—Beautiful sets for 5c.p. Dynamos, finished ready for wire, 10s. each; warranted efficient.

Punchings for laminated armature, from 1½in. to 8in. in diameter, from 4s. to 50s. per gross.

Ammeters, Voltmeters, Galvanometers, 5s. each. Tangents, 10s. Standard Ohms, 2s. 6d. Bridges, 5s. List, 1½d.—S. Bottone, Carshalton.

Moulders' Letters! Moulders' Letters!! From ¼ to 4in. Send for reduced price list.—Leaney, Langton-road, Brixton.

Water-Motor, drives any light machinery, price 5s.—Walton, 9, Queen Anne-street, Shelton, Stoke, Staffs.

Handy **Pair of Steps** and useful Long Ladder combined, 10s. 6d.—Taylor and Co., Driffield. Lists free.

Cuca.—Are there any who have not yet tried the glorious effects of the sacred leaf?

Cuca.—Its marvellous properties and virtues are beyond compare. Try it at once.

Cuca.—By its use mental worry and physical fatigue are unknown. Send for testimonials.

Cuca.—Sample packet, with medical and scientific opinions, 13 stamps.—Marks and Co., 17, Newcastle-street, Farringdon-street, E.C.

A 6H.P. high-pressure double-cylinder **Engine and** Boiler, with 75 tubes, shafting, two propellers, stern tube, valves and cocks, steam gauge, injector, feed pump, and fittings, all complete. Wheel and Steering Gear, awning and stand-irons, four cushions, everything complete for a 40ft. launch, all in good working order, to be sold cheap.—For particulars apply to J. S., 332, Strand, London, W.C.

Cyclists. — Several new Centaur Co.'s Coventry Safeties. List price £17, reduced £12 10s.—Inwood, Cyclist, Gravesend.

Bown's new square rubber **Ball Pedals,** 14s. 6d.; Spring-back Lamps, 3s. 6d.; Alarm Bells, 1s. Bargains.—Above.

Fretwork Machine, partly finished, suit amateur to complete, 30s. Strong Elliptic Chuck, good condition, only 12s. 6d. —G., 21, Stratford-place, Camden-square.

21-16in. **Achromatic Telescope,** with terrestrial and astro. eyepieces, powers 30 and 50, good definition, only 25s.—William Nicholl, Roslea, Clones.

Engine Castings and Forgings, complete set, for 2-horse horizontal engine, cylinder bored, £3.—H. Pestell, Hayward's Heath, Sussex.

Chisel Steel, extra best quality, for granite, 15s. per cwt.—Gilbert, Oxford-road, Sheffield.

"**English Mechanic,**" nearly every back number in stock, 2½d. each, until September.—Sladen, Cank-street, Leicester.

Superior small screw-cutting **Foot Lathes,** new, very cheap.—A. Halls, Cobholm Tool Works, Yarmouth.

To be sold, **Patent for Boot-cleaner,** page 369, Vol. XLIX.—Harris, King-street West, Manchester.

Useful Domestic Invention, for part cash, part royalty.—Harris, 2, King-street West, Manchester.

For sale, one of Watson and Sons' **Magic Lanterns,** quite new, never been used, cost £5, with 4in. condenser, in case complete. Will take £3 for it.—Apply, Wm. J. Fowler, Chorley Wood, Rickmansworth.

No More Restless Nights.—A Boon to Travellers. No parasite comes near the Obeah packet of African herbs, 6d.—Wentworth, 74, Bunbury-street, Nottingham.

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he English Mechanic
D WORLD OF SCIENCE AND ART.
FRIDAY, AUGUST 2, 1889.

MACHINE FASTENINGS.

'OWEVER carefully a machine may be - designed in regard to the strength of parts, the labour will be thrown away if per consideration has not been given to fastenings by which they are connected. s question of fastenings, important as it ı work of a purely structural character, omes far more complicated in its bearings n machinery, as the effects of vibration, cussion, and sudden reversals of pressure have to be taken into consideration.

lmost the whole of the connections to which are now referring are made by means of ts and nuts, and upon their manufacture l adaptation to their work depend the ety and the durability of the machines of ich they form parts. Tensile and shear- strains are those to which bolts are ıally exposed, but under some circum- nces cross-bending strains may fall upon m. In regard to the material to be used bolts and nuts, strength, elasticity, and iability are the three qualities called for a high degree; in the matter of choice of n and steel we rather incline to the former being less liable to crystallise than the ter, unless the quality of steel is very ld, for the tendency of the vibrations and ıcussions occurring in machinery is all in our of causing crystallisation.

n some tests made at Shifnal last year we l round iron from $\frac{5}{8}$in. to $\frac{3}{4}$in. diameter aking at something over 24 tons tension sectional square inch, and showing an ngation before fracture of 22 per cent. and wards, and larger iron up to $2\frac{1}{4}$in. break- ; at from 22 to 23 tons per sectional square h, with elongations of 30 per cent. and wards. This gives an idea of what may asonably be specified, and it is no use signing work upon a basis of strength that not readily attainable, and 22 tons per ctional square inch ultimate tensile resist- ce may be taken as a standard for iron lts, and the working resistance per sec- onal square inch should not exceed 3 tons r tension and for shearing stress.

The proportions of the bolt have to be termined according to the nature of the rain to which it will be subject. If the stress in the direction of the length, the resistance the head to shearing off, and that of the read to stripping must be equal to the sistance of the body of the bolt at the least ameter to tensile rupture. In machine lts generally the least diameter will be at e bottom of the threads. As the same orking stress is adopted for tension and earing, the areas of rupture must be the me for both. The area to be broken in nsion is in square inches, $0{\cdot}7854\,d^2$, if $d =$ e diameter in inches, and the area to be eared in stripping off the head is $3{\cdot}1416\,d\,.\,t$, $t =$ thickness of head in inches, therefore, r equal strength $3{\cdot}1416\ d\,.\,t = 0{\cdot}7854\,.\,d^2$, hence $t = \frac{d}{4}$. It is, however, a very usual ractice to make the thickness of the head ual to the diameter of the bolt, this usage robably dating from the days when bolt eads were made by welding a collar on stead of pressing out of the solid; it is, owever, a waste of material to put so much ı the head. In the thread-resistance to ripping there is a loss in the rounding at he bottom of the thread, which in the Vhitworth bolts and nuts extends about one uarter of the depth, this will cause a loss of urface in length, a little under 25 per cent., o that the thickness of the nut requires in this case with V-threads, to be one third more than that of the head, or about $\frac{d}{3}$; here, again, in practice the nuts are in thickness generally made equal to the diameter of the bolts. In this connection it must be admitted that this excess of strength in the nuts is quite justifiable if the threads are formed in dies, when the metal is not fairly cut away, as is done when the thread is properly cut in a machine or chased in a lathe, but partly scraped off, and partly squeezed up, and the metal generally crushed and weakened. When fairly-cut square threads are used, the least thickness of nut must be half the diameter of the bolt. The diameter of the bolt-head and nut over the sides must be enough to allow a sufficient bearing surface upon the metal on which they press; this also we shall take at 3 tons per square inch of bearing area, and the bearing surface allowed will be that of the circle inscribed within the hexagon or square which forms the perimeter of the head or nut (as sometimes the parts outside of this are rounded off), less the area of the bolt-hole. Let d_1 = the diameter of the bolt-hole, and D = the diameter of the nut measured over the sides; then the bearing area will be $= 0{\cdot}7854\ [D^2 - d_1^2]$, and this must be equal to the sectional area of the bolt itself; $0{\cdot}7854\ d^2 = 0{\cdot}7854\ [D^2 - d_1^2]$; whence $D = \sqrt{d^2 + d_1^2}$. A bolt 1in. in diameter in the solid would cut down to nearly $\frac{3}{4}$in. at the bottom of the thread, so in this case $D = \sqrt{1^2 + \frac{3}{4}^2} = 1{\cdot}25$in.; but 1·75, the diameter of the bolt, is nearer to custom. From this it is seen that the present workshop practice, where it does err, does so on the safe side, so far as the proportions of bolt-heads and nuts are concerned. If a stud is screwed into cast iron, the depth to which it reaches must be at least twice that indicated for the thickness of the nut, as cast iron has not more than half the resistance to shearing exhibited by wrought iron. For reliability, bolts are far preferable to studs when they have only cast iron to hold to; but sometimes the latter are unavoidable.

Knowing that there is ample margin of strength in the heads of nuts, the working strength of the bolt in tension will be measured by its sectional area of the bottom of the thread, and will be equal to $0{\cdot}7854\ d^2 \times 3 = 2{\cdot}356\ d^2$ in tons. When the bolts are used in resistance to shearing force, the whole area will generally be available, and the outside diameter will be taken, the factor (2·356) remaining the same as for tension. There is an advantage to be pointed out as belonging to square-threaded screws over those with V-shaped threads, which is, that the threads on the bolts and in the nuts bear very nearly in the direction of the longitudinal strain upon each other, whereas with the V-threads the strain is at a considerable angle to the surfaces of contact, and therefore a bursting stress is brought upon the nuts; there will, in fact, be a pressure parallel to the surface of the threads nearly equal to half the longitudinal strain.

In addition to the proportioning of the bolts and nuts to their work, we have also to consider the way in which they are used by the erectors in putting a machine together, the most common fault, especially with inexperienced and young mechanics, lies in a tendency to screwing them up too tightly. They do not sufficiently consider the enormous multiplication of power that is afforded by a screw-thread, and it will therefore be as well to show by a little calculation what it may mean. Suppose we have a 12in. spanner to tighten a nut upon a 1in. bolt. The pitch of the thread on that bolt will be $\frac{1}{8}$in., and the force exerted on the nut in a longitudinal direction will be to the force applied to the end of the spanner as the path described by the latter in one revolution is to $\frac{1}{8}$in.; the multiplication of force, then, is equal to $3{\cdot}1416 \times 24 \div \frac{1}{8} = 603{\cdot}187$. Twenty-four inches is the diameter of the circular path described by the end of the spanner. If, now, 20lb. pressure be applied to the end of the spanner, the longitudinal force upon the bolt will be $603 \times 20 = 12{,}060$lb. = 5·43 tons nearly. At the bottom of the thread the diameter of the bolt is about $\frac{3}{4}$in., giving an area of 0·44sq.in. in cross-section, so the stress per sectional square inch would be $5{\cdot}43 \div 0{\cdot}44 = 12{\cdot}34$ tons, which would probably exceed the limit of elasticity of the material, and so permanently stretch and injure it. Of course, this 20lb. is in addition to what is requisite to overcome the friction of the nut upon the bolt. The amount of tightening that should be done upon a nut depends upon the duties of the parts of the machine it is used to connect; in some cases mere solid contact is sufficient, while in others it is necessary to put a considerable stress upon them; but in no case should a stress higher than that decided upon as the working resistance (3 tons per square inch of sectional area) be put upon them. When any stress is put upon a bar of metal, that metal will be extended, by reason of its elasticity, to an amount proportional to the stress to which it is submitted, and, provided the limit of its elastic action is not exceeded, it will on the removal of the stress return to its former length and form; this extension is not much, but it is appreciable, and is very visibly shown in the deflection of girders, and if in the case of bolts holding parts—such as, for instance, the bearings of a main-shaft—together, a force comes into action tending to separate those parts, the bolts will, if previously unstrained, be extended and the joint partially open. On the removal of the force the joint will close again, and it is very easy to see that if this action is continuously repeated, as it would be in a steam-engine, a destructive knocking would be set up that would soon ruin the bearings. In order to avoid this, the nuts must be tightened up until there is as much strain upon them as will be brought into action when the machine is at work, then the action will be as follows:—In tightening the nut we stretch the bolt proportionately, and we also compress the metal beneath it, so that this latter presses upwards with the same force as the bolt pulls downwards, and the bearing-cap and plummer-block are compressed against each other. Now, when the force tending to separate them comes upon the upper bearing, the compression of the plummer-block and cap is eased, the tension of the bolt being taken up on the rod through which the new force acts; but the cap is not raised from the plummer-block, because, being formerly compressed, it extends as it is relieved from the pressure, the plummer-block doing the same, and so both remain in contact if the new force due to the working of the machine does not exceed that previously put upon the connecting-bolts. In the first condition the bottom of the cap was pressed by the bolts against the top of the plummer-block, and in the second the top of the cap is pressed against the underside of the nuts; but it is evident that no further stretching of the bolts can occur until the strain already upon them is exceeded, and, therefore, the joint cannot open, and no knocking will ensue.

This kind of action will occur where the bearings of the main shaft divide at right angles to the direction of the stroke, and it will also appear in the crosshead bearings, and in all places where the direction of the force is at right angles to the division of the bearings. Also in the holding-down bolts of single-acting pumping-engines in which the cylinders are anchored down by a load of masonry to resist the upward pressure of the steam upon the cylinder cover. There will, of course, be numerous places in different classes of machines where primary tightening is necessary, for the reasons explained above;

but these will be obvious in view of the conditions here discussed.

Some idea of how far to screw the nuts down after the metal is in solid contact may be gathered from the following calculations, which would apply to any case, with the necessary alterations of dimensions. For different materials numbers have been found, known as the "modulus of elasticity"—this is the weight which, if such a thing were possible, would stretch a bar of the material to twice its length; the number, which is calculated from experiments within the limits of elasticity is convenient for calculating extensions, for the extension is to the length of the bar in the ratio of the extending force to the modulus of elasticity, which is given for a bar 1in. square. The modulus for wrought iron is 24,900,000lb., and the tension we wish to put upon the bolts is 3 tons per sectional square inch = 6,720lb. Hence we have 24,900,000 ÷ 6,720 = 3,705 as the ratio of length of bolt to its extension. We have also to allow for the compression of the cast-iron cap and plummer-block. We must find the relation of the area of the surfaces in contact at the bearing to the sectional area of all the bolts: we will assume the bearing surfaces of the cast iron to be six times the area of the bolts, then the pressure per square inch would be 6,720 ÷ 6 = 1,120lb. The modulus of elasticity of cast iron is 18,400,000lb. The amount of compression for a given weight is the same as its extension, so, proceeding as before, we have for the cast iron 18,400,000 ÷ 1,120 = 16,428; the sum of the two fractions of which these numbers (3,705 and 16,428) are the denominators will be the total extension required: it amounts to 1-3045 part of the length of the bolts; let this length be 10in., then the extension required will be 1-303 part of an inch nearly. Keeping to the 1in. bolt with a thread of $\frac{1}{8}$in. pitch, the fraction of a turn necessary to be made after the metal is in contact will be 1-38th. The length of the circular path of the end of the 12in. spanner is 24 × 3·1416 = 75·4in.: hence the distance through which the end requires to be moved is 75·4 ÷ 38 = 2in. nearly.

Assuming this as an approximate computation, acting upon it will safeguard us from overstraining the bolts, and if the tension should be found insufficient to prevent slight knocking, we can tighten the nuts a little more; but we have this guide, that every 2in. that the spanner is moved puts a tension of three tons per square inch of sectional area on the bolts.

The nuts having been screwed down to the proper position, means must be taken to retain them there. One plan consists in drilling a hole right through the nut and bolt, to prevent the former from turning; then, as the bearings wear away, the difference must be made up by liner washers under the nuts, for it would not do to go on drilling the bolts through for every new position of the nut, and the arrangement of liners is objectionable, as it does not allow of the same closeness of adjustment as the nut itself would give. Another method consists in putting a lock-nut upon the top of the working nut, and jamming it down hard. If this is done, care must be taken that the lock-nut is not forced down sufficiently to take the bolt tension off the working nut; in which case it would be left slack and useless, and act merely as a washer between the lock-nut and the cap of the bearing.

It must not be supposed, however, that bolts always become slack by the nuts turning, for it is most probable that the bolts themselves may gradually lengthen under the continuous stress, although it is well within the limit of elasticity, for, under conditions of constant vibration, the molecules of metal have every opportunity of rearranging their relative position, and, if they are subject to a high temperature at the same time, such slackening is by that facilitated.

When rods are working upon studs or bolts which act as dead-centres, the stress upon them will be either shearing or bending: if the vibrating or revolving element on the stud is close up to the frame in which it is fixed, simple shearing stress will result; the working strength of the stud or bolt will be $= 3 \times 0·7854\ d^2 = 2·356\ d^2$ tons, or if the stress be given, and it is required to find the diameter of stud necessary to carry it, let $S =$ the stress in tons. Then $S = 2·356\ d^2$; therefore, $d = \frac{\sqrt{S}}{1·535}$.

If, however, the bar is at some distance from the frame in which the stud is screwed, there will be a bending strain. The strength of a round bar to resist cross breaking varies as the cube of its diameter. The breaking weight of a bar an inch in diameter, projecting 1in. from its support and loaded at its free end, is 4,200lb.; therefore, if $d =$ the diameter in inches, and we take 7 as a factor of safety, the safe stress S will be, if $x =$ the distance of the point of application of the stress from the support; $S = \frac{600\ d^3}{x}$, whence $d = \frac{\sqrt[3]{S\ .\ x}}{8·43}$.

There are also cotters used in some cases to fasten the parts of machines; but the circumstances in which they appear are different from those of the joints treated above, and their adjustment must generally be a matter of touch. To enter into this matter, however, we have no space at our disposal here.

THE PRODUCTION OF SODIUM.

THE importance of a cheap method of obtaining sodium is well known to those engaged in several industries, and the records of the Patent Office show that many ingenious inventors have devised methods which they considered worth protecting according to law. Below we give one which Mr. H. S. Blackmore, of Mount Vernon, Westchester Co., N.Y., has recently patented in this country, and in his specification the patentee says that it consists in intimately mixing about twenty-seven and one-half pounds of calcium hydrate, $Ca(OH)_2$; thirty-one and one-tenth pounds of ferric or ferroso-ferric oxides, or a mixture of both; thirty and nine-tenths pounds of sodium carbonate (dry); and ten and one-half pounds of carbon in the form of charcoal, coal-dust, bitumen, coal-tar, or other carbonaceous matter. This mixture is placed in an iron cylinder and gradually heated in a furnace until it attains a low red heat, at which temperature it is kept for from fifteen to twenty minutes. The temperature is then raised until the cylinder is white hot. The metallic sodium in the form of vapour escapes through a delivery tube into a receiver, where it is condensed, while the carbonic oxide and hydrogen gases, which also escape at the same time, are allowed to pass on out of a vent, where they are burned. The above weights are only given as examples, as the patentee does not follow them strictly, for when more of the ferroso-ferric oxide is present than ferric, a less amount of the mixture of the oxides is required, and an additional amount of carbon or carbonaceous matter, &c. The weights have also to be varied more or less for good or poor material. The calcium hydroxide or hydrate, $Ca(OH)_2$, acts upon the sodium carbonate (Na_2CO_3) at a low heat, forming calcium carbonate and sodium hydroxide (NaOH).

As the heat is raised, the carbon or carbonaceous matter present decomposes the calcium carbonate, forming calcium oxide (CaO) or quicklime and carbonic oxide, which, being a gas, passes off. The carbon or carbonaceous matter at the same time also decomposes the ferric and ferroso-ferric oxides present, forming metallic iron and carbonic oxide. The nascent metallic iron in its finely-divided state then immediately unites with the oxygen of the sodium hydroxide (NaOH), forming the oxides of iron, and setting free hydrogen gas and metallic sodium, which pass off in the form of vapour. The metallic sodium having been thus driven off along with the hydrogen and carbonic oxide, the residue consists of calcium oxide (CaO) or quicklime, mixed with ferric and ferroso-ferric oxides. This has only to be mixed with water, which again forms the calcium hydroxide, $Ca(OH)_2$, the ferric and ferroso-ferric oxides being present, and all that is necessary for another charge is to mix it with the requisite amount of sodium carbonate (dry) and carbon, bitumen, coal-tar, or other carbonaceous matter. The iron in this process acts merely as a carrier of oxygen from the sodium hydroxide to the carbon. This can be proved by the iron existing in nearly the same state at the end of the process as when it was started—that is, if too much carbon has not been used, in which case the iron oxides are more or less reduced to the metallic state. The only difference being, perhaps, a little more of the ferroso-ferric oxides than ferric, or *vice-versâ*.

There may possibly be a few other chemical compounds formed in this process, but they are of minor importance, and do not tend to aid or retard the process in the slightest. It is much preferable to use some hydrocarbon or mixture of hydrocarbons, such as bitumen, coal-tar, &c., in this process, inasmuch as they not only aid in decomposition, &c., but the lighter hydrocarbon products, volatilising and distilling over with the sodium, serve to protect it from oxidation, which often takes place, even with the greatest care. Sodium has been manufactured from sodium hydroxide by the action of metallic iron with the aid of heat; but in that process the sodium hydroxide has to be made and then separated from waste products. It is then mixed with iron filings or turnings, &c., and fused. The difficulty in this process seems to be that the sodium hydroxide fuses and becomes liquid at a heat sufficient to decompose it; the iron, having greater specific gravity, naturally sinks to the bottom, and thus retards the process.

In the patentee's process all this difficulty is obviated. First, the sodium hydroxide is formed and decomposed all at the same time, thus economising the time which other processes take up dissolving out and evaporating the fusing. Secondly, the ferric and ferroso-ferric oxides, being of less specific gravity than metallic iron, do not settle down so easily, and the calcium oxide and carbon or carbonaceous matter present tend to hold the oxides in suspension. Thirdly, the iron oxides being decomposed in the mixture leave the nascent iron in a finely-divided and thoroughly mixed state, thus rendering the decomposition of the sodium hydroxide more thorough and perfect. Still further, the waste-product or residue has only to be mixed with a little water in order to slake the calcium oxide, and we have the calcium hydroxide and iron oxides mixed in the same proportions as when we started the process, all else necessary, after drying, being to add the requisite amount of dry sodium carbonate and carbon or carbonaceous matter, and proceed as before. Thus we see that the iron oxides and calcium salts may be used over and over again, with but little loss.

SOLIDIFYING PETROLEUM.

ALTHOUGH many attempts have been made to solidify petroleum—to simplify its transportation mainly, but also with other objects—few, if any, have come into extensive use. A patent has been obtained recently by Mr. Grünbaum, of Stratford, Essex, which has for its subject matter a method of solidifying petroleum and other explosive oils. To carry his invention into effect the patentee solidifies petroleum by the admixture of glutinous or gelatinous matter, such as glue made from fish by the process of boiling, until it obtains the consistency of a stiff paste, with which, if required, all kinds of cheap and suitable combustibles, such as sawdust, lime, carbon, turf, textile fibres, bark, or leaves of trees, or other rubbish, are mixed, in order to effect a slow combustion, as also for the purpose of counteracting that peculiar and offensive odour common with petroleum. This composition is compressed into suitable shape or forms in order to render it practical for the purpose of cooking, heating, and lighting. The solidified petroleum paste is thus a safer (non-explosive) method of transporting the oil, and permits, on arrival, of having the oil extracted again for commercial purposes, the residue to be used as a fuel by itself, or it may be mixed with other combustible waste. The proportion of gelatinous or glutinous substances to the oil for making this paste are in no way restricted, depending entirely on the special

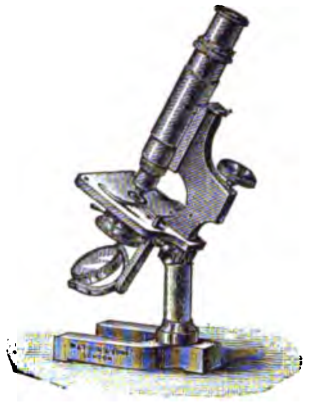

Fig. 1.

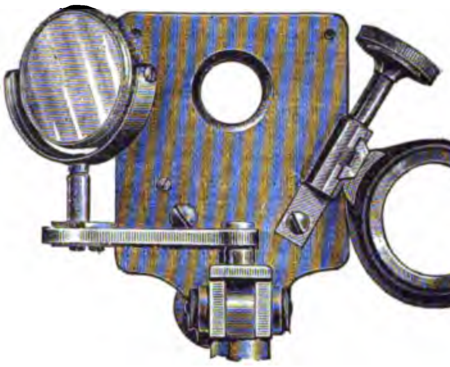

Fig. 2.

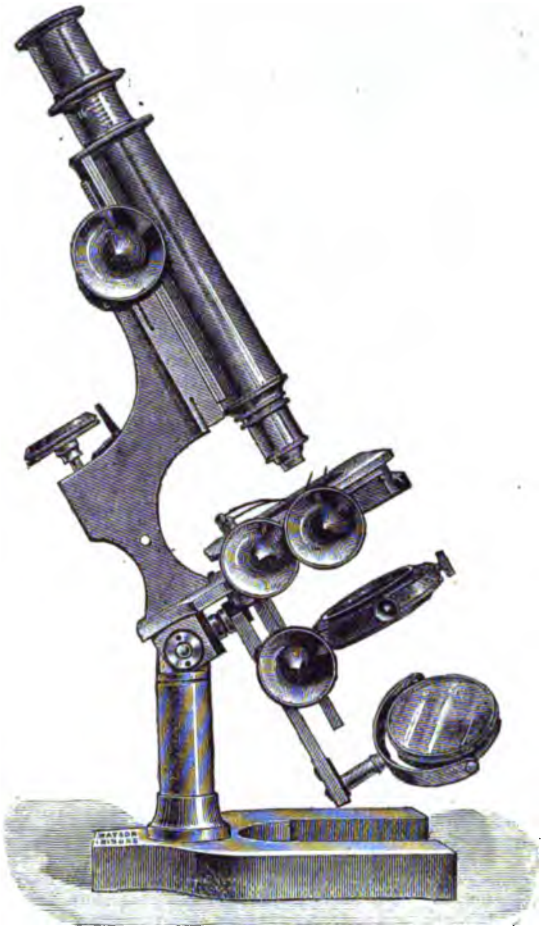

Fig. 3.

requirements—that is to say, if the oil-paste is intended for a long transport, a high percentage of the ingredients may be preferable, while in the case of this solidified oil-paste being intended only as fuel, pure and simple, for cooking, lighting, and heating, then from 4 to 6 per cent. of the ingredients are sufficient. The admixture of combustible waste with this paste for economical and other purposes is entirely optional, and may be in proportion of three to four parts of solids to one part of solidified oil-paste.

THE EDINBURGH STUDENT'S MICROSCOPE.

IN the annexed engravings we illustrate the "Edinburgh Student's Microscope," recently introduced by W. Watson and Sons, of 313, High Holborn, London, on lines suggested by Dr. Edington, Lecturer on Bacteriology, Edinburgh University. The instruments are made in several numbers, and are specially intended for students; but the amateur will also find in them a convenient and first-class microscope. Fig. 1 shows the instrument in its simplest form, with sliding body for coarse adjustment. It will be seen that the Continental horseshoe foot has been adopted; also the body tube is of the Continental size, fitted with draw-tube, which, when extended, gives the full English length of 10in. A point that specially struck us was the perfection of the fine adjustment—a part often neglected in instruments of Continental make. The rotation of a milled head acting on a lever moves the entire body, and that with no perceptible resistance. It is beautifully sensitive, and as a tenth of a turn of the milled head only moves the body the 1-3000th part of an inch, a most precise adjustment can be made. Another point is the hanging of the under-stage, fitting on a pivot so that it can be lifted aside with a condenser in it, and direct light from the mirror obtained at once. Fig. 2 is a view of the underside, and shows the way in which it is done. This is a distinct advantage, and workers with the ordinary form of instrument, in which the condenser must be withdrawn if direct light from the mirror is required, will at once appreciate it. The stage of the instrument is 3½in. square, permitting of the use of large slips. The eyepieces supplied with the instruments are nickel-plated to prevent tarnishing of the objectives, to the manufacture of which Watson and Sons pay special attention, and they are above the quality usually sold for students' purposes.

There are five different forms of the instrument—A, as Fig. 1; B, similar, but with rack-work coarse adjustment; C, fitted with a compound sub-stage, with screws to centre and rack to raise and lower; D, same as C, but fitted with an exquisite mechanical stage (Fig. 3). The fifth form is for petrological work, and is fitted with all necessaries for this department of investigation.

The idea that any microscope will do for a student is not encouraged by Messrs. Watson and Sons, and their endeavours to supply students with a really high-class instrument will, no doubt, meet with practical approval. The Edinburgh student's microscopes are throughout of the highest quality.

We have also seen a form of the Abbé Illuminator, now so popular, of Messrs. Watson's make, intended to go with these instruments, rendering them very complete, as it will work with objectives of the highest angular aperture.

THE PARIS EXHIBITION.—III.

Prof. Elihu Thompson's Experiments—The Phonograph and Graphophone.

IN a former article I have spoken of the Thompson electrical welding process. We will now examine some other curious experiments and applications of the actions produced by alternating currents, and which were repeated by M. Abdank at his lecture on Thompson's experiments.

An electro-magnet is excited by an alternating current dynamo giving about 30 ampères in the circuit of the electro-magnet, and having about 250 alternations per second. These successive inverse magnetisations give a sound which gives an idea of the period of the machine. With this electro-magnet several interesting experiments may be performed. If we hold a disc of copper over the pole of the electro we shall experience a very strong repulsion, and if we let go the disc it will fly away from the pole. During this experiment the disc gets very hot. These effects are due to the induced currents in the metallic mass. If we now hold the metallic disc of copper over the pole of the magnet supporting the disc so that it may turn about its centre, we shall experience the repulsion of the disc from the pole and the creation of heat; but there will be no rotation, because there is perfect symmetry in the horizontal components of the field. Let us now interpose a metallic screen between the pole of the electro-magnet and a part of the disc. The forces which act upon the latter are no longer symmetrical, and the disc assumes a movement of rotation. A ball of copper placed over the magnet, or in a beaker of water over the magnet, may be made to rotate in the same manner.

Prof. Elihu Thompson has employed the actions of alternating currents in the construction of a very interesting motor. The current from the alternating dynamo is sent into this motor, which begins to rotate just as any ordinary electric motor would do. The speed of rotation increases, and the humming sound of the motor gets higher and higher, the period of magnetisation of the motor getting more and more rapid. Now, at a given moment, the sound of the motor will come into unison with the sound of the dynamo; this indicates that the motor and the dynamo are working synchronously. If at this moment we remove the brushes of the motor and short-circuit the induced bobbins, the motor will continue to work in virtue of the repulsions, which have been illustrated by the simpler experiments of the rotating disc, &c.

Coming back to the alternating electro-magnet with which we began these experiments, we can make an experiment showing a very simple example of an electrical transformator. An incandescent lamp is connected to a flat spiral of insulated wire, and is placed in a beaker of water over the electro. Immediately the electro-magnet is excited, the lamp takes a fixed position in the beaker and glows. We have here a simple transformator, the first element of which is the electro-magnet, and the second the spiral of wire connected to the lamp.

Near Prof. Thompson's installation, in the American section, we shall find Edison's phonograph and Tainter's graphophone. Our readers know that in these instruments, which are perfected phonographs, the vibrations of the voice are inscribed on a cylinder of wax by means of a style fixed to a diaphragm of mica. Two styles are used, one for the inscription of the sounds, and the other for their repetition. The former is a sharp style which cuts the forms of the vibrations into the wax. The latter, on the contrary, is a smooth point which runs in the furrow made by the first style, and repeats the sound. In Edison's new phonograph the regular rotation of the cylinder is obtained by an electro-motor. In Charles Sumner Tainter's graphophone, the motion is produced by a pedal worked just like a sewing-machine. (A centrifugal regulator is used in both instruments.)

These instruments, I need hardly say, give much better results than the old form of phonograph, and when well regulated the scraping noise inherent to them may be reduced to a minimum, and all kinds of sounds reproduced with the greatest delicacy. The wax cylinders are easily removed from the instruments, and can be sent from one place to another just as a letter. This was, of course, possible with the inscription on tinfoil obtained in the old form of the phonograph.

C. Detaille.

RECENT THERMO-MOTIVE ENGINES.

RECENT experiments on petroleum-spirit engines by Mr. Yarrow, and aqua-ammonia engines by Mr. McGovern, have recalled the attention of engineers to the relative values of different media for the conversion of heat into mechanical work, and revived the interest excited thirty years back by the performances of the Du Trembley engines, wherein ether was used to augment the amount of work obtained from the fuel, the ether being evaporated by the heat of the exhaust steam, and acting in an auxiliary cylinder.

It is a mere common-sense definition that the theoretical efficiency of a heat-engine is represented by the fraction used of the total heat contained in the expansive medium, and therefore the greater the range of temperature between the entering and exhausting vapour or gas, the greater should be the efficiency. This will not, however, apply, without some collateral considerations, in all cases. For instance, in a steam-engine working solid—that is, without any expansion—the temperature of the exhaust steam will be the same as that of the entering steam, and therefore if thermometric values alone were taken, there would be no efficiency, and therefore no work done. But work is done, and therefore heat used, which is indicated by condensation in the cylinder, more than a cylinderful of steam being furnished from the boiler during each stroke.

Passing from the theoretical to what we will term the commercial efficiency of the engine, we have to consider the proportion of added heat which is converted into mechanical work. If the whole of the heat imparted to the machine could be utilised, the engine would be, commercially speaking, perfect, and it is towards this end that the attention of the practical and constructive engineer must be directed.

The theoretical formula makes no difference for differences of media of conversion of heat to work; but under practical conditions it has been shown that in the interests of economy the physical character of the converting medium should be taken into careful consideration.

The fact that the Du Trembley ether engines of thirty years back were ultimately abandoned, is no proof of the inefficiency of the system itself, mechanical difficulties in the way of leakage militated against its success, the loss of an expensive medium such as ether would counterbalance the heat saved, and furthermore its vapour, when mixed with air, being explosive, its use was a source of common danger to those employed about the engines and boiler. As time has progressed, means have been found to execute work in a more perfect manner, and the result is shown in the absence of any notable loss of spirit used in the petroleum engines referred to. The petroleum also does not evaporate at so low a temperature as ether, the relative heats of evaporation at atmospheric pressure being 130° and 101° Fahr. There is one very great practical advantage to be noticed which petroleum vapour possesses over that of ether, which is, that it is itself a lubricant, and so preserves the working parts from wear, whereas ether is a solvent of grease, and its use therefore calculated to lead to excessive friction and correspondingly increased wear of the working parts

In Mr. Yarrow's experiments upon the comparative efficiencies of steam and petroleum spirit vapour the conditions were such as to eliminate criticism; the gas-burner that supplied the place of a furnace, the boiler by which the heat so supplied was taken up, and the engine operated being the same throughout, both for water and petroleum. so that in this case the results are to be accepted without any allowance whatever. The duration of each experiment was three hours, the pressure at the end of that time being brought to what it was at the commencement. The gas burnt per hour was, for steam, 82·2c.ft.; for spirit, 83·48c.ft. The actual work done per minute as measured by a brake was, steam, 2,524ft.-lb.; spirit, 4,722ft.-lb. The efficiency is in direct ratio to the work done, and in inverse ratio to the fuel consumed; therefore the efficiency of spirit to that of steam in these experiments was as 1·84 to 1. The indicator diagrams worked out to 11,950ft.-lb. per minute in the case of spirit, and 5,199ft.-lb. per minute in the case of water; the ratio found from these quantities being 2·26 to 1 in favour of spirit. For all practical purposes, then, we may put down the efficiency of spirit as twice that of water under the conditions of the experiments. It may be mentioned that separate sets of pipes were used for steam and spirit, so that there could be no admixture, and when spirit was being used it was heated in a copper coil placed within the boiler, in which steam was raised for the other set of experiments, so that the method of taking up the heat from the gas-burner in one case was identical with that in the other, the heat when spirit is used passing through the water in the boiler to the coil, and it may be noted that when the pressure of steam in the boiler was 30lb. per square inch, that of the spirit in the coil was 55·8lb. per square inch. In these investigations the engine was not worked expansively; therefore the relative economy under expansive working is not yet experimentally determined.

Some commentators upon the results of the experiments under consideration have hastened to suggest that when worked expansively the spirit will not exhibit so great a superiority to steam; however this may be at very high rates of expansion, the spirit has at all events a very good start to commence with, as we shall now show. Between the brake results and the indicator cards the efficiency of the spirit in the experiments may be taken as twice that of the steam. We will see what rate of expansion of the steam would be requisite to make its efficiency equal to that of the spirit working non-expansively. If r = the rate of expansion, p_1 the initial pressure, and $p\,m$ the mean pressure of the steam, then, by the usual formula for mean pressure—

$$p\,m = \frac{1 + \text{hyp. log. } r}{r} \times p_1$$

If, then, the work obtained from a given quantity of steam working solid is to be doubled by expanding it, it is evident that—

$$r \times p\,m = 2 \,.\, p_1.$$

Therefore—

$$r = \frac{2 \,.\, p_1}{p\,m}$$

$$= 2 \times \frac{p_1}{p_1 \left\{ \dfrac{1 + \text{hyp. log. } r}{r} \right\}} = \frac{2 \,.\, r}{1 + \text{hyp. log. } r}$$

Whence dividing both sides of equation by r, and multiplying by (1 + hyp. log. r), we find that the hyperbolic logarithm of r is = 1, and therefore r = 2·718, which is the rate of expansion at which the steam must be worked to give economy equal to that of the spirit vapour working non-expansively.

The rapidity of evaporation of spirit is an advantage in producing quicker running; in the trials the number of revolutions per minute under steam averaged 312·6, and under spirit 552·2. This difference of speed may account for the different ratios of efficiency shown by the brake and by the indicator diagrams.

The spirit used is distilled from petroleum, and stands mid-way between gasoline and benzoline, having a specific gravity of 0·68; and a given amount of heat will evaporate nine times as much of this spirit as of water. It is not, however, only the quantity of spirit evaporated that is to be considered, but the proportionate volume of vapour formed, which, in the case of this spirit, is about one fifth of that yielded by water, bulk for bulk; hence the total gain in favour of spirit should be at the rate of 1⅘ to 1, which is almost exactly that shown by the brake. The fact that pressures far in excess of those for steam at given temperatures are obtainable is further in favour of the new agent, as it means the advantage of high pressure without the corresponding difficulties attendant upon high temperatures; thus, at 300° Fahr. the pressure of steam is only 53lb. per square inch above the atmosphere, while that of spirit is 125lb. per square inch above the atmosphere.

In these researches petroleum spirit has been used in the same way as, and as a substitute for, water, and in the economy resulting there is nothing inexplicable; but we must not stop at the comparison of the amounts of work done by the two vapours. It is necessary to examine the economy of the whole arrangement in comparison with other methods of using the new agent. The point has been raised as to the preference to be given to the use of petroleum as fuel working a spirit engine, or as a direct agent by explosion in the working cylinder. The quantity of petroleum used as fuel, as given by Mr. Yarrow, is about 3lb. per horse-power per hour, and the petroleum engines in which the spirit is exploded use from 1lb. to 2lb. of oil per horse-power. The latter class of motor is, however, hampered at present by considerable disadvantages, which certainly displace it so far as the purpose to which Mr. Yarrow's engines are at present applied—that is, to the propulsion of launches—is concerned. Petroleum engines, making one effective stroke in every four, must necessarily be large and heavy in proportion to the power developed, and although no boiler is required, that used with the spirit-vapour engine is so small and simple as to be much outweighed by the increased size of its rival; there are, moreover, some other difficulties not quite settled in regard to modes of ignition where the spirit is used explosively, which tend to retard the general adoption of machines so actuated at present.

Returning to the theoretical expression for efficiency, which is [T − t] ÷ T, where T = the absolute initial temperature, and t = the temperature at the exhaust, we see that the efficiency varies directly as the range of temperature, and inversely as the initial absolute temperature. The absolute temperature is that measured from the theoretical absolute zero, 458° below the zero of Fahrenheit's scale. Assume that we have steam at 25lb. pressure, and temperature 265°, as compared with spirit vapour of 50lb. pressure and temperature 220°. Then as the temperatures at atmospheric pressures are 212° and 130° respectively, the range of temperature is—steam, 265 − 212 = 53°, and spirit 220 − 130 = 90°, and the absolute initial temperatures are 7670° and °, respectively; the co-efficients of efficiency would therefore be, for steam $\frac{53}{670}$ = 0·079; for spirit vapour $\frac{90}{588}$ = 0·153. The ratio of these efficiencies accords almost exactly with the results shown by the brake, for the figures were 1·84 to 1 in favour of spirit vapour, and 0·079 × 1·84 = 0·145, which compares fairly with the 0·153 found above; to the advantages of admitting of the use of greater ranges of temperature, then, must the proved superior economy of the spirit vapour over the steam be attributed.

Having considered the spirit-vapour engine as far as the data available will allow of our proceeding, we will now turn our attention to another engine, in which economy is sought in the use of a medium of heat conversion less wateful than water. This machine, in which a solution of ammonia is used, has been described before the American Society of Engineers by Mr. McGovern. The apparatus with which the experiments have been performed comprises a Porter-Allen steam-engine, with a single cylinder and automatic expansion-gear; a horizontal return-tube boiler set in brickwork, and the appliances necessary for condensing the ammonia. The feed liquid—water saturated with ammonia—is pumped into the boiler through a tubular heater. The boiler has about 370ft. of heating surface, and 9sq.ft. of grate. The cylinder of the engine is 11·5in. in diameter, and 20in. stroke. The absorbing process is thus conducted. First, there is introduced into the exhaust-pipe a jet of liquid called the "spray" from the boiler; this jet is ⅛in. in diameter, and its point of entrance to the exhaust-pipe is at the junction of the two branch pipes leaving the cylinde.r The spray pipe is brought from the heater and carried to a cooler, and thence to an exhaust-pipe. The cooler consists of a coil of pipe contained in a vessel through which cold water circulates. A branch from the outlet-pipe of the cooler is carried to the feed-well for the use of the jet condenser. The exhaust vapour, after leaving the spray jet, passes to the first "absorber," which is a surface condenser containing 500 tubes 41in. long and ⅝in. outside diameter; from this the vapour passes into a second similar absorber having 150 tubes 40in. long and the same diameter as in the first. In this vessel the vapour is almost or quite completely reduced to the liquid condition, in which state it flows into a well, from whence it is returned to the boiler by means of the feed-pump. The feed-well serves for the storage of feed liquid, and it also acts as a jet condenser to reduce any vapour that may remain to the liquid form. The low temperature of the cooler and absorbers is maintained by circulating water.

The engine itself acts exactly like a steam-engine, but the medium of conversion is a mixture of ammonia, gas, and steam. When the water is heated in the boiler it liberates the gas, which is reabsorbed by the condensed steam after doing duty in the cylinder. A series of experiments have been carried out on this plant, the engine being worked alternately with steam and with aqua ammonia, each test lasting eight or ten hours. The general results were that with a steam-pressure of 66·5lb. the engine made 198 revolutions per minute, and indicated 32 horse-power, consuming 5·62lb. of anthracite coal per horse-power per hour. When aqua ammonia was used the engine indicated 61·8 horse-power, and burned 2·65lb. of coal per horse-power per hour. It must, however, be taken into consideration that when the engine was using steam it worked against the atmosphere; but when ammonia was used the engine worked with a vacuum. This vacuum, however, seems to have been nominal, for there was no air-pump on the engine, and the diagrams show little or no vacuum. We may here note that, had a vacuum been created by a pump, it is probable that all the ammonia-gas, or nearly all, would have been withdrawn from the water, because, although it is absorbed by the water, it is not condensed, but still exists as a permanent gas. On the subject of condensed steam and absorbed gas, however, we shall have something to say further on. In point of fact, the diagrams did not show that the vacuum supplied even 10 per cent. of the whole power developed when ammonia was used. In these experiments the ammonia-steam combination was worked very expansively, the cut-off taking place at about one-seventh of the stroke; and this is very satisfactory, as it affords a comparison between steam and ammonia steam, both working expansively, and so cuts out conjectures such as have been started in connection with the Yarrow spirit-vapour engines.

The reason that the engine, when running under steam, only indicated 32H.P. was that that was the limit of the steam-supplying power of the boiler, and the fact stands that this same boiler was capable of supplying ammonia vapour equivalent to 58H.P. at a much lower rate of combustion. The exact powers were 32·26H.P. and 58·14H.P., thus showing an increased capacity of boiler and engine, together amounting to 80 per cent.

So far as we can gather from the facts recorded, it would seem that the reabsorption of the ammonia gas by cold water at the end of each stroke, is equivalent to a discharge into the atmosphere when steam is used, and that the release of the ammonia under the influence of heat is more readily effected than the generation of steam of equal energy. In this connection we will refer to the views of the late Charles W. Williams on the subject of condensation. He held that the steam commonly said to be condensed was really only held in solution in the water of condensation, the same as a gas might be, and he supported his views by some interesting experiments, of which one consisted in passing steam into a vessel of cold water until the latter boiled, and then, by letting the boiling water spread out in an open pan, exhibit the escape of the steam which had been passed into it, the remaining water having practically the same weight as before the commencement of the experiment. From this point of view, steam could only condense into water by coming in contact with some foreign material, and hot water would be water containing dissolved steam. The accuracy, or otherwise, of this view we shall not discuss here, but mention the suppositional state of things, because it bears a certain analogy to the facts by which we are confronted in the working conditions of the aqua-ammonia engine.

To the readiness with which water, under a slight increase of temperature, will give up its dissolved ammonia may probably be attributed, to a considerable extent, the economy of the aqua-ammonia engine. If we take a quantity of water at freezing-point, and pass steam into it, at atmospheric pressure it will continue to absorb or condense steam until its temperature has risen to 212°, when it will have received about 312 times its own volume of steam. If we now stop the supply of steam and apply heat to the water, it will commence giving off steam at atmospheric pressure. At freezing-point water will absorb 1,149 times its volume of ammonia at atmospheric pressure, and at 68° 680 volumes. Directly the water is warmed, it will commence to give off the ammonia gas; and when its temperature has reached 68°, it will have given off 469 volumes of gas at atmospheric pressure. From this it appears that a large quantity of ammonia gas will be evolved at a comparatively low temperature; and as higher temperatures are reached, the pressure of the steam will be very materially subsidised by that of the ammonia gas.

In order to be able thoroughly to analyse the action which takes place with the aqua-ammonia medium, many more experiments of a physical character are requisite, as our information in respect to the behaviour of mixed gases and vapours under the influence of heat is exceedingly scanty, but enough has been shown to demonstrate the necessity of further investigation in this direction.

It is to be feared in regard to the ammonia engine that the strong alkaline action of the gas will prove destructive to the working parts, antagonistic as it is to the existence of grease of any description, but so far on this point we have no practical information.

What may be the ultimate outcome of these various new departures it is difficult to forecast, but up to the present time the steam-engine, for purposes of the greatest importance, holds its predominance, the only thermo-motor that has at all encroached upon its domains being the gas-engine, which after a struggle of thirty years has secured some foothold, where comparatively small or intermittent power is required, and where boilers are objectionable. The objection to gas-engines lies chiefly in their bulk for a given power, though where there is plenty of space this is not of so much consequence, and where the motion is all in one direction they are very convenient and clean.

The great hopes at one time entertained in regard to hot-air engines have never been fulfilled. It is true that of these a fair number of a small size are used, being chiefly of value where water is scarce; but the high temperature at which they work is decidedly against their adoption. Some years ago we were told, in connection with some large hot-air engines designed for marine work, that while two thousand pounds was saved in fuel, twenty thousand was being burnt out in machinery, and there can be no doubt that the destructive influence upon the machinery of such high temperatures as are necessary, acting in conjunction with absolutely dry gases which absorb the lubricants, must prevent the extensive adoption of engines of this class.

It is curious to observe that still, as heretofore, notwithstanding the number of scientific minds presumably at work on the theory of heat-engines, that the new inventions and most notable attempts at improvement come from the workshops rather than from the colleges—in fact, as in the earlier days of the steam-engine, after a valuable result has been achieved, the reason of its success is sought out, and so we may look forward in the course of time to the evolution of a theory of the aqua-ammonia engine that shall gather it within the fold of other orthodox thermo-dynamic engines. **F. C.**

SOME RECENT ADVANCES IN PHOTOGRAPHY.

THE dawn of photography is intimately associated with researches on light. When the science of optics was in its infancy, the question whether the solar rays possessed any chemical properties was earnestly canvassed amongst scientific men. The first reliable information on this point was supplied by a Swedish chemist, Scheele, somewhere about 1774, who obtaining what he called "dephlogisticated marine acid gas" by the action of hydrochloric acid on manganese ore, soon found that when a mixture of equal parts of this gas and hydrogen was exposed to the action of sunlight, chemical combination occurred with explosive violence. Some years later, Davy showed the elementary nature of Scheele's gas, and gave it the name it now bears—viz., chlorine.

In the early part of the current century Ritter observed that there are solar beams which, while they do not possess luminosity, are capable of effecting chemical metamorphosis.

Soon after Ritter's discovery, Thomas Wedgwood published his method of producing sun-pictures by coating specially-prepared leather or paper with a solution of silver nitrate, and exposing it to the action of sunlight under a painting on glass.

It appears that Nièpce was the first to employ the camera-obscura with any success, and he partially succeeded in fixing the image on specially-prepared plates of silver. After his death, Daguerre entered into an agreement with the younger Nièpce to pursue the research for their mutual advantage, and, in 1839, the beautiful process known as the Daguerreotype was communicated to the Académie des Sciences at Paris.

In the same year Henry Fox Talbot described his process of producing pictures on specially prepared paper in a communication read by him before the Royal Society of England on the 31st of January. He introduced chloride of sodium as a fixing agent. Subsequently iodide of potassium was employed for the purpose, and afterwards hyposulphite of sodium was introduced by Sir J. Herschel, and this reagent was found to give the most satisfactory results. Robert Hunt and Archer quickly followed with their discoveries of the efficiency of gallic and pyrogallic acids.

When the use of albumen was found out, photography began to make rapid strides, which were still further accelerated by the application of printing processes. The names of those who have in recent years been instrumental in bringing the art to its present high state of perfection-ment are legion, and are so well known that they need not be alluded to here. It suffices to state that English scientists have led the van, and have been prompt to take up and still further develop the improvements made in other countries, till at the present time the art has become not merely a fine art, but receives extensive application in various industries, and is one of the most potent and delicate adjuncts of scientific research.

But although photography has improved so wonderfully, and, in some respects, has reached almost the acme of perfection—e.g., in its rapidity of action—it is well known that it possesses a grave defect. It seems, at present, incapable of producing pictures in which the true value is given to the various qualities of colour. To take an example:—Blue, even in its darker shades, is reproduced quite light; whilst the colours yellow, green, and red are given a value which is very dark. Thus the natural effects of colours are badly rendered.

This apparent anomaly is, of course, due to the fact that the rays of blue light have the greatest actinic power. White light is reproduced very light in photographs, simply because it contains blue in its composition, and further the other colours in nature affect the plate merely by reason of the amount of similar actinic rays which they may contain.

It thus appears that a photographic plate is extremely sensible to the blue rays, and very slightly so to all others. Hence the time of exposure that is sufficient for blue is far from being sufficient for the other coloured rays.

If, with an ordinary apparatus, an attempt be made to prolong the time of exposure in such a manner as to permit the green rays to make their due impression on the plate it will be found that the blue rays have acted about forty times too long, and the proof will be useless.

Photographers have been endeavouring for a long while to modify the sensitive films in such a manner as to render them, if possible, more sensitive to the yellow, green, and red rays of light, rather than to the blue rays; but they are still far away from having solved the problem. Even those plates which are termed "isochromatic" or "orthochromatic," invented by Vogel, Obernetter, and d'Attout-Tailfer, which are certainly more sensitive to the green and the red rays than the old plates were, are still very far from being equal to the task.

While endeavouring to obtain photographic films which shall approach in sensibility that of the human retina, it has occurred to M. G. Lippmann that some success might be obtained by a rational and systematic arrangement of coloured glasses. He carried out a thorough investigation of this idea, and at a recent meeting of the Académie des Sciences at Paris he gave an interesting account of his experiments.

M. Lippmann operates with an Attout-Tailfer plate. Before the objective a piece of blue glass is placed, and the plate is exposed for the short time necessary for the blue rays to impress an image on the film. Then, without interfering with the apparatus, and taking care not to displace it, he substitutes a piece of green glass, and continues to expose the plate for that length of time which is necessary for the green rays to fully act. The green glass was selected of such a quality that it allowed the least possible trace of blue light to pass through it.

Under these conditions it is possible to allow the green rays to act for the whole length of time that they require without fear that the blue rays will spoil the picture owing to over-exposure. The red rays are then allowed their turn, a piece of red glass being substituted before the objective in place of the green glass. This red glass must be selected with great care, and must again be of a kind that will permit the least possible trace of green or blue light to pass through it.

The final result of this triple exposure is to give a clear photograph in which green foliage, yellow or red draperies, &c., instead of giving dark tints and blurred outlines, are rendered with a delineation and colour-value surpassing the finest engraving.

Yellow glasses have already been employed in photography, and they eliminate, it is true, a portion of the blue light. Their use is described by M. H. W. Vogel in his work, "La Photographie des Objets Colorés avec leurs Valeurs Réelles," p. 1888, published at Paris by Gauthier-Villars, 1887. But the results obtained by M. Lippmann with his successive arrangement of blue, green, and red glasses, surpass any that have hitherto been dsscribed, and they appear to herald the dawn of a new era in photography—especially in landscape photography.

While giving due honour to M. Lippmann, it is only fair to notice that the idea of using coloured glasses in photography, was foreshadowed by M. Ed. Becquerel, in the year 1881. Indeed the subject was approached as early as 1854 by Becquerel, who, in his process of chromo-photography, or helio-photography, as it was called in France, succeeded in producing a coloured picture; but the hues could not be fixed so as to resist the effect of diffused light, and so it was relegated to the list of scientific curiosities. It was, however, in endeavouring to obtain coloured pictures by employing coloured glasses that he foreshadowed the notion of obtaining the true effects of light, shade, and quality of colour.

It must also be mentioned that since the publication of M. Lippmann's paper, M. Delavries has made a communication to La Société Chimique de Paris, in which he states that he has obtained photographs representing the proper value of the different colours by employing orange-tinted glass of selected quality and thickness; he believes that, could the quality and thickness be carefully adjusted, his method, which is still in embryo, would be much simpler and less complicated than that of M. Lippmann.

Whatever may be the ultimate value of these recently-proposed methods, they indicate work in the right direction, and all similar research will be welcomed as tending towards the production of an instrument by the assistance of which the mysterious phenomena of light may be more satisfactorily investigated, and which in the words of the late Robert Hunt, "Shall give the votaries of art tablets upon which Nature shall impress herself in all her delicacy and decision, in all her softness and grandeur, and in all her richness of tone and breadth of effect."

A MODEL LOCOMOTIVE.—XIV.

Motion-Plate and Slide-Bars.

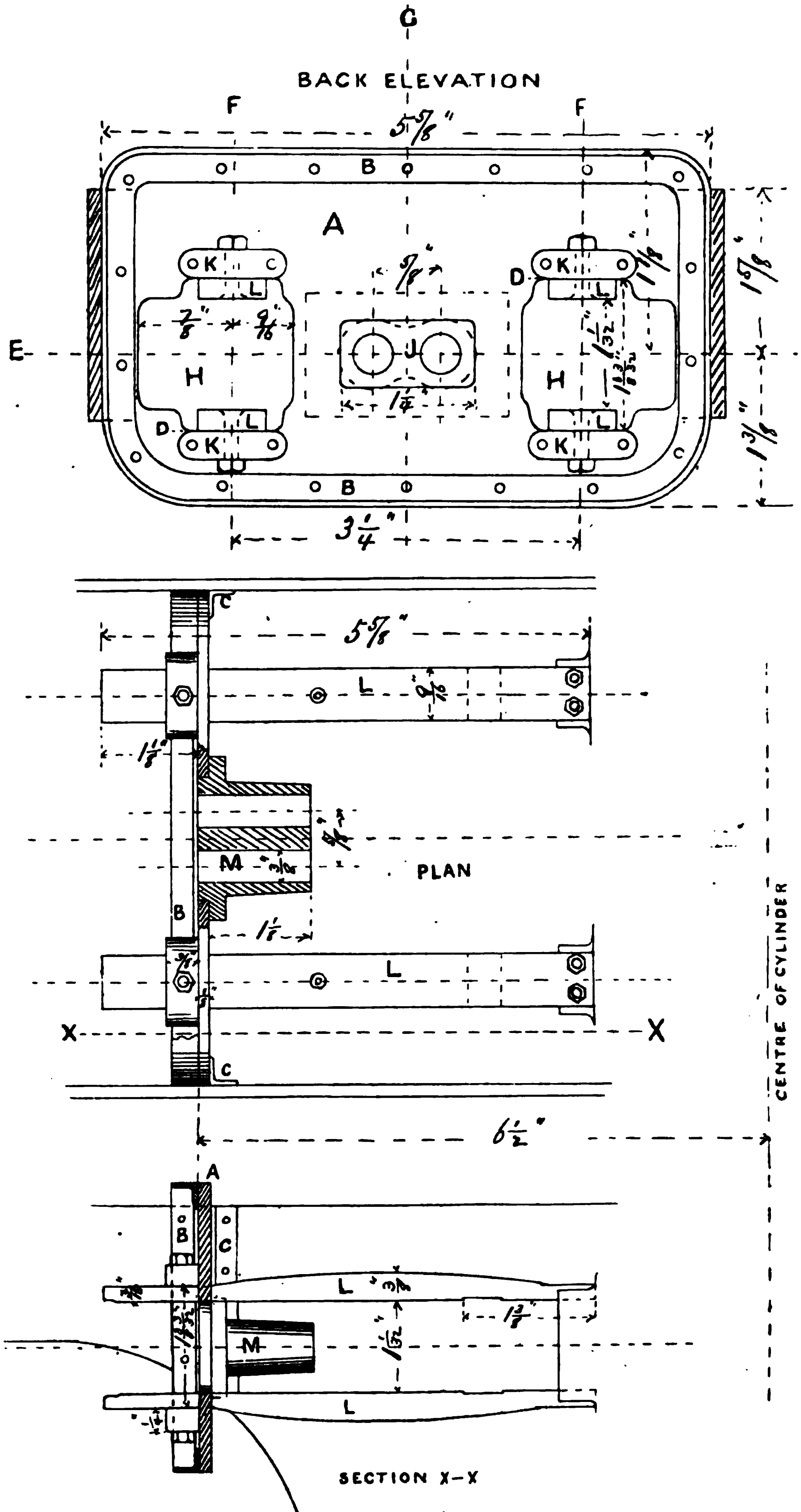

Fig 74

THE motion-plate extends across between the frames, and carries those ends of the slide-bars which are farthest away from the cylinders. In Fig. 74, the plate A is of wrought iron, ⅛in. thick, corresponding with a thickness in practice of 1in. or 1⅛in. It is stiffened with angle iron, and attached to the frame-plates with angle irons. As a rule the angle iron is not carried below the frame-plates. Sometimes the upper edge of the motion-plate is curved to the radius of the boiler, the boiler resting on, and being supported thereby. The top angle irons then riveted, usually on both sides, to the same curvature, afford a broad base of support. Of late years many motion-plates have been made of cast steel, having the holes and edges surrounded and stiffened with ornamental beadings. When the expansion-links of the valve-gear come between the motion-plate and the cylinders, large holes have to be cut in the plate to clear the links, and allow the eccentric rods to pass through. But keeping the plate well back from the ends of the slide-bars, as in this example, this cutting out can be avoided, and the dimensions of the plate diminished accordingly, and we gain the further advantage of supporting the guide-bars at a position approaching to the centre, where the stresses on the bars due to the moving connecting-rod and crank are greatest. It is because of this increase in stress towards the centre that the bars are commonly thickened-up there, and thence tapered down towards the ends.

When an engine is running forward, the thrust and wear is always upon the upper bars, when running backwards it is upon the lower ones. Bessemer steel is most frequently used for guide bars. Mr. Stroudley uses cast iron; and wrought iron, case-hardened, is also employed.

For the model we had better prepare the motion plate, and fit it in its place before attaching the blocks for the guide-bars, or cutting out the holes. Prepare, therefore, a piece of ⅛in. plate, and square it, and mark and cut to the outlines given in Fig. 74. Bend a piece of angle-iron, B, round the edge, and also prepare two straight strips, C, for the side opposite, and rivet through to the plate. These serve both to stiffen the plate, and to attach it to the framing. Drill all the rivet-holes in the angle-irons, and from these mark off and drill the holes in the frame plates. Then clamping them together, reamer out, if necessary, the holes to take tight-fitting rivets. Put in four temporary bolts, two at top, and two in bottom holes. Block up the framing, having, as we suppose, the cylinders bolted in place, and back covers on, and level the top edges of the frame-plates either with spirit-level, upon a levelled table, or with scribing block, working from a surface plate. While thus set up level, take with a scribing block the heights of the shouldered portions of the hinder covers, drawn in Art. XII., Figs. 67, 68, p. 407, and transfer them to the motion plate, scribing lines thereon at Fig. 74, D, and also scribe the horizontal centre line E, midway between them. Likewise scribe vertical lines, F F, corresponding with the distances apart of the cylinder centres, and the vertical centre line G between these. Having the cardinal dimensions thus set out, the plate may be removed, and the holes shown in back elevation, Fig. 74, be struck out. The holes H H, encircling the guides and cross-head, are made wide enough to inclose the cross-head and the pump ram. Two pumps are used on locomotives, when pumps are employed at all. To lessen work, I only propose to make use of one; but would nevertheless cut the holes in the motion-plate symmetrical on each side for appearance' sake. The central opening J is to take the check-piece cast with the valve-rod guide. To cut these openings, drill a succession of holes in contact with each other, and so remove the central pieces; afterwards file the edges to outline.

For the attachment of the guide-bars, prepare blocks of wrought iron or steel, K, and unite them with rivets to the motion-plate in the position and to the dimensions shown. To these blocks the guide-bars will be bolted with countersunk bolts.

The blocks K being riveted on, the motion-plate may now be returned into place, and riveted to the frames.

Strips of Bessemer steel will be most suitable for the slide-bars L. Elaborate lining out is not necessary, as in actual practice; but it will suffice to first file the wearing face of a bar true, then square one edge from this, and scribe and file the opposite edge therefrom. Then square and file the ends to the length given, mark the outline of the back parallel with the face to a little distance inwards, thence bellied towards the centre, as shown, and file. Mark the positions of the bolt holes with compass calipers, scribing from the ends and edges, and drill. Set the bars correctly in position on cylinder covers and motion-plate blocks, and mark holes in covers and blocks from those already drilled in the bars, and fasten together as shown.

When the bars are set in place, try their parallelism both between faces and between edges by means of a gauge made to the exact widths, and slid along. The crossheads when attached to the piston-rods should afterwards be slid along, and their tight or easy working noted, and corrected if necessary.

Observe the slight shouldering down of the faces of the bars to permit of the passage of the guide-blocks past them, so preventing the formation of a ridge on the bars; also note the oil-holes in the top bars.

The guide M for the valve-rods is an iron casting checked into the hole J in the plate, and bolted or riveted to it. It is bored out at ⅝in. centres for the valve rods, to ⅜in. diameter, the bore being large and of great length in order to distribute the friction over a large surface, and so diminish wear. This casting should be fitted to the motion-plate, and the centres of holes scribed in place before boring, to insure accuracy.

J. H.

A PLANTE SECONDARY BATTERY.*

PROBABLY no secondary battery can be more readily made or more easily managed than the one invented by Planté. It is therefore especially adapted to the wants of the amateur who makes his own apparatus. It takes a longer time to form a Planté battery than is required for the formation of some of the batteries having plates to which the active material has been applied in the form of a paste, and its capacity is not quite equal to that of more recent batteries; but it has the advantage of not being so liable to injury in unskilled hands, and of allowing a more rapid discharge without injury.

Each cell of the battery consists of 16 lead plates, each 6in. by 7in. and 3/32in. thick, placed in a glass jar 6in. by 9in., with a depth of 7¾in. Each plate is provided with an arm 1½in. wide, and of sufficient length to form the electrical connections. The plates are cut from sheet lead in the manner indicated at 3 in Fig. 1—i.e., two plates are cut from a sheet of lead 8½in. by 14in. This method of cutting effects a saving of material. The plates, after being cut and flattened, are roughened. One way of doing this is shown in Fig. 2. The plate is laid on a heavy soft-wood plank, and a piece of a double-cut file of medium fineness is driven into the surface of the lead by means of a mallet. To avoid breaking the file, its temper is drawn to a purple. After the plate is roughened on one side, it is reversed and treated in the same way upon the opposite side. If a knurl is available, the roughening may be accomplished in less time, and with less effort, by rolling the knurl over the plate. Half of the plates are provided with four oblong perforations into which are inserted H-shaped distance pieces of soft rubber, which project about ⅛in. on each side of the plate. The perforated and imperforate plates are arranged in alternation, with all of the arms of the perforated plates extending upward at one end of the element, and all of the arms of the imperforate plates similarly arranged at the opposite end of the element. The plates are clamped together by means of wooden strips—previously boiled in paraffin—and rubber bands. The strips are placed on opposite sides of the series of plates at the top and bottom, and the rubber bands extend lengthwise of the strips.

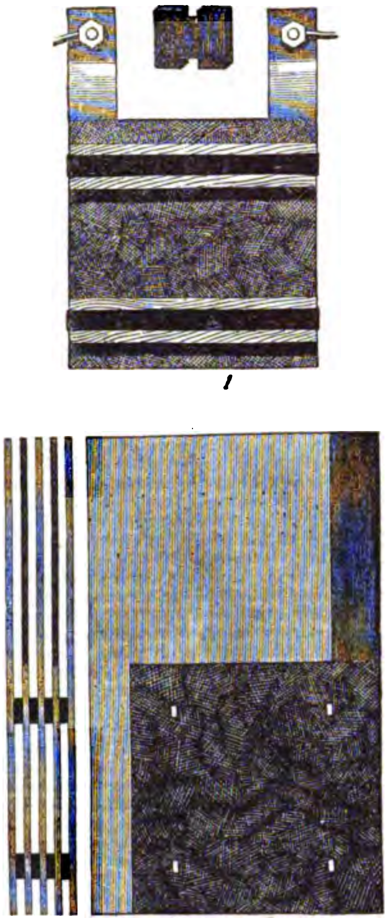

FIG. 1.—Plates of Secondary Battery.

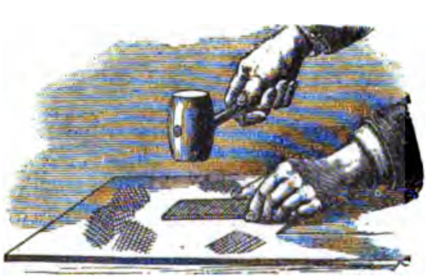

FIG. 2.—Roughening the Plate.

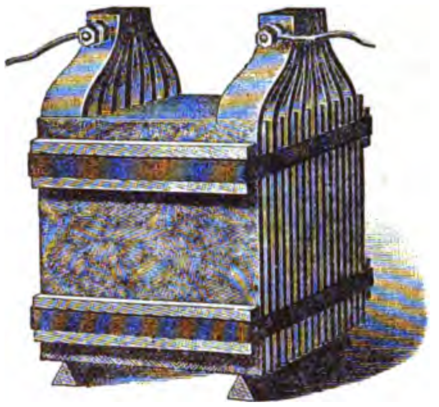

FIG. 3.—Plates Connected.

The arms of each series of plates are bent so as to bring them together about 3 or 4in. above the upper edges of the plates. They are perforated to receive brass bolts, each of which is provided with two nuts, one for bending the arms, the other for clamping the conductor.

The element thus formed is placed in a glass cell, and the formation is proceeded with as follows: To hasten the process, the cell is filled with dilute nitric acid (nitric acid and water equal parts by measure), which is allowed to remain for twenty-four hours. This preliminary treatment modifies the surface of the lead, rendering it somewhat porous, and, in connection with the roughening, reduces the time of formation from four or five weeks down to one week. The nitric acid is removed, the plates and cell thoroughly washed, and the cell is filled with a solution formed of sulphuric acid 1 part, water 9 parts.

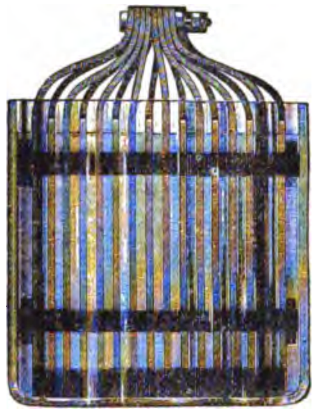

FIG. 4.—Complete Cell.

The desired number of cells having been thus prepared, are connected in series, and the poles of each cell are marked so that they may be always connected up in the same way. The charging current, from whatever source, should deliver a current of ten ampères with an electromotive force 10 per cent. above that of the accumulator. Each cell of this battery has an electro-motive force of two volts, and the voltage of the series of cells would be the number of cells × by two. It is a simple matter to determine the amount of current required to charge a given series of cells. For example, a battery is required for supplying a series of incandescent lamps. It has been found uneconomical to use lamps of a lower voltage than 60. It will, therefore, require a battery having an E.M.F. of 60 volts to operate even a single lamp. This being the case, at least 30 cells of battery must be provided, and on account of a slight lowering of the E.M.F. in use, two extra cells should be added. It will, therefore, require 32 cells for a small installation, and the machine for charging such a battery should be able to furnish a current of 10 ampéres, with an E.M.F. of 75 volts.

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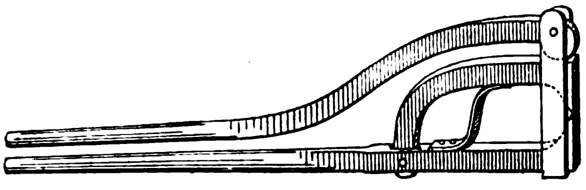
* By GEO. M. HOPKINS, in the *Scientific American*.

To form the battery, it is placed in the circuit of the dynamo and kept there for 30 hours continuously, or for shorter periods aggregating 30 hours. It is then discharged through a resistânce of 20 or 30 ohms, and again recharged, the connections with the dynamos being reversed, so as to send the current through the battery in the opposite direction. The battery is again discharged through the resistance, and again recharged in a reverse direction. These operations are repeated four or five times, when the formation is complete. It will require from five to seven hours to charge the battery after it is thoroughly formed. It must always be connected with the dynamo as connected last in charging.

Although amateurs may find pleasure in constructing and forming a secondary battery, there is no economy in securing a battery in this way. It is less expensive and less vexatious to purchase from reliable makers.

HOW TO MAKE A BOLT AND RIVET CUTTER.



As the patent cutters are expensive, very many small shops may not be provided with a bolt and rivet-cutter. I have made one that works splendidly, and thinking that others might like to know how to make one, I will tell how it is made. Take a piece of ¾-square iron 24in. long for the bottom piece. In the end weld a piece of tool steel for cutter. This should be ⅝in., so as to have solid steel cutters. In the bottom piece, 7in. from the end, punch a hole with a flat punch and round down from above the hole. The other jaw is made from the same kind of iron with steel welded on the end for cutter. The upper handle can be made from round or square iron, whichever is handiest. The spring can be made from any piece of old spring, and is put on with two small rivets. The end piece can be made from ⅝in. stake iron. It is in one piece and bent so as to fit around the lower jaw. The figure shows the cutter complete, and will give a good idea as to how it is made. I think that some of the boys will find this cutter very useful. But if any have a better one, let us hear from them.—C. V. Marsh in *Blacksmith and Wheelwright.*

AN IMPROVEMENT IN ANEMOMETERS.

By H. C. Russell, B.A., F.R.S.*

One of the most interesting and practically important questions in relation to wind is what is its maximum velocity or pressure, for the one depends on the other. I need hardly say that many attempts have been made to devise instruments capable of answering that question. It has been generally admitted that existing anemometers using Robinson's Cup are unequal to the task, because a gust lasts but a few seconds, often not more than five or six, and the recording parts made to register an hour's work on ½in. or 1in. of paper will not show satisfactorily a gust lasting 10 seconds, that is $\frac{1}{360}$ part of an hour; or, in other words, if one could measure such a gust, it would be $\frac{1}{360}$ part of an inch on the paper, and the smallest error in measuring becomes so magnified when the measured velocity in 10 seconds is converted into velocity per hour that results are rendered very uncertain. Pressure-plates have also been tried in every form, but it is found the results are not satisfactory, because when a gust of wind coming along at a velocity of say 50 miles an hour strikes a pressure-plate, it has just the same effect upon it as if it were a hammer striking it a blow; it sets it into rapid motion which by acquired momentum carries it much further than it ought to do. Now Robinson's Cups are free from this defect, and, although not without drawbacks, they are in my opinion the best means we have of recording gusts of wind. Of course the open cup, like the pressure-plate, is struck by the advancing gust, but at the same moment the same gust strikes the back of the opposite cup and resists any tendency to run away, and it seemed to me that what was wanting was a means of recording with all possible accuracy, the interval of time which the cups took to run a given number of evolutions, and I have accomplished this by putting in a series of pins in the first wheel, so that they make an electrical contact on a light gold spring for every ten revolutions of the cups. So far there is nothing new. Many anemometers have been made to record by electrical contacts. The point that I think is new is that these contacts are recorded on either of the astronomical chronographs, so that the interval between two contacts can be determined with certainty to within one-tenth of a second or even less. The intention is to use this method only for very strong winds, the Observatory Anemometer has an ordinary scale of 1in. of paper to the hour, which may be increased to 2in., and this is quite enough for all ordinary winds, and more than it is usual to have in observatories. The new method is one that can at any moment be put into operation by turning an electrical key, and at all other times it is at rest, and costs nothing either in paper or battery force.

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* A paper read before the Royal Society of N.S.W.

HEAT-ENGINES OTHER THAN STEAM.—II.*

The theory of the working of heat-engines is indissolubly connected with the name of a Frenchman, an ancestor of the present President of the French Republic (M. Carnot). In 1824 M. Carnot published his work entitled "Reflexions sur la Puissance Motrice de Feu," in which he enunciated the natural law known by his name. M. Carnot was one of those who at the time held the "caloric" theory, as it was termed—that is to say, he believed that heat was a material substance; he had not then realised the dynamical theory of heat—i.e., that heat and motion are convertible, which is now, as I have said, universally accepted, and, therefore, although the theory as he propounded it is true, yet in some of his deductions he has since been proved to be incorrect. You will notice during our consideration of it that it is hedged completely round with specified conditions, and you will frequently find (even in some of the textbooks, I am sorry to say) that some one or more of these conditions is neglected or eliminated, with the result that absolutely fallacious arguments are propounded. Carnot based his arguments on a fact which we all intuitively feel to be true, that given two bodies of different temperature in proximity the one to the other, there is a continual tendency towards the establishment of equilibrium of temperature between them. Further, he pointed out that this tendency is an invariable accompaniment of the conversion of heat into motion; and he stated that which is obvious, if these previous statements of his are correct, that whenever there is a difference of temperature it should be possible to obtain production of motion.

The doctrine of Carnot may be roughly defined in this way. The utmost work which can be obtained from a theoretically perfect heat-engine (when the working agent does not change its state, as from steam to water) is represented by the difference between the temperature at which the working agent is received into this ideally perfect engine, and that at which the working agent leaves the engine.

The perfect or ideal engine must be, according to the Carnot theory, absolutely and entirely reversible; but let us see some of the impossibilities in practice this theoretically perfect engine involves.

First, we should need for the working agent a perfect gas, the volume, and therefore the pressure, of which would vary exactly as the temperature. We should also need an engine absorbing for itself no portion of the work developed—that is to say, a frictionless engine, and one also in which none of the heat imparted to the working agent was lost either by radiation or conduction, or, in fact, in any way whatever—as I have said, impossibilities.

I commenced by showing you cubes, the black one representing a definite quantity of heat, and the smaller red one representing the amount of that heat utilised in practice in a very fair high-pressure compound non-condensing steam-engine of the present day. But you will now realise that, as no mechanical combination can possess the impossible qualities which must be possessed by an ideal engine, we are really not treating our steam-engine fairly in making this comparison, unless we bear the above impossibilities in mind. Of course, this reasoning applies equally to the gas-engine and to the gas-engine cube. In order to utilise to the utmost the quantity of heat represented by the black cube, we should require that that heat should be delivered to the engine at the highest possible temperature which can be attained, and we should require to take all the heat out of it, so that when we rejected the working agent from our engine, it would be at the lowest possible temperature.

As to this question of the lowest possible temperature: I have shown you that the addition of heat to a gas causes the volume of that gas to increase if the pressure remains constant. Now, if we can imagine the reverse of this process carried on sufficiently far, we can realise that the volume of the gas will be infinitely reduced, so that when the whole of the heat has been abstracted from it, it would have entirely disappeared. We should then reach that which is called the "absolute zero of temperature."

The text which I commenced adopts the steam-engine as a standard of comparison of the relative advantages of heat engines. It is necessary we should have something that we can grasp and readily understand to base our comparison on, and we will, therefore, take the steam-engine for this purpose. It is that heat engine which is most largely in use, which has been most fully considered and investigated, although there are some who tell us that we, even now, know nothing of the more abstruse points in connection with its working. I do not at all propose to discuss this, or to delay about it, but will only use, for our comparison, the record of the practical results in efficiency which have been obtained.

Unfortunately, in taking the steam-engine as our basis, we are met with the initial difficulty that such an apparatus consists, as a fact, of two distinct and separate forms of heat-engine, each with its own mechanical efficiency, or rather want of mechanical efficiency. Perhaps it will be as well that I should now define precisely what is meant by "mechanical efficiency." It is that percentage of the units of heat put into an engine which is transposed by the machine into mechanical work, or delivered from it in such a state as to be capable of doing mechanical work.

I have already told you that a "heat unit" is the amount of heat necessary to raise 1lb. of water 1° Fahr. There is one more term which I shall have to define, and that is the one used by engineers when they speak of the work performed by an engine. They say it is so many "horse-power."

James Watt adopted this term "horse-power" in order to give the lay mind some idea of the work which could be done by any given engine or machine. He made many experiments as to the amount of work which a horse was capable of doing, with the result that when this work was reduced to that which was equivalent to the raising of a weight in a given time, he found that the average horse could do as much work as was represented by lifting a weight of 22,000lb., there or thereabouts, through a height of 1ft. in 1 minute of time; but so that his customers should not grumble, complaining that the engines with which he supplied them were not capable of doing as much as the number of horses which he stated was the power of the engine which he sold them, he determined to give an ample margin, and he therefore estimated each horse-power in his engines as represented by a weight of 33,000lb. (an excess over the true value stated above of 50 per cent.), lifted 1ft. high in 1 minute of time, or 33,000ft.-lb. This is the horse-power which the engineer commonly uses.

Now, as I have shown you that heat is convertible into mechanical work, it follows that a heat unit can be represented by some proportion of a horse-power. If you will remember the experiments by which Count Rumford proved that heat and mechanical work were convertible, you will realise that it would have been possible to have obtained from these some equivalent which should represent exactly the quantity of heat in a given amount of mechanical work. With this question of the mechanical equivalent of heat the names of Mayer—a German scientist—and Dr. Joule are inseparably connected. About the year 1842, each of them published (Mayer as the result of calculations, and Joule as the result of experiment) a statement as to the value of the mechanical equivalent heat. In the year 1849, Dr. Joule, when he had been experimenting for over seven years, read a paper before the Royal Society, in which he stated that he considered it important that the relations between work and heat should be definitely ascertained, and with absolute accuracy; or, in other words, that that which we now speak of as the mechanical equivalent of heat, or perhaps more commonly as Joule's equivalent, should be ascertained with absolute certainty. He proceeded to describe the experimental apparatus which he had devised and employed for the purpose of discovering the true value of this, also describing the method of using this apparatus which he had adopted.

Shortly stated, it consisted of a series of revolving paddles placed in a closed vessel containing a definite amount of water, at a given temperature, these paddles being caused to revolve in the water (and thus to churn it as it were) by means of cords passing over pulleys actuated by a falling weight, or weights. Repeated experiments were made, and, as a result, it was found that a weight of 772lb., when falling through a distance of 1ft., would increase the temperature of 1lb. of water 1° Fahr. Precautions were taken to measure exactly the loss of heat by radiation and conduction, and every circumstance which could possibly affect the result was taken into consideration. Dr. Joule's communication of this date to the Royal Society winds up with the following conclusions:—1. The quantity of heat produced by the friction of bodies, whether solid or liquid, is always proportional to the force expended. 2. The quantity of heat capable of increasing the temperature of 1lb. of water (weighed *in vacuo*, and taken at between 55° and 60° Fahr.) by 1° Fahr., requires for its evolution the expenditure of a mechanical force represented by the fall of 772lb. through the space of 1ft."

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* Extracted from the Cantor Lectures delivered by Mr. H. Graham Harris, M.Inst.C.E., before the Society of Arts.

It follows, from what I have just said, that Joule's equivalent being 772lb. lifted 1ft. per minute, or 772ft.-lb., and the indicated horse-power being 33,000ft.-lb., 42¾ heat units expended per minute, or 2,565 heat units per hour, is the equivalent of an *indicated* horse-power. You will notice that I use the term "*indicated* horse-power," emphasising the *indicated*.

You all of you know that the engineer is nothing if not accurate. I am sorry to have to say it, but the accurate engineer has no less than five forms of horse-power of which he speaks, and unless you pin him down to telling you exactly what horse-power he means—whether indicated horse-power, or brake horse-power, or nominal horse-power, or whatever it may be—he will most likely succeed in confusing you, and probably himself. Mr. Preece and other electricians now want to put another sort of horse-power upon the unhappy engineer, and they want him to have and to use a special electrical horse-power. However, I do not wish to trouble you with any of these other kinds of horse-power; I always propose, in these lectures at least, to speak of indicated horse-power, that is, horse-power developed in the cylinder, and capable of being shown by the indicator on the indicator diagram, which I shall have presently to describe.

Now, the best Welsh steam coal has been proved by frequent analysis to contain combustible material which, when burnt to destruction, would be capable of developing about 14,500 heat units for 1lb. weight of coal; therefore, as 2,565 heat units per hour equal 1H.P., it follows this should, theoretically, be obtained for ·17, 17-100ths of 1lb. of such coal consumed per hour. This would be the consumption in the ideal engine; but this, as I have shown you, is an impossible machine.

Here is another instance of the lucidity, the simplicity of statement, adopted by the engineer. You will see that he states his horse-power as pounds weight lifted 1ft. high in a *minute* of time, while he talks of his fuel consumption as that used per horse-power in an *hour* of time.

Referring to our cubes again, the red cube represents the fuel utilised by a steam-engine consuming practically the smallest quantity of fuel, of which there are absolutely certain records, and you will see that the horse-power there is only obtained for about 1½lb., or 150-100th, instead of 17-100th of 1lb. of coal, and that the mechanical efficiency, therefore, is not quite 1-9th, or, practically, about 11 per cent.

Let me once more say that I am not suggesting for a moment the possibility of realising the ideal steam-engine. Remember, that in order to utilise the whole of the fuel, or, in other words, to obtain an indicated horse-power for 17-100th of 1lb. of coal per hour, you would, among other impossible things, require steam of a temperature, and of a pressure, such as would make its density equal to that of water; while the products of combustion of the fuel which had raised the steam to this temperature must escape at the temperature of the atmosphere, and the steam must be expanded to such an extent as to bring it down to the absolute zero of temperature.

I have told you that the initial difficulty in taking the steam-engine as our basis of comparison is, that it really consists of two distinct and separate forms of heat-engine—the one the boiler, the other the engine itself.

Let me now show you what is really the efficiency of the engine alone and without the boiler. Look at the black cube again, and assume that it now represents the amount of heat units which are supplied to an engine using some 18lb of water per horse-power hour, delivered to it from the boiler in the form of steam at 150lb. pressure, the steam exhausting from the engine, or leaving it at the pressure of the atmosphere, and therefore at a temperature of 212°. Now, the red cube, which represents the efficiency of such an engine, is, as you will see, much larger in proportion to the black cube, representing the heat delivered to it, than was the red cube of the efficiency of the engine and boiler combined.

These cubes represent the fuel and efficiency of such an engine and such a boiler as those tried by the judges at the Royal Agricultural Society's Show at Newcastle in 1887, or at the electric-motor trials of this Society. In fact, they may be called very fair, or even exceptionally good examples of the ordinary commercial high-pressure compound non-condensing engine. The efficiency of the modern quadruple expansion marine engine is slightly greater than this, but not so much so as to affect the argument which I shall base upon the cubes.

I have purposely shown you the efficiency of the engine and of the boiler combined, and then that of the engine alone, because, as I shall have to tell you again later on, almost all of the "heat-engines other than steam" are engines in which the boiler, or its equivalent, is entirely absent, and in which the heat is produced in the cylinder of the engine itself; and I am prepared to suggest that, to some extent, the efficiency of these other heat-engines is due to the fact of the absence of the equivalent of the boiler, and to the fact that the heat is developed in the engine cylinder itself, and that there is no separate vessel in which it is produced.

I know that there may be quoted against this statement the fact of Watt's great invention—that of the separate condenser. Here, increase of efficiency was obtained by utilising the heat in two vessels in succession, instead of in one, and I may also be referred to the increase of efficiency in marine and other engines, due to the use of the triple, or even quadruple cylinders, in which, in succession, the steam is expanded, but I think a little consideration will show that an increase in the number of vessels in which the heat is utilised is not an advantage *per se*.

Further, we shall find that one of the most promising suggestions for the improvement of these other heat-engines is that the number of cylinders in which the working agent is used in succession shall be increased—i.e., that the engine shall be made compound, or even triple compound. But you will see that these additional cylinders are intended to utilise the heat which is at present lost by passing away in the exhaust, or, in other words, the object is to increase the range of the temperature through which the engine works, not by adding to that which is initially developed, but by utilising a portion of that which is at present thrown away.

Having now stated to you, pretty fully, the nature of the theory of working of the steam-engine, and having done this because it is used in my text, I would like to still further clear the ground—although I may be accused of being very elementary—by spending a few minutes on the question of expansion in a heat-engine.

Let us see how expansion operates in a steam-engine. You all know that the principal portion of a steam-engine consists of the vessel called the cylinder—that being the vessel in which the work is developed; you know also that it is a truly cylindrical vessel of a given length, in which a piston, or disc, is caused to work backwards and forwards by the pressure of the steam which passes alternately into either end of the cylinder, between the covers and the moving piston. From the piston a rod proceeds, working steam-tight through a stuffing box in one of the covers. To this rod a jointed rod is attached, which transposes the reciprocating motion of the piston into the rotary motion of the crank-shaft.

In this diagram you will see a square which is shaded or hatch-lined. This square represents, by its length, the portion of the stroke, or the distance through which the piston has travelled, and by its height above the base line at any point, represents the pressure existing at that point, say, in pounds per square inch. This square diagram, therefore, tells us that the piston has moved from end to end of the cylinder, and that while it has done this, the pressure existing in the cylinder has been uniform and at a maximum—that is to say, there has been no expansion. You will see there is stated on the diagram that the ratio of steam used to work done is as 100 to 100.

If you look at the next diagram you will see that it is only of the full height for half its length, and that at that point the upper line begins to fall—that is to say, the pressure begins to decrease, and goes on decreasing, following a uniform curve until the end of the cylinder is reached, when the pressure is at its lowest. This diagram would tell us that the steam, or other working agent, had been maintained at the pressure at which it was admitted to the cylinder for half the length of the stroke of the piston, that then the inflow of the working agent had been stopped, and that which was in the cylinder had been allowed to expand, and had thereby become increased in volume, decreased in pressure, losing some of its heat in the process, because of the work which it had done in expanding and pushing the piston forward. Upon the diagram the advantage to be obtained by this expansion—that is to say, the ratio of steam used to work done—is stated as 100 to 169.

In the next diagram the same principle has been illustrated, but here it is supposed that the inflow of the working agent at its full pressure has been stopped when the piston has moved through a quarter of its stroke, the remaining three-quarters being done by expansion.

You will see that the right-hand end of this diagram is much lower than the right-hand end of the diagram above it—i.e., the pressure has fallen in this case lower, more work having been done; more heat having been abstracted. And look what has been the result of cutting off the inflow of the working agent as early as one-quarter of the stroke. Here the ratio of steam used to work done is as 100 to 238·4.

PFANNKUCHE'S NEW METHOD OF CURRENT MEASUREMENT.

A NEW instrument for measuring current and potential which possesses some highly original features, has been devised by Mr. Pfannkuche, of Cleveland, Ohio. He employs the well-known thermopile, which is acted upon by the heat generated by the current in the main circuit, and the current thus generated in the thermopile is measured in a suitable galvanometer. The instrument is shown in the accompanying illustrations, Figs. 1 and 2, in side elevation and section respectively. The bars *a a'* are composed of German silver, and between them are inserted the alternate joints of the thermopile or thermo-spiral B B, the joints being insulated from the bars by thin plates, P, of mica. The bars, insulating plates, and thermo-spiral are secured together and to the base-board H by means of insulated bolts, O. The German silver bars *a* are provided at their ends with the terminals C C' while the bars *a'* are provided with end terminals C^2 C^3.

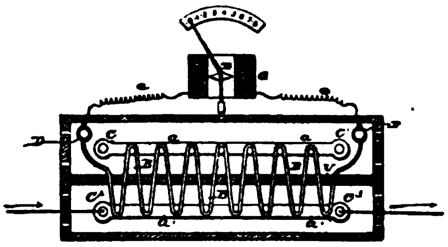

Fig. 1.

The galvanometer G is included in the circuit of the thermo-spiral B B by means of the conductors, *e e'*, which connect the helix of the galvanometer with the terminals D D' of the thermo-spiral. The partition N prevents the heat of the bar *a'* from being transmitted to the bar *a*.

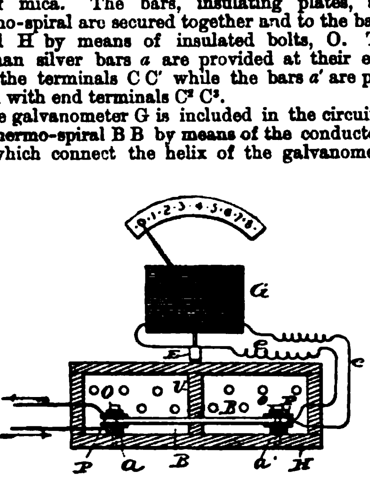

Fig. 2.

In the operation of the apparatus the current to be measured, or a portion of it, is first converted into a thermo-electric current, the thermo-pile standing in the same relation to the main circuit as a converter, the primary coil of the thermo-pile being represented by the heating-bar or device through which the current to be measured is passed. As is well known, variations of heat applied to the alternate joints of a thermo-pile produce variations in the current generated by the thermo-pile, so that the variations of currents to be measured are indicated by the variations in the strength of the thermo-electric current.

The apparatus is constructed so that when no current is passing through the heating wire or rod the two sets of alternating joints of the pile are of exactly the same temperature, and hence when no current is passing through the device the galvanometer points to zero.

Upon the passage of current through the bar *a'* to the terminals of which are connected the ends of the circuit in which the current is to be measured, the bar will commence to heat, and the heat will increase as the current to be measured increases in quantity, the temperature of the bar *a'* varying with the varying quantity of current passing through it, and as the difference of temperature of the bars *a a'* varies, such variations will be indicated by the deflections of the galvanometer, so that the latter operates to indicate and serve as a measure of

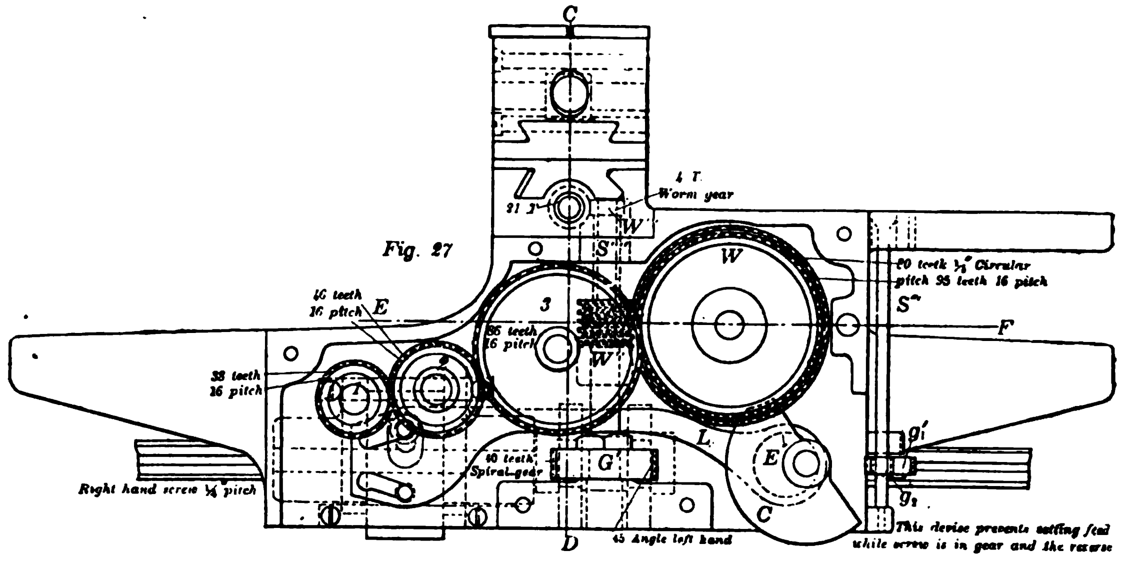
Fig. 27

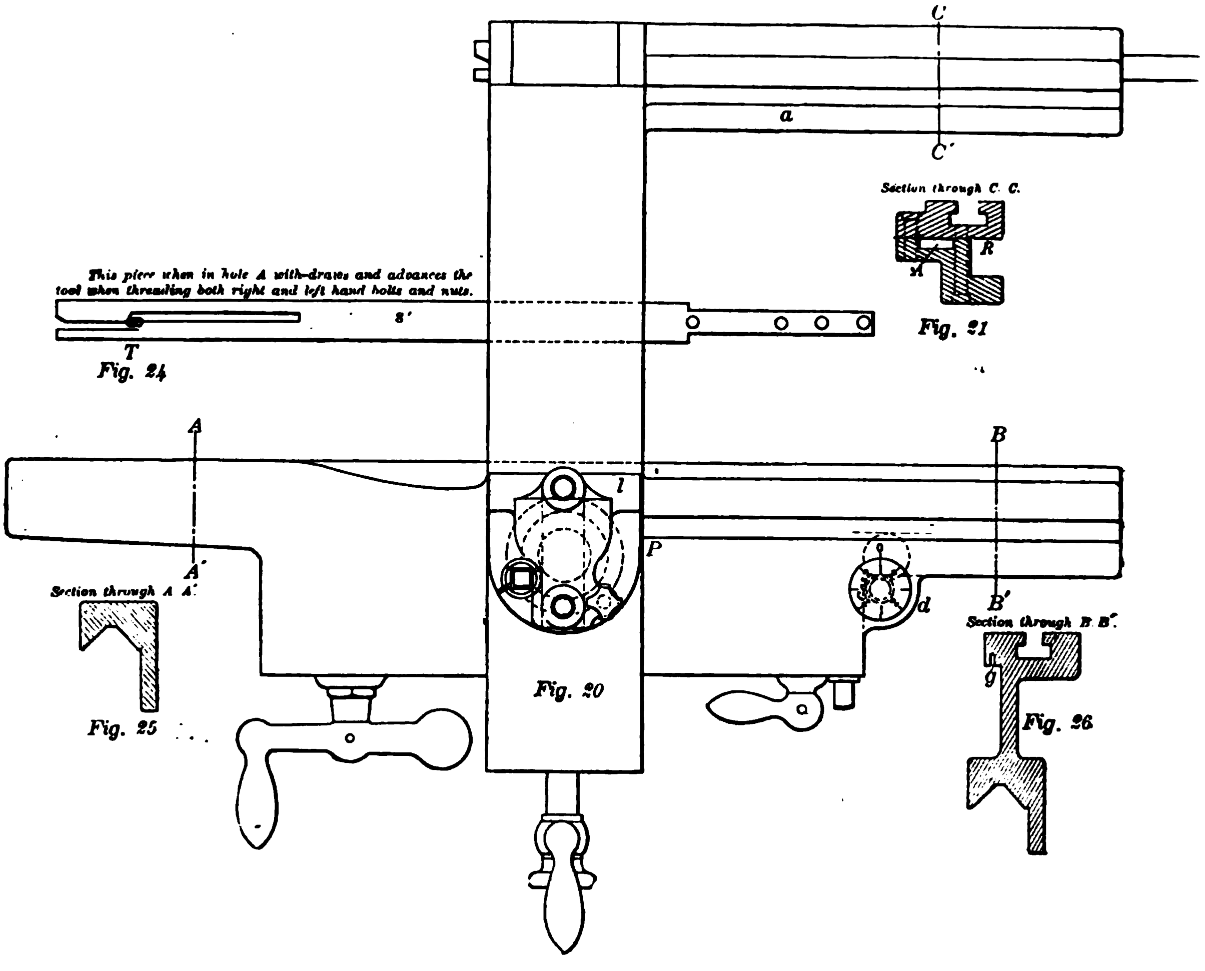
Fig. 20
C
a
C'
Section through C. C.
R
A'
This piece when in hole A withdraws and advances the tool when threading both right and left hand bolts and nuts.
S'
T
A
A'
Section through A A'.
l
P
d
B
B'
Section through B B'.
g

Fig. 24

Fig. 21

Fig. 25

Fig. 26

the current passing through the bar a'. The bars a a' are made of the same material, and are uniform in size and shape and in every way, so that the temperature of the alternate joints of the thermo-pile when no current is passing through the instrument will always be the same, regardless of what the temperature in the containing box or room, in which the apparatus is placed, may be. In view of the well-known fact that the difference of potential of a thermo-pile depends for given material and construction only on the difference of temperature of its alternate joints, it follows that the instrument's readings must always be correct, no matter whether the outside temperature be high or low, nd it is by the varying strengths of the thermo-electric current, which act upon and are recorded by the galvanometer, that the strength of the current in a circuit can thus be measured without employing the current itself as the direct agency for actuating the device.—*Electrical World* (*N.Y.*)

It is said that by holding lead pencil writing over steam until it is quite damp, it is rendered durable, and will not blur afterwards.

DETAILS OF SWEET'S 16in. ENGINE LATHE.*

Fig. 20 shows a general plan of the carriage and tool post. Owing to the construction of the head-stock and the gap, the arm *a* forming the back bearing of the carriage does not extend to the left side of the cross slide. A T-slot for bolt heads extends the full length of *a*. The section *c c* shows the construction of the arm *a*, also of the gib piece which holds the carriage down at the back side. A projection of the bed shown in section at S, Fig. 22 (page 5), fits the recess R, Fig. 21, and gives an exceptionally large bearing. The opening A', Fig. 21, extends the full length of the gib, and receives a rectangular steel bar, shown in plan at S'. This piece is made to fit closely in groove A, but will slide endwise easily. Its operation is as follows:—A steel clamp, shown in section at C, Fig. 22, and in plan at C', is placed on the lathe-bed, and the reduced end of the bar S" slides through the projecting jaws of the clamp. Taper holes and pins are provided in the bar for different lengths of screws, and when the pins are drawn to the clamp by the movement of the carriage, the bars stop until the tongue shown in section at T, Fig. 24, reaches the offset in the slot, when the tool post is carried back and forward by the amount of difference in the plane of the slot. The device is shown in transverse section at T, Fig. 32, and its action is further described in connection with this figure. The construction of the front side of the carriage is shown in section A A and B B, Figs. 25 and 26. The front side of the bed of the lathe projects under and beyond the groove *g*, Fig. 26, which receives a steel strip so fastened that it moves with the carriage, but can drop of its own weight on the bed. This prevents the turnings from falling down on the guide. A plan of the tool post is shown at P. The graduated disc at *d* is in direct connection with the main screw, and by observing the position of the disc the operator may, when cutting screws, disengage the carriage, and run it back by hand, set his tool for a new cut, and when the disc comes in position, throw in the nut, and the tool will coincide with its previous path. The section E F, Fig. 27, shows the construction of the friction feed clamp. the shaft S" and gear *g'*. which engages with the rack, are one piece [illegible] ut in position from the

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* By Prof. C. I. King, in *American Machinist* (seep p. 345, 386, 410).

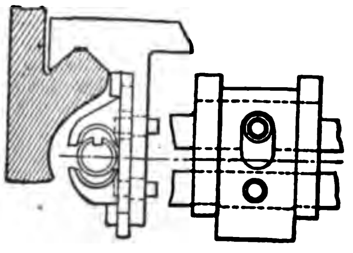


Fig. 30

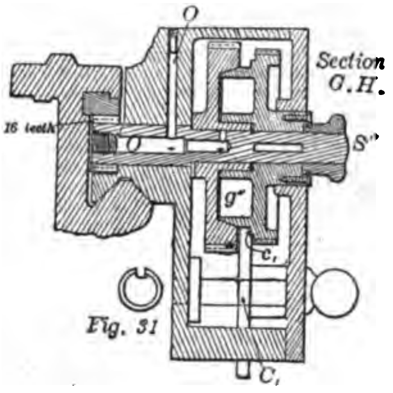


Fig. 31

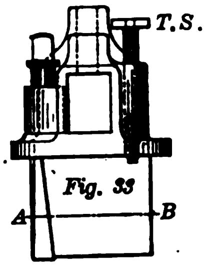
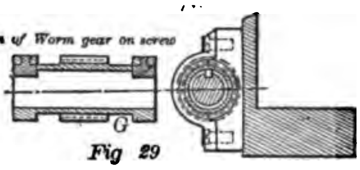
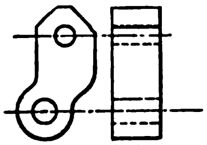


Fig. 33



Section of Worm gear on screw

Fig 29



Support for end of screw

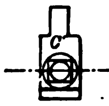


Fig. 23

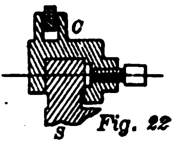


Fig. 22

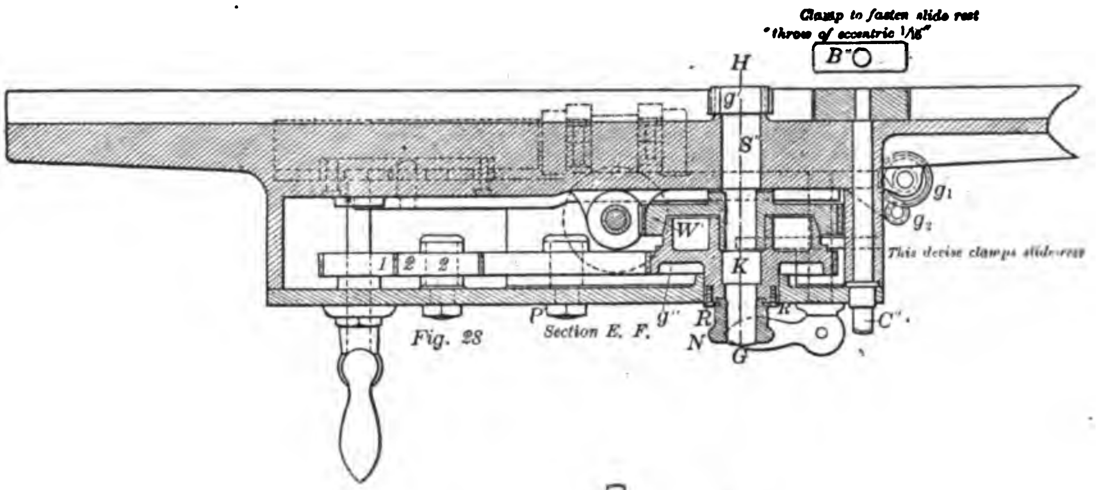

Clamp to fasten slide rest
"throw of eccentric 1/16"
B''
H
g'
S'
g₁
g₂
W'
K
This device clamps slide-rest
1
2
2
P
g''
R
N
G
R
C''

Fig. 28

Section E. F.

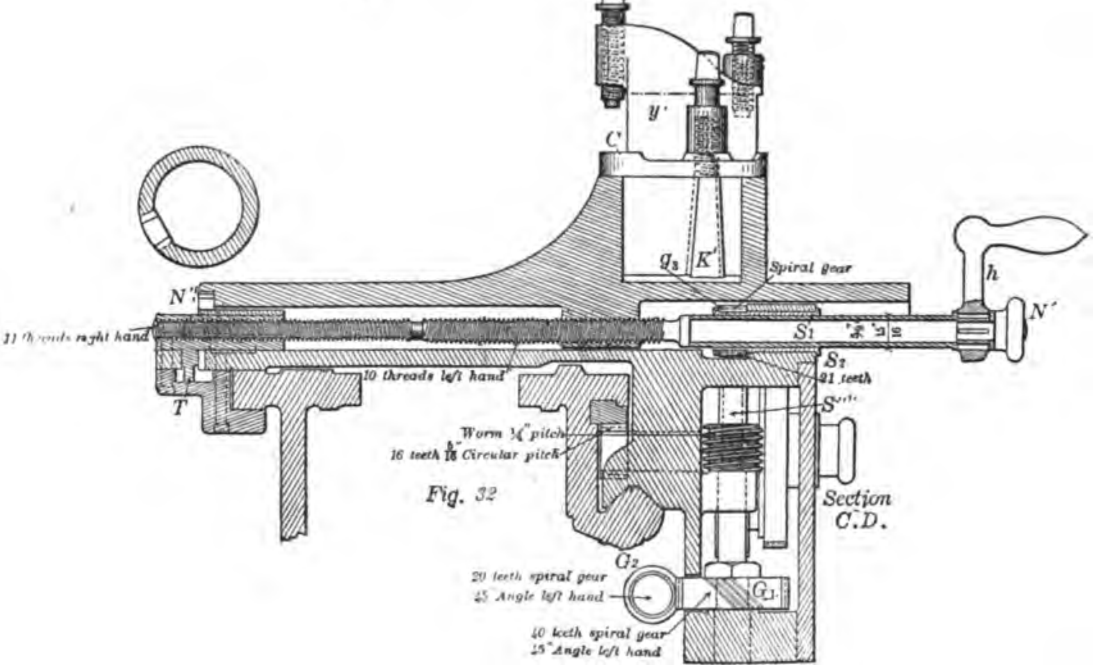


Fig. 32

back side of the carriage, and the worm-wheel W′ and gear g'' go on from the outside. To increase the area of the bearing of W′, its hub is extended outward to the plane of the disc of g'', while the hub of the gear extends over W′ to its disc. On the outside of g'' the hub extends through the cover-plate P′, and is there connected with the star nut N by means of two half-rings, R R, recessed into the hub of N, and screwed to the hub of g''. A key, K, is fitted in the shaft s'', and connects with the gear. To gain access to gears 1, 2, 3, and g'', it is necessary only to remove plate P′, these wheels coming off with it. This will also expose the remainder of the inside mechanism. The device for clamping the carriage in position is shown at C″, Fig. 26. An eccentric is turned on the inner end of the shaft, to which is fitted a block, B″, which has a vertical movement as the shaft turns. The index plate is moved by two small spiral gears g_1 g_2, Figs. 27 and 28, which connect with the main screw, g_2 being fastened to the shaft S′′′. Motion is imparted to the feed train from the screw by two 45° spiral gears; the one on the screw is shown in the longitudinal and transverse section at G, Fig. 29. This gear is of steel, and has short keys in each end which fit the spline of the screw. Two journals are turned—one on each side of the gear—and they fit in the bearing shown at Fig. 29.

In Fig. 27, the arrangement is shown of the wheels in position with the cover plate removed. The second spiral gear is shown at G′ and near the middle of the shaft s'''' is the worm W″, shown in dotted lines. At the upper end of S′′′ is a second worm W′′′, which drives a spiral gear fast to a sleeve on the cross-feed screw. The nut is drawn in and out by means of a steel lever L, and eccentric E′, Fig. 27. At the opposite end of L are two slots diverging at the necessary angle, and a pin from each half of the nut fits into these slots. A separate plan and side elevation of the nut is shown at Fig. 30. The cam C_1, Fig. 27, is fast to the eccentric shaft; one end of this cam turns in such a position as to prevent clamping the feed train when the nut is in use, and by reversing it, it prevents putting in the nut when the friction is in use.

In the vertical section G H, Fig. 31, the cam C_1 is shown in place with the nut open, and the eccentric cannot be turned unless the gear g'' be withdrawn sufficiently to let the step g' on the cam pass the worm. The shaft s'' is oiled through the holes O O, the oil being distributed from the inside. The transverse section C D, Fig. 32, fully represents the position of the two spiral wheels $g_1 g_2$. At g_3 is a section of a third spiral wheel which is driven by the worm W''' at Fig. 27. This wheel is fast with a sleeve S_1 inside of which is a second sleeve S_2, made to turn with the first by a key and spline. The transverse screw is fitted to this second sleeve, and is free to turn in it. The outer end of this sleeve is hardened, and terminates with a collar, in the face of which eight spherical countersinks, equally distant, are made. Through the hub of the handle h four holes are drilled to coincide with those in the collar. In these holes pins are placed which are somewhat longer than the thickness of the hub. In operation it is only necessary to screw the star nut and washers N' against the pins, which will force them into the countersinks, and give a positive motion to the screw. The screw extends the full length of the carriage, and has two threads cut on it, of ten and eleven pitch respectively, and left and right-hand. The left-hand thread is fitted to a nut, which is a part of the slide, while the right-hand thread is fitted to a steel nut N'', fitted to the carriage. This nut also has a ¼in. end movement when caused to slide by the offset in the slot of the bar s', Fig. 24. It is easily seen that we have here a device giving a rapid movement of the slide, and a long range of travel with a minimum length of screw as the screw travels with the slide, and while the slide travels faster than the screw it does not overtake the handle until the full 12in. radius has been reached. At T', Fig. 32, a side view of the tool post is shown. It will be seen that two set screws are provided for holding the tool when heavy work is to be done, and that much larger steel can be used for tools than with the ordinary tool post. Also, when it is necessary to move the tool to one side of the slide, it can be placed at right angles to the slot, so that it will rest only on the ledge l, and be held by the single screw above. The lower end of the post is cylindrical, and fits in a hole in the slide, and it is fastened in position by a taper key K', which is drawn up by a cap nut, the cylinder being split to allow it to expand. The post is raised and lowered by the thumb-screw T S, Fig. 33.

EDISON'S MIMEOGRAPH.

THE following report of the Committee on Science and Arts of the Franklin Institute refers to the mimeograph or duplicating system devised by Mr. Edison. The apparatus is called the mimeograph, and is intended to be used for duplicating autographic and type-written work, drawings, music, &c. In its operation it is claimed to be an improvement on pre-existing methods of duplicating, including some new features. The principle employed is not new, consisting in puncturing a sheet of paper or similar material with small holes along the lines to be reproduced, thereby making a stencil. This is placed on the surface to be printed, and a colouring material rubbed or pressed on it, so as to be forced through the holes on to the surface below, which is thereby printed.

The apparatus for autographic duplicating, and the operation, may be described as follows: There is a hardened steel plate, the surface of which is covered with fine points, to the number of about 200 to the square inch, formed by scoring it with grooves. This plate is made 1¼in. or 3in. wide, and long enough to extend across the width of the stencil sheet, which is to be prepared, and it is set in one end of a convenient wooden frame. A slab of slate, or other suitable material, is set in the remaining portions of the frame, the top surface of all being flush, and making a level bed. The stencil sheet, which is a thin paper covered with paraffin, is laid on this bed, the part of it to be written on being kept over the steel plate. The writing or drawing which it is desired to duplicate is then done with a smooth-pointed steel stylus, which is used with about the same pressure and ease as a lead pencil. As the stylus passes over the stencil paper the latter is pressed down on the steel points so that they are driven through it, making numerous small holes along the lines which the stylus traverses. The stencil thus prepared is placed between the two frames, one of which slides within the other, and is clamped down, so that the stencil is thus stretched smooth and securely held. These frames carrying the stencil are then hinged at one end to the bed, the sheet to be printed is placed on this bed and the stencil brought down upon it. An ink roller covered with semi-fluid ink is then passed over the stencil, pressing the ink through the holes which have been pierced in it down on to the paper below, thus making the desired impression upon it. Printing may be done in this way very rapidly, at the rate of several hundred an hour, and one stencil may be used for as many as 3,000 copies before it is worn out by the enlarging of the holes.

To prepare a type-written stencil: The edges of a sheet of paraffin paper are folded over a piece of coarse silk cloth, back of which is laid a stiffening sheet. They are then passed through a typewriter in the ordinary way, except that no ribbon is used. The type strikes the paraffin paper, driving it against the silk cloth, which is termed "perforating silk." Wherever the type strikes, the paraffin is taken up by the cloth on the other side, and, owing to its coarse texture, small holes are pierced through the paper in the lines of each letter. Copies as good as actual type-written work are taken from the stencil thus made by placing it in the printing frame and using the inking roller, as before described. From 1,000 to 1,500 copies may be made from one stencil. The type is not at all injured, as in some processes—merely needing occasional cleaning.

The sub-committee has examined the apparatus, its operation, and the work produced, and is very favourably impressed with the results obtained. It has also made some investigations into other methods of preparing stencils for printing, and in no instance in the comparison has its judgment been unfavourable to the mimeograph. The method employed of puncturing the stencil sheet from below upwards by pressing upon a slab covered with numerous small points is believed to be original, and worthy of special commendation. Perforations so made, being largest toward the surface to be printed, make a fuller and more continuous line than those made from above. The apparatus is deemed very useful for the purpose for which it is designed, and the sub-committee recommend the award of the John Scott Medal to the inventor.

Red Lead.—Most commercial red lead consists of a mixture of oxide of lead with pure red lead. A small proportion of carbonate of lead is also generally present, formed by exposure to air after manufacture. To remove the free oxide of lead from commercial red lead various substances have been recommended, such as a solution of sugar of lead, or cold dilute acetic or nitric acid. Sugar of lead does not remove the carbonate of lead, while in the case of acetic and nitric acids there is danger of peroxide of lead being separated. Mr. J. Lowe—*Dingl. Polyt. J.*, 271, 472-477—recommends the use of a 10—12 per cent. solution of nitrate of lead. 200—300c.c. are sufficient for 20grm. of red lead. This solution removes not only the oxide of lead, but also the carbonate and any traces of metallic lead. The red lead should be first digested for a considerable time, and then boiled with the nitrate of lead solution. The percentage of free oxide of lead in the samples examined varied from 16—31 per cent. The purified red lead is brighter in colour than the original sample. Nine samples of purified red lead were examined as to the percentage of peroxide of lead obtained from them by digestion with dilute nitric acid. They yielded from 25·4—25·7—per cent. PbO_2. The *Journal of the Society of Chemical Industry* says:—"This agrees with the results obtained by Mulder, Phillips, Houton-Labillardière, and Pichon, and points to the formula Pb_4O_5 for red lead, instead of the usually accepted formula Pb_3O_4, which requires 34·88 per cent. of PbO_2. At the same time, it is probably possible by long-continued burning to obtain Pb_3O_4; for Dumas found that a sample of red lead, after three burnings, contained 33·2 per cent. PbO_2. In the formation of red lead, not only the temperature, but also the duration of the heating is of importance. As long as free PbO is present, and the composition of the colour is Pb_4O_5, there is much less danger of the red lead being spoiled, owing to the formation of Pb_2O_3, than when the colour has the composition Pb_3O_4. The suggestion that red lead is a mixture of Pb_3O_4 and Pb_4O_5 is not compatible with analytical results. It is pretty certain that both compounds exist, but a red lead containing free PbO seems to have the composition Pb_4O_5."

A 30lb. Vacuum.—An American paper says:—"The Johnstown Pneumatic Tube Company has built near Marion, N.J., an experimental tube 30in. in diameter and 1,000ft. long. It is made of No. 18 sheet steel, the sheets being 50in. long. The joints are lap seam, and the tube is strengthened with cast-iron rings. The cars are spherical, weighing 750lb. each, and roll on a longitudinal steel rail 4in. wide and ⅜in. thick, fixed in the bottom of the tube. The spheres travel the 1,000ft. in about 13 sec., equal to about 53 miles an hour, 30lb. vacuum being used. Light cars of papier mâché or other material are proposed." The *Engineer* says:—"If we could get such a vacuum in this country the low-pressure engine might be put on its legs again. Our barometers have evidently very little effect on atmospheric pressure as compared with those in the States."

SCIENTIFIC NEWS.

◆

AN ephemeris of Barnard's comet e 1889 (June 23) has been compiled by Dr. Spitaler, of Vienna. On Aug. 4, Berlin midnight, the position will be R.A. 4h. 20m. 35s., N. Dec. 50° 0·3' The brightness is, however, decreasing.

Dun Echt Circular No. 174 publishes a telegram from Prof. Krueger, announcing the discovery of a bright comet by Mr. Davidson, of Melbourne. Local mean time July 23, 8h. 43m. R.A. 12h. 46m. 9s.; S. Dec. 32° 29' 6. Daily motion 11m. +; 2° 48' +.

Mr. W. H. S. Monck has issued "A Catalogue of the Aphelia of Comets," corrected for precession to 1890.

Prof. Celoria has published in the *Astronomische Nachrichten* a new orbit for the binary star Gamma Coronæ Borealis, which is considered superior to that of Doberck. He makes T = 1840·508 and the period 85·2767 years.

The death is announced of M. Hippolyte Leplay, the well-known chemist.

The committee appointed to consider the basis upon which the grant of £15,000 a year for University Colleges in Britain should be distributed have recommended that the grant should be divided as follows:—To Owens College, Manchester, £1,800; to University College and King's College, London, £1,700 each; to Liverpool University College, £1,500; to Mason College, Birmingham, the Yorkshire College, Leeds, and Nottingham University College, £1,400 each; to Bristol University College, the Durham College of Science, Newcastle-on-Tyne, and Firth College, Sheffield, £1,200 each. The committee are of opinion that University College, Dundee, should be dealt with in connection with the Scottish Universities, and especially with the University of St. Andrew's; but they recommend that it should for the present year have a grant of £500.

The Archduke Ludwig Salvator, of Austria, has been elected an honorary member of the Vienna Academy of Science. He is the second son of the Grand Duke Leopold II. of Tuscany, and holds the rank of colonel in the Austrian army. He is chiefly known, however, for his great devotion to natural science. He has made a number of scientific journeys, mostly in his own yacht, to various countries bordering on the Mediterranean, as well as to America, Asia, and Africa, and has published several interesting works descriptive of his travels. It was he who first drew attention to the Tunisian Harbour of Bizetta, and its probable importance in the future.

Another scientist who claims royal or princely blood is Prince Albert of Monaco, who has done much useful work in deep-sea researches, and has recently devised a new apparatus for the purpose. With a view to remedying the defects of the instruments used in the expeditions of the *Challenger*, the *Blake*, and the *Vettor Pisani*, Prince Albert devised an apparatus which is constructed on new principles, and may be let down closed to any desired depth, then opened for purposes of observation, and re-closed before being brought to the surface. With this appliance Prince Albert has operated with satisfactory results to a depth of 500 mètres in the Mediterranean waters.

The expedition to explore the submarine flora and fauna of the ocean, under the supervision of Geh. Medicinal-Rath Prof. Hensen, M.D., which is to last for several months, has been subsidised by the Emperor William to the the amount of 80,000 marks. A special subject of investigation will be the effect of light on the oceanic fauna, and Dr. Hensen, it is understood, will undertake a series of experiments with this object by means of the electric light. The east coast of Greenland is the first cruising ground.

The Government are evidently unable to see their way to introduce what is called "technical education" into the elementary schools; but they will introduce a measure dealing with the "higher branch" of the subject. Has any [illegible] a definite idea of what "technical education" [illegible] that it could be given in elementary schools [illegible] what is the "higher branch"?

A testimonial is to be presented to [illegible] Kennedy, of University College, by his [illegible] students. Prof. Kennedy has held the chair of Mechanical Engineering for fifteen years.

The monument to Ohm, to be erected in Munich, has been the occasion of gratifying co-operation on the part of physicists and physicians of all nationalities. The great pioneer in the enlistment of the electric force in industrial and professional work—for technical and therapeutic purposes—illustrates, in the movement to honour him, the essential kinship of the sciences, the subscriptions for his monument coming in with equal liberality from French, Italian, English, and Russian *savants*.

In the United States the monument to Audubon "hangs fire," which is perhaps characteristic of the people. They can appreciate the work done by Ohm, because that helps industrial progress; but they probably think that Audubon's best monument is his works. If the monument business were carried out as some would like, what a surfeit of statues there would be in, say, the year 2000!

The Board of Trade desires to avail itself of the organisation of the London Chamber of Commerce for the purpose of ascertaining the probable extent to which a Government Laboratory for Standardising Electrical Instruments would be used (*a*) by supply companies for the certification of meters, voltmeters, and ammeters, and (*b*) by manufacturers of electrical instruments. Replies for 1890 and 1891 are, therefore, invited to the following questions. The individual replies will be considered as confidential, and only the aggregates will be published. (1) Supposing a standardising laboratory to be ready at the commencement of the year 1890, how many ordinary house meters do you expect to send in for certification? (2) How many ammeters do you expect to send in? (3) How many voltmeters do you expect to send in? (4) State whether you expect to send in as an undertaker or as a manufacturer.

The University of Michigan (Ann Arbor) has adopted a course of study for the degree of Bachelor of Science in Electrical Engineering. This course will be parallel with those in civil, mechanical, and mining engineering, with the same requirements for admission. In addition to special electrical courses, laboratory work, &c., complete tests of central electric light and power stations will be undertaken, and the student will be made acquainted with the best practice in electrical manufacturing and engineering by visits to places where such enterprises may be seen on a large scale.

The Broadway line at Albany, N.Y., will be the longest electric railroad in the world, being, with its branches, 16 miles. That of the greatest length now being operated is 14 miles in Topeka. The power is to be furnished by dynamos driven by three 90 horse-power engines. The fifteen new cars ordered will weigh over four tons each.

The Chicago, Milwaukee, and St. Paul's Railroad have adopted a wheel-tread which is turned to the same radius as the top of the rail on which it runs, so that the two fit into each other, and a large bearing surface is secured. The experiment is said to have been highly satisfactory.

It is not often that a locomotive is struck by lightning whilst in motion, or even when standing in the "yard"; but, according to American papers, the engine of an express train on the New York and Newhaven Railway was struck by a "bolt," the shock dazing and half-stunning the engineer and fireman, and disabling the engine. It is described as a "tremendous bolt of lightning."

An "American inventor" has discovered a chemical compound from which light, heat, and power can be obtained at a cost much below that of electricity.

A remarkable cave of stalactites has been discovered on the top of the Taygetus range. Judging from the narrowness of the entrance and the assertion of the natives that the opening had not been observed before the earthquake of two years ago, it would seem that the cave had not before been entered by man. The height of the cave varies. For a distance of about thirty paces from the entrance it is from 3 mètres to 4 mètres high, whilst further on it reaches a height of from 5 mètres to 10 mètres. In width it measures from 10 mètres to 18 mètres. Thousands of stalactites hang from the roof in wondrous groups, whilst others, formed by the dripping from above, rise in curious shapes from the floor. The cave is extensive, and has many windings. The floor is very uneven. The discovery of the cave is, says the *Athenæum*, regarded as very important, and as likely to attract the notice of specialists, since it would seem to rival even the renowned cave on the Island of Antiparos.*

Lieut. Schwatak has reported the discovery of a large tribe of cave-dwellers in the unexplored regions of Northern Mexico. Their abodes are exactly like the old, abandoned cliff dwellings of Arizona and New Mexico. So wild and timid were the inmates that it was hardly possible to get near them. Upon the approach of white people they usually fly to their caves or cliffs by means of notched sticks placed against the face of the cliffs. They can also ascend perpendicular cliffs without the use of these sticks if there are the slightest crevices for their fingers and toes. A number of children, playing in a deep canyon, were interrupted, and immediately fled to the low brush and rocks, and could not be found, hiding as completely as young quail. These cliff-dwellers are usually tall, lean, and well formed, their skin being blackish-red, much nearer the colour of the negro than the copper-coloured Indian of the United States. They are said to be sun-worshippers.

It was always obvious that if any means could be devised of storing up the momentum of a carriage when bringing it to rest, it might be made available for starting the vehicle again. The tramcar starter of Messrs. Vereker and Yeates has, it appears, been working successfully for some months on a car belonging to the Southwark and Deptford Tramway Company. The apparatus consists mainly of a coiled spring in connection with a clutch arrangement and a spud on the driver's platform. A simple movement of the driver's foot will throw the apparatus into or out of gear, and one revolution of the car wheels is sufficient to charge the spring for the purpose of restarting. On starting the car the first forward movement of the horses causes tension on the traces and at once releases the spring, which, acting upon the wheels, causes the car to move gently forward several feet—the car, in fact, following the horses up. The apparatus when being wound up acts as a powerful brake; it can be used as an emergency brake, and can be operated from either end of the car.

It is proposed to hold a World's Exposition in the United States on the anniversary of the discovery of America—1492-1892. Four committees, each of 25 members, have been appointed to settle the preliminaries, and the New York Chamber of Commerce has appointed a committee of 60 to co-operate. It is proposed to arrange the Exhibition on a gigantic scale, under Government auspices, and it will be international, in the sense that all nations will be invited to take part in it.

It is stated that the contagiousness of phthisis is now officially recognised in Germany, and that every soldier is to be examined once a month to see whether his chest expands under the influence of drill and athletic exercises. If it does not, he is to be dismissed from the army as being predisposed to phthisis, and likely to infect his comrades.

The Municipal Council of Rome has decided to devote a sum of money towards the formation of a Pasteur Institute.

The determination of the boiling points of potassium and sodium has, it is said, been satisfactorily accomplished by Mr. Perman, by placing the metals in a hollow iron ball surrounded by a screen of fireclay and heated with one of Fletcher's blowpipes. The temperature was found in each case by means of an air thermometer, consisting of a glass bulb with a capillary stem, which was lowered into the vapour of the boiling metal, sealed, and broken open under water, the temperature being then calculated from the volume of water entering the bulb in the usual way. The mean results gave 742° C. as the boiling-point of sodium, and 667 as that of potassium, the figure for sodium being more trustworthy than that for potassium on account of the smaller amount of the latter metal employed.

The occultation of Jupiter by the moon on August 7th is one of a series, during the year, of thirteen eclipses of the planet's light from some portion of our globe. The passage of Jupiter along a looped course during this period, as seen from the earth, causes the latitude limits of visibility to vary irregularly. The January and December occultations are invisible from the proximity of the sun; of the other eleven, six are visible at the latitude of Greenwich. It is remarkable that this is the only one occurring when the moon is above the London horizon. The planet disappears at the dark edge at 7.4 p.m., and reappears at the bright edge 57 minutes later. We gave the position-angles last week. The angular diameter of Jupiter at the time is 37″, or $\frac{1}{50}$ of that of the moon. The disappearance is therefore not instantaneous, but gradual through about $1\frac{1}{3}$ minute. Of the satellites, III. disappears a few minutes previously, II. follows the planet rapidly, while IV., nearly at greatest eastern elongation, only disappears about a quarter of an hour later. As to I., it disappears behind the planet at 6.19, and does not reappear from eclipse in the shadow till 9.31 p.m.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE ETHER AND THE CONSTITUTION OF MATTER.

[30199.]—In the interesting work, "Stellar Evolution," recently published by Dr. Croll, he attacks the theory of the luminiferous ether. Quoting the views expressed by Mr. Charles Morris in an article on "The Matter of Space" (*Nature*, Feb. 8, 1883), Dr. Croll says: "The hypothesis of an ether specially distinct from matter he considers a gratuitous assumption, and one of the last surviving relics of 18th-century science; and unless it can be proved that highly disintegrated matter is positively incapable of conveying light vibrations, there is no warrant for assigning this duty to a distinct form of substance." Now, I should like to see the point discussed as to whether *matter* in any form, as we know it, *is* "incapable of conveying light vibrations"? It seems that this view "has been advocated also by Euler, Grove, and others"; but do other physicists admit that this is possible?

Sir W. Grove, in a lecture at the London Institution, in 1842, maintained "that heat and light, according to the undulatory theory, were the results of the vibrations of ordinary matter itself, and not that of a distinct ethereal fluid." This view of the matter, however, does not appear to me reconcilable with the views of Sir William Thomson, and the authors of the "Unseen Universe." I should like to hear the opinion of "F.R.A.S." and others of your able correspondents on this subject. In connection with this matter Dr. Croll refers to the opinion held by some writers that the ether may possibly be merely a continuation of the earth's atmosphere. "Our atmosphere," Dr. Sterry Hunt says, "is not terrestrial, but cosmical, being a universal medium diffused throughout all space, but condensed around the various centres of attraction in amount proportional to their mass and temperature, the waters of the ocean themselves belonging to the universal atmosphere." A similar theory was advanced by Mr. Matthieu Williams in his "Fuel of the Sun," and, according to Dr. Croll, the same idea was suggested by Sir W. Thomson in 1854, but has since been abandoned by him. Are there any good grounds for maintaining such an opinion? As is well known, the ether is supposed to be a perfect fluid, the nature of which is continuous, not molecular. If we are compelled—by the wave theory of light—to consider it as possessing such a constitution, it follows, I think, that it cannot consist of any form of matter that we are acquainted with. But does the undulatory theory *absolutely* require a constitution of the kind?

With reference to the vortex theory of matter, Dr. Croll raises the objection that it is inconsistent with the first law of motion. If this be true, it seems curious that the objection should have escaped the notice of Sir W. Thomson and other physicists who advocate the theory. Dr. Croll's argument is that the supposed vortex motion of the atoms would give rise to an enormous (so-called) centrifugal force, which must be counterbalanced by the pressure of the ether. But this cannot be, as the ether offers no resistance to the passage of the atom as a whole. Dr. Croll says: "If this perfect fluid outside the vortex atom can exert this enormous force on the revolving material without being itself possessed of vortex-motion, there does not seem to be any necessity for vortex motion in order to produce resistance." This objection appears worthy of consideration.

With reference to the (suspected) compound nature of the chemical elements and the supposed existence of a hypothetical substance called *protyle*, the elementary constitution of the gaseous nebulæ (as shown by the spectroscope) certainly seems in favour of such an hypothesis. These nebulæ, which are supposed to be the original form from which solar systems (containing so many so-called elements) are supposed to be evolved, are known to consist chiefly of hydrogen and nitrogen (and in some cases nitrogen only). How, then, have all the known elements been formed from two gases, unless these elements be really compound bodies? I may mention in this connection that a very interesting paper by Prof. Haughton on the "Law of the Atomic Weights of the Chemical Elements" appears in the last number of the *Proceedings* of the Royal Irish Academy. Considering Newland's law of atoms, and Mendelejeff's periodic law, Dr. Haughton plots the elements "according to their atomic weights and valencies; the vertical co-ordinates being atomic weights, and the horizontal co-ordinates, being valencies, counted, for convenience of plotting, positive or negative, according as the element belongs to an odd or even number of sevens." He finds that the nine points representing lithium, beryllium, boron, fluorine, sodium, aluminium, phosphorus, sulphur, and chlorine lie upon a simple serpentine cubic curve with one real asymptote, and a lineal branch which passes through carbon, nitrogen, oxygen, magnesium, and silicon. There is a possibility of another element, hitherto undiscovered, on the cubic branch with the atomic weight 13; another with atomic weight 16·4, and another with weight 25. On the lineal branch there is a possibility of three unknown elements with atomic weights 18, 22, and 26 respectively. But hydrogen refuses to conform to the law, and "remains alone outside the harmony." It appears there are six missing elements related to hydrogen. These Mendelejef thought should be looked for between hydrogen and lithium, but Dr. Reynolds has "proved that they must be sought for behind hydrogen, which is the last note of the primeval octave. Are they to be found between zero and unity, or looked for 'behind the looking glass' in the unknown land of negative atomicities where heat, light, and electricity reside?" Taking the common centre of gravity of the fourteen elements (regarded as equal weights), and joining this point with the point representing hydrogen, Dr. Haughton finds that this line is very nearly parallel to the asymptote of the cubic curve, the difference in direction being only twenty minutes of arc, and he adds, "Hydrogen, the first born, and king of the elements, sits alone, without brothers or sisters, and seems to resemble the fabled Isis of Egyptian mythology." The question is naturally suggested whether hydrogen is not identical with the hypothetical *protyle*. But this has, I believe, been suggested before. Prof. Gruenwald has, however, attempted to show (*Astronomische Nachrichten*, No. 2797) that hydrogen is really a compound body composed of two elements—viz., "coronium" (which gives the 1474 K line), and "helium" (the element giving D_3). Possibly, then, either "coronium" or "helium" may be the sought-for *protyle*.

J. E. G.

ζ BOOTIS—CRESCENT OF VENUS.

[30200.]—Of course, the measures Mr. Sadler quotes of this star were made two years ago, and are not correct for present date. At that time I could see two round distinct discs in contact; but now can only slightly elongate. I should estimate that the discs now appear scarcely more than one and a half times as long as broad, which would be about 0·3″, I suppose, and I believe ζ Boötis is now not wider than that. My estimates of P. A. vary from 300° to 320°; but the star is so close, and definition generally so bad, that the estimate is almost worthless. The list of binary stars in *Observatory* this year does not include ζ Boötis; but η Coronæ is stated to be 0·6″. This I easily divide. μ^2 Boötis 0·7″ is plainly wider. 42 Coma Berenices I see as two discs in contact, evidently much wider than ζ Boötis, and it is 0·39″.

With reference to the visibility of the crescent of Venus, I have not yet been able to make any experiments on the visibility of an artificial crescent placed at proportionate distances; but I have made a few rough calculations which may be of interest to those who think it possible. Supposing Venus to subtend an angle of 1′, it is seen at a distance of 60°, or 3,600 times its apparent diameter roughly. If Venus be one arc diameter, it follows it must be definable at 100 yards. I take a white crescent on a black background, and by means of a lens produce a minute image in the focus. If this be $\frac{1}{360}$°, it should be definable as a crescent at 10in. from eye—the normal sight distance. That means that the *shape* of an object $\frac{1}{100}$in. diam. must be discernible. Again, a man 6ft. high subtends the same angle at about four miles distance. Now, possibly one might infer, from motion or other accident, that the minute speck was a man; but, if he kept still, would it be possible to any sight to say whether he was upright or bent. Four-inch letters should be definable at 400 yards. I have asked a few people to look at 5in. letters, and not found one who can see them at 200 yards well enough to tell one letter from another.

Now, in these cases, we are not troubled with glare, nor in the shorter distances with boiling atmosphere; but all the circumstances are favourable. I commend the reproduction of a minute image by means of a lens to those who think they see Venus as a crescent; but I submit that, unless the claimant can pass the test of deciphering previously unknown letters at distances correspondingly greater than ordinary mortals, he must admit self-deception in the matter.

I have some reasons for doubting cases of exceptional sight in my own experience. I stood on a pier at a yacht race, and the sailors there passed opinions freely on the yachts when returning. They identified the leaders at a distance at which I could not venture a guess, and, as the yachts neared, they pointed out the peculiarities of each. "That is so-and-so's half-a-mile ahead of the others." Well, when the leader arrived, *it was not the yacht they asserted it to be.*

Again, I was looking out of a window at a boat on the beach, and inquired if it was Thompson's boat? A young girl said it was, and declared she could read the name painted on the board behind seat. I was astounded, for I could barely see that there was something white. I inquired if she could distinctly read it, and she told me the name. On going out to the boat it turned out to be a different name, and not that particular boat at all. In fact, all the astonishing instances of extraordinary vision that I have been able to investigate have turned out to be instances of self-deception.

We must remember that defining the shape of minute points is a different thing to the extreme sensitiveness that enables some to pick up faint objects.

Edwin Holmes.

WHITE SPOT ON SATURN'S RING.

[30201.]—I have not seen it pointed out that this apparently fixed spot is compatible with the rotation of the ring (or rings).

One portion of the ring is subject to the direct light and heat of the sun, the other portion is screened from these, and (assuming that the planet is not in a state approaching incandescence) is in intense cold.

These great differences in light and temperature may cause great physical changes in, or on, the matter which appears to us as rings, changes which may not be immediate.

Assuming that that place on the ring, whereat the white spot is apparent, is *emerging*, it will be coming out of intense cold into sensible heat, and the white spot may represent the effect of the cold or darkness, or both, gradually being neutralised by the light or heat or both. The spot would appear (I may say, remain) fixed in that place, because there only would these conditions be maintained.

Observations of the planet after conjunction should dispose of this theory, because then the place corresponding with that whereat the white spot is now apparent, would be *immerging*, the conditons would be reversed, and there should be no white spot.

Phos. Bron.

DAYLIGHT OBSERVATIONS.

[30202.]—It is a well-known fact that a cloudless night following a hot day offers the worst possible definition for celestial observations. As the earth cools, and the temperatures of air and earth become more uniform, so does definition improve, and is best just before dawn.

Sm.

SNOW ON THE MOON.

[30203.]—Many thanks to "F.R.A.S." for his reply in 29977, p. 280. My "authority" for saying that the brightest peak of Aristarchus—equal in brilliancy to new-fallen snow—lies "sunk thousands of feet below the general surface level of the globe" is Neison, p. 273.

He shows us that "the central mountain is 10° bright, this last being the brightest on the whole moon," and equal to newly-fallen snow, by Proctor's quotation from Zöllner (Proctor's "Moon," p. 167). The summit of this brilliant central mountain rises to 1,280ft. above the plain, which, in turn, is sunk 5,073ft. below the outer level, and hence its apex is 3,793ft. below the general level of the globe. Thus I fail to see wherein my "assertion" was erroneous.

In letter 29737, p. 70, referring to the brilliancy of Aristarchus as *possibly due to snow*, "F.R.A.S." says: "I see no more reason why Aristarchus should not have snow upon its highest peaks than I do why the Himalaya should not be similarly covered." This involves, as it seems to me, the admission that the sunk central mountain may also be snowed, for the moon is an airless planet; there is no air-jacket with its aqueous vapour and gradually decreasing density with the elevation. The question of elevation above the surface is not there, as with us, a prime factor *in re* the snow-line (modified by latitude). This is right, is it not? But if the central peak of Aristarchus is snowed, I can see no valid reason why the general surface, standing some 4,000ft. above its level, should not be snowed also, or where this would "prove too much."

2. With regard to there being no greater accumulation of meteoric dust on the lunar surface (to form a stain) than on our earth, I feel sure that "F.R.A.S." will modify this view when he considers that, in our case, it is annually overlaid by fresh snow, or removed by rain and wind, whereas on the moon—where there is no atmospheric disturbance—it can accumulate for literally thousands of years.

3. As to the rays being the tracks of electrical surface discharges between, or *from*, quasi-volcanic centres, which removed the stain of meteoric dust from the snow surface, this latter, as a "non-conductor," is in my favour.

I look on the snow coating as equivalent to the non-conducting glass of a Leyden jar, and the semi-metallic meteoric dust as equivalent to a granular coating of tinfoil outside the jar. If this latter were globular in form, the simile would be more complete.

The connection between the interior and exterior would be through orifices, which in the moon would be the "craters," or quasi-volcanoes, when active it is from these as centres the rays pass out. I would even ask "F.R.A.S." whether he does not consider that the view of electrical induction and discharge does not explain *better* than any theory yet out, the fact that rays so often pass out directly to, and end suddenly at, other craters, occasionally ray centres? Also that this view accords better with their being superficial, rather than deep-seated structural features, such as dykes, filled in with some (universally) white material.

I must expect now and then such passages as the last paragraph in "F.R.A.S.'s" letter; but I have only so far "made up my mind" as to consider that the theory solves consistently many of the peculiar features of lunar surfacing—such as the absence of water, absence of polar caps, and of distinct colour; brightness of all hills, relative darkness of levels, circular forms, clefts, and rays, and that it is worth working at to alter and improve. A basis, in fact, for a "working hypothesis," which is more in accordance with recent views as to planetary development than any theory of lunar surfacing by volcanic action.

As Charles Darwin said of the "Origin," "I cannot believe that if false it would explain so many whole classes of facts" (Darwin's "Life," Vol. II. p. 210).

I am always thankful for all that "F.R.A.S." gives me, and generally benefit by it; a little cold water occasionally on me will do the theory no harm, if it is worth anything.

Asam, June 29. **S. E. Peal.**

DIRECTION OF LIGHTNING.

[30204.]—Some years ago, whilst standing at a window watching a thunderstorm, I saw a streak of lightning close at hand, the thunder being almost simultaneous; the peculiarity of the lightning stroke lay in its form, which was that of a gigantic letter Y, the stem on the earth, and the arms widely diverging into the clouds above, giving a decided impression that the stroke must have been an ascending one.

Afterwards, on another occasion, whilst watching a storm which had passed overhead, and was travelling away north-eastwards, I saw repeated strokes of ascending lightning, which rose from the earth in single stems and ramified right and left among the clouds like the branches of a tree. On this occasion I went to a neighbour's house and called him out to witness the phenomena, which resembled the explosion and dispersion of rocket stars; each discharge appeared to take an appreciable time, say, a full second.

Hammer.

[30205.]—In spite of the incredulity of Mr. R. A. Proctor, there is no reason to doubt that your correspondent, "A Fellow of the Royal Astronomical Society," did really see a flash of lightning go up from the earth to cloud. In the high regions of the Andes I have myself noticed the same phenomenon; in one instance a majority of the flashes during a storm appeared to strike upwards, and [illegible] country, while attentively watching the thunderstorm which occurred in the neighbourhood of London on 6th June last, I distinctly saw four flashes pass from the earth upwards, one of them on reaching the lower cloud strata became curved, assuming the appearance of a sickle.

Of course to estimate the direction of a lightning flash the observer must be suitably placed and also possess fairly good vision. I imagine the late Mr. Proctor was rather deficient in the latter respect, and probably a flash of lightning, whatever its direction, would convey nothing more to him than a sense of glare. I have not had any opportunity of seeing Mr. Proctor, but some of the maps and plans prepared by him leave the impression that his eyesight must, to say the least, have been decidedly abnormal.

V. N.

[30206.]—Surely there can be no doubt that a flash can proceed from the earth to a cloud. I have seen the occurrence more than once. Whether or not they were "return strokes," I am unable to say. I have also seen a flash descend from a cloud vertically proceed horizontally, and finally turn upwards again to the clouds, the length of the flash occupying nearly half the visible horizon.

Sm.

[30207.]—Referring to the direction of lightning, I can say that, during the storm of June 6th last, several members of my family and myself were quite agreed that we saw four or five flashes strike upwards. It will be remembered that, notwithstanding the severity and long duration of that storm, hardly any damage was reported as having been done by it.

Blackheath. **J. S. C.**

[30208.]—In your No. for July 26 "F.R.A.S." mentions a fact that he observed when watching a thunderstorm from an elevation between 800ft. and 900ft. above the sea level. In August, 1873, the loudest clap of thunder I ever heard startled all Calcutta. There was no storm at the time, and that clap was not repeated; but the next day I was informed by a gentleman, an officer of the Telegraph Department, that he was in bed at the time, and saw what he described as a large ball of fire, rise apparently from the floor of the room he was in, and meet an electrical discharge that crashed through the ceiling, in the middle space. The upward and downward discharge combined, with no result except the loud report, and the disruption of the floor and roof of the room, which were both built of concrete. This happened in the part of Calcutta called Chowringhee, and was the subject of considerable discussion in the local papers at the time.

Delta.

THE VELOCITY OF LIGHTNING.

[30209.]—In order to be able to answer "F.R.A.S.'s" modest query as to whether he is entitled to believe the evidence of his own eyes, one would need to know what angular velocity his eyes can follow, what was the distance of the flash, and what was the actual velocity of the lightning? There seems to be overpowering evidence that what is known as "ball lightning" occasionally travels very slowly. In the last number of *Nature* there is a most circumstantial account of the way in which lightning entered a room in Cassipore (a suburb of Calcutta) where there were eight people, and was seen as a brilliant ball of yellow fire about 6in. or 7in. in diameter, which passed from one end of the room to the other "at a pace just sufficiently slow to allow it to be readily followed by the eye." This seems to have been the residue of ordinary lightning, for a person watching in the neighbourhood saw an ordinary flash strike the house. It seems to have travelled from the roof down the iron rail of a staircase, and to have broken its way through a wall into the room, where it was seen by the eight people (Europeans) above referred to. This story is very similar to a great many others supported by evidence which we cannot reasonably doubt.

We know that the velocity of transmission of an electric current along a wire varies with the resistance, and that the velocity decreases with the resistance. It seems, therefore, not unreasonable to suppose that the velocity of an electric discharge through air is much less than the velocity of a current in a wire.

As far as I am aware there are no measures of the velocity of lightning flashes, and I heartily wish that some of the clever mechanicians who read the English Mechanic would endeavour to make such measures. The simplest way, it seems to me, would be to photograph a flash on a band of Eastman paper revolving by clockwork within the camera. If there is any difference in the shape of the flash as shown upon the moving band, and on a photograph taken in a fixed camera, one might determine the angular velocity, and from this the actual velocity, if the distance of the flash were known either roughly from the interval of time between the appearance of the flash and the sound of the thunder, or more accurately, from simultaneous photographs taken a mile or so apart so as to give a parallax.

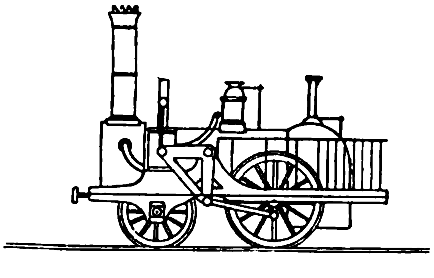
As to the angular velocity which the eye can follow, it seems to differ with different people, and probably depends on the brightness and size of the object which the eye tries to follow. One loses sight of the spokes of the wheels of a train when it it is only going at a moderate pace; but one can clearly see the forms of the carriages, and often persons in them, even in the most rapidly-passing express train. I find that I lose sight of all the spokes of the wheel of a moving carriage at about the same time, although as the carriage is passing on, the bottom of the bottom spoke is at rest, and the top of the uppermost spoke is moving with double the velocity of the carriage. The power of following such moving objects evidently depends on the ease with which the eye can be moved after the object, as well as on the duration of the image on the retina.

A. C. Ranyard.

LOCOMOTIVES.

[30210.]—In reply to "A. S. L.," p. 439, 30166, several early locomotives were constructed with vertical cylinders and a bell-crank.

This design was introduced by Mr. Roberts, of the firm of Sharp, Roberts, and Co.—now Sharp, Stewart, and Co.—and in the year 1833 an engine was built for the Liverpool and Manchester Railway, named "Experiment," No. 32, which we here illustrate.



It will be seen that the cylinders were placed vertically over the leading wheels, the motion of the cross-heads being communicated to the crank-pins upon the driving-wheels by means of connecting-rods and bell cranks. The leading-wheels had outside, and the driving-wheels inside, bearings. Diameter of cylinder, 11in.; length of stroke, 16in.; driving-wheels, 5ft. diameter.

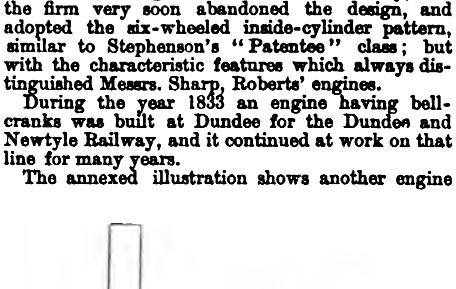
This engine had no eccentrics to actuate the valves, a short lever on the bell crank giving the throw by a long rod to rocking gear on the foot-plate. The valves were tubular, without lap or lead. The pistons had not the usual elastic packing rings, but were made nearly frictionless by exactly fitting the vertical cylinders, and having a white metal surface.

In 1834, Messrs. Sharp, Roberts, and Co. supplied three engines exactly similar to the "Experiment" for the opening of the Dublin and Kingston Railway.

None of the engines were found satisfactory, and the firm very soon abandoned the design, and adopted the six-wheeled inside-cylinder pattern, similar to Stephenson's "Patentee" class; but with the characteristic features which always distinguished Messrs. Sharp, Roberts' engines.

During the year 1833 an engine having bell-cranks was built at Dundee for the Dundee and Newtyle Railway, and it continued at work on that line for many years.

The annexed illustration shows another engine named "Experiment." It was built by Messrs. Stephenson and Co., in 1826, for the Stockton and Darlington Railway, being No. 6 in the books of that company. This engine had six-coupled wheels, and outside, inclined cylinders:—



Cylinders, 9in. diameter; stroke, 24in.; diameter of wheels, 4ft.; boiler, 10ft. long, 4ft. diameter. The boiler contained two fire-flue tubes, 1ft. 6in. diameter. The exhaust steam was conveyed from the cylinders to the chimney by two pipes, one for each cylinder.

Clement E. Stretton,
Consulting Engineer Asso. Soc. Loco. Enginemen and Firemen.

LOCOMOTIVE OF CUGNOT.

[30211.]—This locomotive, which is only casually referred to by some writers on the steam-engine, appears to have been constructed by a French engineer, Nicholas Cugnot, the first model having been made at the early date of 1763, and tried in 1769. I have not succeeded in finding either illustration or detailed description of this ancient machine.

Dr. Lardner, who I believe resided for some time in the French capital, in his work on the Steam-engine (1851) alludes to this engine, and mentions that "the original machine, which the French claim to be the patriarch of locomotives, is still preserved in the Museum of the Conservatoire des Arts et Métiers."

As the early date of this engine would seem to entitle it to some little more attention than the trivial notice bestowed upon it by the generality of writers, it occurs to me that the present time may not be inopportune to direct attention to this quotation from Lardner, thinking that some readers of the English Mechanic who take an interest in a fair and impartial history of the locomotive may intend a visit to Paris during the season, and supposing the machine to be still existent, might like to avail themselves of the opportunity of examining this ancient relic belonging to the history of so important an invention.

A. Marson.

DAMS.

[30212.]—Will W. A. Ross (letter 30160) be good enough to enlighten my ignorance by telling me what reason he has for saying that the Gilleppe or any other dam "can never burst"? If, as he states, the dam is of earth, let me tell him that if a leak no larger than a knitting-needle is formed and left alone, the dam is gone, however substantial it may be. If there is an iron pipe through the dam it is not safe.

Uncle Sam.

FRONT-SLIDE LATHES.

[30213.]—In reply to "F. A. M.'s" letter in your issue of July 26 *re* front-slide lathe by Bement, it appears to have been made 35 years ago, and thoroughly tested; and lathes have been made with front slides in this country quite as long, and have not met with approval by the 'cute Yankee, nor by the slow-and-sure British. First the unequal strains, second the inferior rigidity, have been the reasons.

About seven years ago we advertised these front-slide lathes, and stated we were open to make to any design. The result was that two were sold, and both gave a fair amount of satisfaction; but upon the whole, taking the advantages of the front slide and the disadvantages above mentioned, the purchasers would be quite as well satisfied with the patterns now used. Any English maker would be willing to make to "F. A. M.'s" drawings.

We are now about making some of these lathes, and in order to satisfy the requirements of intending purchasers, shall be pleased to have suggestions, either through your columns or otherwise. We propose to make them with double slot bed, similar to the new No. 15 or 16 pattern, which were designed for the British Government, and will stand competition.

Britannia Co.

ROSE-ENGINES.

[30214.]—In reply to "F. A. M." (letter 30184), I have again to remind those gentlemen who are interested in this subject that it will be quite necessary to ask their questions in simple and specific terms, so that everyone may understand.

I notice that "C. C. E." uses "trade terms" when speaking in connection with rose-engine turning (clearly showing that he has been under the tuition of a practical man), and which are short and expressive. As far as I have heard, Field's engine is correctly described by "F. A. M."; but I think there are still plenty of makers in England. Mr. G. Plant, of Birmingham, made one to my specification not many years ago; Messrs. Birch, of Manchester, are now engaged upon one; Messrs. Holtzapffel, I have no doubt, would be pleased to take an order; Mr. W. Mills, Clerkenwell, E.C., I suppose, is still in business; Mr. Evans, of Wardour-street; Mr. Milnes, of Bradford; Mr. Hines, and a Glasgow maker (whose name I have forgotten) are, or were, all capable men.

But the facts of the matter are these: Engine-turning is under a cloud—there is no demand for it in England, and in the U.S.A. it is completely "played out." In bank-note work it is superseded, as I have before said, by the geometrical engraving lathe, and which is quite out of the way of an amateur, the cost being £1,050.

I am not surprised that "F. A. M." should have been refused a sight of Messrs. Bacon's lathes, it not being usual to allow any stranger in such workrooms. I cannot blame them, as it is the only way to keep their business secrets intact. The "medallion printing" is very pretty indeed; the style is not confined to medallions, as the last time I was in London I saw some very nice work in Maclure and

McDonald's window in Queen Victoria-street. The operation is not difficult, being mainly dependent on the exquisite fitting of the apparatus. I have heard my old master call it "damask work."

July 28. **Norman Maclean.**

ROSE-ENGINE, ENGINE-TURNING IN IVORY, &c.

[30215.]—I AM much pleased to see that "C. C. E." has found time to write again, and hope all our readers will derive some benefit from the present correspondence.

With regard to "C. C. E.'s" classification of rose-engines, I beg to differ on one point respecting No. 2—that watch-case turners do not, and will not, use their engines for any other purpose than that of engine-turning cases, dials, and other small articles. The reason for this is patent to any practical man—viz., that the stress of large work on the cutting slide completely destroys the delicate "set" of that part of the slide-rest, and makes the turning of a gold watch bottom a serious operation, when it is remembered that if a "waster" occurs, the workman has not only lost his own time, but has to pay for the case being rebottomed, as well as the loss of the gold caused by re-melting. In other respects Nos. 2 and 3 can be, I think, well combined. In days gone by, before I got into business for myself, we made an unsuccessful attempt to keep one of our rose-engines (by Fieldhouse—a real beauty) for re-turning watchcases and other light work; but were unable to do so, owing to pressure of work, and, therefore, any cases which came to be done were the cause of much grumbling in our workroom as to who would have them to do, as it involved a re-setting of the lathe to do an hour's work. The "goldstone" alluded to by "C. C. E." is used by engine-turners for the purpose of brightening the edges of tools after sharpening. It is a hard, black stone, and is found, I believe, in Asia Minor. It requires a dexterous manipulation to produce the desired effect. Other methods of polishing the cutter are used, but the main effect of the polishing process is to take the grain of the stone from the facet after sharpening. In regard to ivory-turning, I have often been called upon to try and produce some pleasing bit of ornament with my lathe; but as this "trying" entails a great expenditure of time and money, it has not, at present, resolved itself into any practical form. I, too, have tried the sheath or tube on the shank of the drill, and still think that that is the simplest and most practical form of engine turning in ivory. There is still another method practised by the late Jacob Perkins in the year 1819. (See specification of Patent No. 4,400, October 11th, 1819. Republished 1858, price 4s. 2d.), in which he used a spring for going over convex and concave surfaces; but I do not think the idea of much account. In the geometrical engraving lathe there is no moving head-stock, and the subject would occupy too much space of the "E. M." to give a full description; but if "C.C.E." will permit me, I will send to him the MS. for perusal. I should be glad to see, or have described, the specimens of engine turning in ivory alluded to in "C. C. E.'s" letter, as I can hardly believe that the engine-turning of ivory is a lost art; and, finally, given the lathe, the work to do, and the pattern, with time *ad lib.*, I have never been beaten yet. This statement applies to work done with the rose-engine, &c., as I am but a poor turner otherwise, my practice being confined to turning rough wood chucks for carrying work in the lathe, &c.

N. Maclean.

117, Harwood-street, Sheffield, July 28.

NICKEL CRUCIBLES AND BASINS.

[30216.]—NICKEL crucibles, such as are commonly sold by dealers in scientific apparatus, may be used instead of platinum for the quantitative analysis of silicates which require fusion with sodium or potassium carbonate. The fused product, however, must be dissolved out with water only. Nickel crucibles must not be exposed to the action of dilute acids even in the cold for any length of time.

I have never experienced any difficulty in completely detaching the fused mass from crucible with boiling water. The results, compared with analysis made in platinum crucibles, are perfectly satisfactory for all the constituents of ordinary silicate minerals.

Nickel crucibles may also be used for the conversion of Cr_2O_3 into alkaline chromates by fusion with sodic carbonate and potassic nitrate, but such treatment soon injures the crucibles, and they are evidently unsuitable for the purpose. But it is in organic work that both the crucibles and basins are most useful. For fusions with NaOH or KOH, or for strongly igniting with lime, baryta, soda lime, &c., they are distinctly preferable to either platinum or silver, and I thoroughly believe that in time they will entirely supersede the latter metal for fusions with fixed caustic alkalies in organic work.

Nickel crucibles are useless for weighing ignited precipitates, &c., as they alter in weight upon each ignition. For fusions they should be protected in the same way as platinum, and not be exposed to the direct action of the flame. Gas containing much sulphur has a very injurious effect on the outer surface.

Wishing to ascertain how far it is possible to substitute the cheaper nickel vessels for platinum and silver in such work as above alluded to, the condition of the nickel has been carefully noted after each experiment, and the above is a brief statement of the results of such observations. The vessels used were those ordinarily sold by Messrs. Townson and Mercer; but I have no reason to suppose that they are different to those sold by other dealers. I intend to make some experiments in spinning sheet nickel into crucibles and basins, and shall send you the results.

H. W. Constable.

8, Portugal-place, Cambridge, July 27.

AMERICAN ORGAN v. HARMONIUM.

[30217.]—YOUR correspondent, p. 437, is evidently a poor player, otherwise he would be able to get plenty of expression even out of an American organ. Harmonium players (?) usually like a lot of noise, instead of real musical effect; hence their preference of the harmonium. A real, good, and artistically constructed harmonium is a very rare instrument, and all practical men are fully aware that expression is more easily obtained from the American organ.

When your correspondent, "998," p. 437, has had more experience with the American organ he will be better qualified in passing a more correct opinion about the expression which is certainly obtainable from the American organ. Both he and Mr. Casson would instruct your readers by answering the straightforward question put forward by "Organon," on p. 459. When this question is correctly answered, then this mysterious subject will be settled.

In conclusion, I admit that the harmonium has more body of tone than the American organ; but my long experience of both enables me to distinctly assert that expression is obtainable as much from the American organ as from the harmonium.

Swansea. **G. Fryer.**

A NEW DEPARTURE IN SCIENCE.

[30218.]—THE *Times* of July 23 gives a special paragraph, and ought to have supplemented it with a leader, on the following startling and most important discovery—viz.:—"That at a meeting of the Balloon Society, held the previous evening, a resolution was proposed, seconded, and adopted by the chairman, and so established as a fact, that the unfortunate collapse of the 'Eclipse' balloon was caused by the gas in the balloon getting mixed with air 'electrically charged,' and so causing an explosion, without ignition," and then follows a suggestion for scientists to discover a non-explosive gas.

No person can possibly have the daring temerity to express the slightest doubt of the truth of this great discovery on such aëronautically high authority. **Up in a Balloon.**

THE HARDENING AND TEMPERING OF STEEL.

[30219.]—THANKS to Mr. Alfred H. Allen for his kind notice of my letter, though will he excuse me for saying it does not appear to have been very comprehensive? I, too, am disappointed, and, in fact, much chagrined to find that my meaning is so hard to grasp; for it would seem that I must have been very unintelligible indeed. I do hold that the hardening is due to the carbon assuming the diamond form; and the very arguments he puts forward against it are among those that confirm me in my opinion. The tempering of glass is quite consistent with the views expressed (not too plainly, I fear), in the latter part of my letter; though the different character of the tempering is what may be expected from the very different constitution of the substances. As to the condition of the residue, it is a matter to which I have devoted much thought; and it was the proof drawn therefrom, that the carbon suffers some change of state, that first inspired me with my present notion. For, as I particularly pointed out, there is a remarkable distinction between the precipitates obtained from an annealed and a hardened specimen of the same steel. And then seeing its intimate diffusion through a large proportion of iron, it is evident that though exhibiting some coherence at the moment the iron is dissolved away, it must easily become disintegrated into a condition so impalpable as to be unavailable for any test as to its physical nature.

I once thought that a polishing-powder of some commercial value might be thus obtained; but of this I am not now so sanguine, though I have yet to learn the manner of residue left from chilled iron. And, further, it was the circumstance that the solution of this residue can be almost entirely effected by the application of heat, that led me to think that there might be an adamantine form of the carbide of iron which would not be of so chemically inert a nature as diamond pure and simple. Lastly, the limited conditions set forth in the last paragraph of my letter, as arising from my hypothesis, would be violated did an excess of carbon crystallise from solution in molten iron in any higher form than graphite.

Perhaps I may be better understood if I briefly state my contention thus—that a small percentage of carbon or carbide of iron may be crystallised in situ, from its solid solution in iron, by suddenly cooling from a red heat; and that it has this property in virtue of the great variations in its specific heats within the limits of the tempering temperature. Most, if not all, substances exhibit, in a more or less degree, a similar rapid increase approaching their melting points; and this, I also contend, according to the manner and medium in which they are cooled from fusion, has much influence in determining their ultimate solid form. But carbon, silicon, and boron are altogether peculiar, in each showing a quite anomalous and isolated range of variations, at a temporature far removed from the point of fusion. And that certain compounds containing either of these substances are also susceptible of a great change in their physical natures, while still retaining the solid form, seems to me to be worthy of attention as indicating some connection between the two properties.

While not asking acceptance for my speculative exposition of the possible process of the change, I think it can hardly be disputed that the suggestion as to its nature affords the most complete explanation of the behaviour of the hardened steel. This alone is strong presumptive evidence in its favour; that I think to find further support in the causes that may bring about such a change, is the natural outcome of an inner consciousness of right. Here perhaps I have gone astray, though I think not. Supporting testimony keeps cropping up, but in such chaotic disorder that it will require great pains to arrange it so as to be clear without being diffuse; and it may be several weeks before I can advance the theory to another stage. **I. Q.**

USEFUL AND SCIENTIFIC NOTES.

◆

Standardising Permanganate.—Many analysts still prefer to standardise their permanganate with pianoforte wire, but the trouble always is to exclude the air after the iron has dissolved. Jahoda operates as follows:—The iron is dissolved in boiling acid in a flask, which is closed by a cork, through which goes a doubly-bent tube, the end of which is made to dip into a beaker containing a solution of sodium bicarbonate. When solution is complete, and the liquid allowed to cool, the soda solution finds its way into the flask, but, no sooner have a few drops got in, than an evolution of carbonic acid gas drives the fluid back.

Why Sixty Seconds Make a Minute.—Why is our hour divided into 60 minutes, each minute into 60 seconds, etc.? Simply and solely because in Babylon there existed, by the side of the decimal system of notation, another system, the sexagesimal, which counted by sixties. Why that number should have been chosen is clear enough, and it speaks well for the practical sense of those ancient Babylonian merchants. There is no number which has so many divisors as 60. The Babylonians divided the sun's daily journey into 24 parasangs, or 710 stadia. Each parasang or hour was subdivided into 60 minutes. A parasang is about a German mile, and Babylonian astronomers compared the progress made by the sun during one hour at the time of the equinox to the progress made by a good walker during the same time, both accomplishing one parasang. The whole course of the sun during the 24 equinoctial hours was fixed at 24 parasangs, or 720 stadia, or 360°. This system was handed on to the Greeks, and Hipparchus, the great Greek philosopher, who lived about 150 B.C., introduced the Babylonian hour into Europe. Ptolemy, who wrote about 140 A.D., and whose name still lives in that of the Ptolemaic system of astronomy, gave still wider currency to the Babylonian way of reckoning time. It was carried along on the quiet stream of traditional knowledge through the Middle Ages, and, strange to say, it sailed down safely over the Niagara of the French Revolution. For the French, when revolutionising weights, measures, coins, and dates, and subjecting all to the decimal system of reckoning, were induced by some unexplained motive to respect our clocks and watches, and allowed our dials to remain sexagesimal—that is, Babylonian, each hour consisting of 60 minutes. Here you see again the wonderful coherence of the world, and how what we call knowledge is the result of an unbroken tradition of a teaching descending from father to son. Not more than about a hundred arms would reach from us to the builders of the palaces of Babylon, and enable us to shake hands with the founders of the oldest pyramids and to thank them for what they have done for us.—MAX MULLER in the *Fortnightly Review*.

REPLIES TO QUERIES.

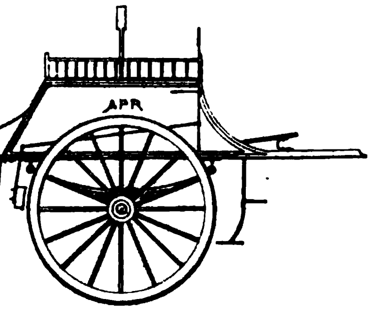
⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[67862.]—**Distribution of Weight.**—"Caspian" begs the whole question when he says: "Consider the weight as resting on four pairs of struts, and equally distributed over each." This could not be done without some means of adjusting the pressures on each strut, such as screws, wedges, &c.; but this was not contemplated in the original query. If we have a weight supported by more than three struts, and require to determine the vertical pressure on the ground of each strut, the problem is indeterminate. For example: Take the usual three-legged camera stand, and set it up in any position with the camera or a weight on the top. The pressure on the ground for each leg can be calculated. But now suppose a fourth prop to be added, with a screw pressing on a spring under its foot to adjust the pressure. It is evident that the fourth prop might be made to support a varying amount of weight, by means of the screw, without disturbing the position of the weight, so that the problem is indeterminate. In a work called "Economies of Construction," by R. H. Bow, C.E. (Spon, Charing Cross), I find the following:—"In the three-limbed support there can be no doubt about the amount of stress each prop has to withstand; but in the four-limbed support it might be assumed that, *theoretically*, each prop supported its full share of the load, but in reality it would be impracticable to cause the distribution of the stresses to approach, with certainty, even roughly, to such equality, and then a very slight failure of the foundations of one of the props would not only relieve it from stress, but also the prop diagonally opposite to it."

Bath. M.I.C.E.

[68104.]—**Catering.**—Two correspondents have drawn attention to the want of means for hot air to escape from the measuring vessel. This is, of course, necessary, and I should have shown it. For measuring variable quantities the vessel is generally of glass—or with a glass face—graduated like measuring glasses, and with a loose cover. For measuring one quantity only the cover is fixed, and is provided with either an air-hole closed by means of a float-valve or an open glass tube of small diameter, in which the rising liquid can be observed, &c. PHOS. BRON.

[68813.]—**Dog-Cart Brake.**—Why not fix a brake on your trap like the one shown in the sketch below? The rod on which the brake-block is fixed is connected at its fulcrum to another rod, passing through plummer-blocks on the bottom of the cart to the other side, where it is bent down, and has a block fixed, similar to that on the side shown in the sketch. To apply the brake, pull the handle backwards. It can be held in any position by means of a rack. If not clear, write again.



METEOR.

[68870.]—**Slide-Rest on Gap-bed Lathe.**—To A. F. SHAKESPEAR.—My slide-rest is of the description you mention—i.e., for use on a straight bed. I should be much obliged if you would kindly inform me if it could be altered so as to suit the gap-bed, as of course the gap prevents my using the slide-rest close to mandrel. The bed has a projection on each side similar to the V's on a screw-cutting lathe, but square. Any hints you can give will be gratefully received. F. ALLEN.

[68900.]—**Small Water Motor.**—Several water motors have been illustrated recently (for which see indices); but I think the querist will find that a turbine gives the best results. A dynamo can, of course, be driven direct from the turbine (or water motor), and if the water-power can be obtained for nothing, or practically nothing, the dynamo will give the electric-light as cheap as gas, or cheaper, according to circumstances. Would advise the querist to look up his back numbers. There was a good deal about water motors in the last volume. NUN. DOR.

[68904.]—**Finings.**—Ordinary finings are made, according to the recipes, of 1lb. isinglass (finely shredded, or rather chopped) in 3 or 4 pints of sour beer, cider, or weak acetic acid. The isinglass must be "cut," as it is called. But here is a wrinkle, which may be useful, according to whether it is used with brains or not: isinglass is simply gelatine—glue, in fact—so that as isinglass is rather expensive, perhaps gelatine will answer the purpose, or even a good glue—one of the clearer specimens. When the gelatine has dissolved in the acid liquor, add some more beer or any of the liquid which it is required to "fine," and strain through a cloth or hair sieve. Then add more of the liquor, and the "finings" are ready. They must be stirred up well with the beer—"roused," I think, is the term. A pound of isinglass will make] 12 gallons, and a pint or a little more is enough for a barrel of beer. NUN. DOR.

[68907.]—**Gold Leaf.**—The gold leaf is put on by means of a tip and a brush. The surface to be covered is first coated with gold size, and when that is "tacky" (i.e., sticky and nearly dry) the leaf is placed on it, and worked down well by dabbing with a soft brush. If the surfaces are flat, of course a clean bit of cloth to press the gold leaf down is all that is necessary; but when they are carved and undercut the brush is almost indispensable. The leaf is lifted by touching the tip on your greasy hair, when it will readily take the gold from the book leaf. NUN. DOR.

[68911.]—**Dead Centre.**—A two-cylinder engine, whether stationary or road-roller, has the cranks placed at different angles, as in the locomotive, and, therefore, there is no real "dead centre." With single-cylinder engines, the fly-wheel must be barred round if the piston has stopped at a dead point. In the case of locomotives, you will no doubt have noticed that the train which should go forward, at times goes back a little way first; but that is because, after steam has been shut off, the engine has run on, and possibly come to a stop with the valves in the "dead" position or on the centres. Then, reversing, a little steam shifts them, and reversing again, the valves are in a position to take steam for forward gearing, and the cranks being at different angles away we go! The steam roller, when it has one cylinder only, has, of necessity, a fly-wheel. NUN. DOR.

[68915.]—**Auxiliary Screw.**—Wm. Hosken must understand that a screw-propeller must go at a great speed to do any work at all. His screw turns only once to one turn of the handle, which would not even move the boat without exhaustive labour. His must be a cramped position to turn the handle. My idea of a large wheel acting on the small screw-wheel was because of the speed required. I could offer small alterations to simplify my auxiliary propelling screw-rudder such as should be entertained before making up. I shall certainly put my plan into work, but am too busy at present. F. C. BAKER.

[68920.]—**Ammonia Motor.**—The querist should give an idea of which ammonia motor he means, because there have been several—ether motors as well. All that can be said is that the statement he quotes requires verifying. It need scarcely be mentioned that either ammonia or ether engines require the greatest possible perfection of workmanship, as "escapes" would render them intolerable. In America they tried an engine with bisulphide of carbon as the motive-power vapour. Imagine that escaping—and you can't well prevent it! K. L.

[68921.]—**Pedals for Piano.**—The levers must be skewed, of course. See p. 136, No. 916, for an instance. There are several methods illustrated in back volumes. M. AND CO.

[68922.]—**How are Thimbles Made?**—"Thimbles," of course, means the shields for fingers used by those who drive the needle. They are stamped out, spun, or in case of precious metals possibly turned; but in the majority of cases they are struck up from annealed discs of metal between a die and a sink—possibly two or three. The indentations are put in with a milling tool, and the inside is generally polished in the lathe. Common thimbles are struck up by one blow of the machine. SENEX.

[68933.]—**Electrical.**—Under this caption Mr. F. W. Mason (p. 462) speaks of "bisulphuret" (of carbon) and of "spt. of turpentine." I presume that bisulphide of carbon is meant, and "turpentine." According to certain recipe books there are oil, essence, and spirit of turpentine; but when you come to inquire you find that the oil, the essence, and the spirit mean simply "turpentine"; but "see that you get it." Perhaps Mr. Mason means something else by "spt. of turpentine." Anyway, it is advisable to be correct in such matters: so I venture to ask if there is any difference between the oil and the spirit of turpentine? DOUBTFUL.

[68941.]—**Case-Hardening.**—"Twisting and bulging" have nothing to do with case-hardening. If the articles are packed properly in the case-hardening box, they will neither twist nor bulge. Of course, the querist does not say how he case-hardens, which may be the "key" of his query. SLOP.

[68996.]—**Telephone.**—It is difficult to answer the query of "A. B." without examining the arrangements of the telephone circuit. During a thunderstorm many parts—nay, all—of a telephone circuit are affected; but "A. B." does not give an idea of the arrangements, nor even of the "damage" which he wants to rectify. It is perfectly useless to put such queries, for those who could, and would, reply if a clear statement of facts were put before them, will not bother themselves to find out first of all what the querist means. Surely, when information is asked for, which will be given freely and gratuitously, the least one can ask for is that the questions should be formulated definitely! CEETHAT.

[69001.]—**Problem.**—With four weights you can weigh from 1lb. to 30lb. inclusive; but not to 40lb.—at least, I do not think so. The weights are 1lb., 3lb., 6lb., and 20lb. each. The rule is as follows: The numbers 1, 3, and 6 are the only ones with which you can make all the numbers from 1 to 10 inclusive. Then to the total add 10, and then add to your set of weights a weight of that denomination, and you can then weigh from 1 to the total of all your weights in the set. For instance, suppose you have the weights 1lb., 3lb., and 6lb., now 1 + 3 + 6 = 10; add 10 more = 20; then add to your set a weight of 20lb.; then 1 + 3 + 6 + 20 = 30, and you can weigh from 1lb. to 30lb. inclusive. Again, 1 + 3 + 6 + 20 = 30, add 10 = 40; then a weight of 40lb. Now 30 + 40 = 70, and you can weigh from 1lb. to 70lb., and so on. With 1lb., 3lb., 6lb., and 20lb. weights the way of weighing is as follows:

1	=1	20−(6+3)	=11	20+1	=21
6−(3+1)	=2	(20+1)−(6+3)	=12	(20+3)−1	=22
3	=3	20−(6+1)	=13	20+3	=23
3+1	=4	20−6	=14	20+3+1	=24
6−1	=5	(20+1)−6	=15	20+6−1	=25
6	=6	(20+3)−(6+1)	=16	20+6	=26
6+1	=7	20−3	=17	20+6+1	=27
(6+3)−1	=8	(20+1)−3	=18	(20+6+3)−1	=28
6+3	=9	20−1	=19	20+6+3	=29
6+3+1	=10	20	=20	20+6+3+1	=30

New York, July 15. JAY-ES-SEE.

[69016.]—**Railway Gradients.**—The following are some of the steepest gradients on the G.W.R. in the South Wales district of which I can ascertain the values:—Pontypool-road towards Crumlin, 1 in 45 and 1 in 65; Crumlin to Llanhilleth, 1 in 43; Hirwain Pond to Glynneath, 1 in 45 for about five miles. There are steep gradients at Cockett (both ways), from Dynevor to Neath, at Pyle, on the Ely Valley and Forest of Dean branches, and in the Stroud Valley, but I cannot tell the rate of rise or fall. On the Brecon and Merthyr line there is a long incline, said to be 1 in 37 for seven miles. At Rhymney, on the L. and N.W.R. line, I recollect seeing a notice board indicating 1 in 32 (I believe I am correct), and from thence to Abergavenny there are several steep banks. Near Abergavenny, on the G.W.R., there are gradients of 1 in 80 and 1 in 81. At Round Oak and Brierley Hill there are gradients of 1 in 75. I have no recent table of gradients, and on some of the sections of the G.W.R. there is no list of gradients given; the foregoing are, therefore, the best I can give. C. E. B.

[69053.]—**Incandescent Lighting with Leclanches.**—It is very necessary that the inaccuracy of the reply by R. H. Craven to this query should be pointed out. When did he get 1·4 ampère from an ordinary Leclanché, and who measured it? Also, how would F. W. Mason arrange the nine cells he advises? If in series, would he expect to get a light? I think both the above gentlemen would find themselves in the dark. The last reply of the three is reliable, and the querist will find that less than 12 large-size cells will be of no use. Couple the twelve cells in three series of four, and the three sets in parallel. If the light is insufficient, add another series of four cells parallel with the others. W. A. WALTON.

[69055.]—**Blue Salt.**—To "YOUNG ANALYST" AND "PRINCIPIA."—Thanks for answers, but you have not rightly read my query. The metallic substance I have is soluble in the alkalies AmHO, KHO, NaHO, and their carbonates. I do not think either copper, nickel, or chromium forms a soluble blue salt with all these. The colour is ultramarine. TRUE BLUE.

[69056.]—**Black Needles.**—To "PRINCIPIA."—The black needles are obtained by fusing the substance with an alkaline carbonate and adding H_2O to the mass, also by dissolving the substance in HCl, adding Hg, which forms an amalgam. TRUE BLUE.

[69057.]—**Lavender Bead.**—To "YOUNG ANALYST."—The bead is same colour hot or cold, oxidised or reduced. It is lavender, or pale mauve; excess does not alter it. Formed from black needles, as above. TRUE BLUE.

[69057.] — **Lavender Beads.**—To "TRUE BLUE."—No oxide or mixture of oxides forms a lavender-purple bead with borax before the blowpipe; but the powder of some minerals containing the exact proportion of alkali (soda, potash, or lithia) requisite, will convert a colourless bead of boric acid containing black cobalt-borate balls into a bead having precisely the tint of lavender. "Landauer," to whom "Young Analyst" refers you, never, so far as I can ascertain, mentions the word "lavender," either in the original German, or in the English translation of his book on blowpipe analysis. Indeed, I believe it was I who introduced the term "Lavender" (which I got from Werner and Jamieson's list of comparative colours) into this subject. So far from being "a vague definition," as "Young Analyst" calls it, it is the only term which precisely defines this exact shade of pale purple. W. A. ROSS.

[69071.]—**Instantaneous Photos.**—The maximum exposure for instantaneous objects varies with the size they are taken on the plate. A shutter working at $\frac{1}{20}$th of a second is hardly rapid enough for street scenes, if the moving objects are to be about ½ the diameter of the plate (the usual size). I always employ a Newman shutter, and use it according to the light, &c., at its top speed, $\frac{1}{100}$'s. or $\frac{1}{32}$'s. The size of the stop must depend on the lens; if Ilford slow plates are to be used, the largest stop that gives reasonable definition being employed. If "Hx." wants to use his negatives for the production of lantern slides, where absolute sharpness is necessary, he had better employ more rapid plates and a smaller stop. With a good rectilinear lens, 9 U.S. ought to cover perfectly to the edges. F. H. L.

[69090.]—**Brighton Engines.**—In my reply to this query, No. 282 should be "Rowfant," not "Rowfont." Hailsham, which "W. E. C. B." gives as 78, I know to be 76; Knowle is 78. 172, Chichester, is now altered to 487. The old Lancing and Worthing, Nos. 451 and 452 were both scrapped in June, 1886. Two new tanks came out in May, 1886, 354 Lancing, and 355 Worthing. C. F. D. MARSHALL.

[69090.]—**Brighton Engines.**—No. 38 Millwall (1874), 42 Tulse Hill (1877), 45 Merton (1877), 48 Leadenhall (1876), 65 Tooting (1874), 66 Hatcham (1874), 77 Wonersh, 78 Knowle, 79 Minories, 80 Bookham, 83 Earlswood (all 1880)—these belong to the "A" or Terrier class—97 Honfleur (1874), 99 Bordeaux (1874), 107 Alderley, and 109 Strasburg (1876), 114 Trouville, 118 Trocadero (1877), 122 Leghorn, 125 Navarre, 127 Poitiers (1878), 125 Foligno, 136 Brindisi (1878), 157 Barcelona (1881) —these belong to the "E" class—161 Havant, 162 Penge, 172 Chichester, 178-193 had no names, 192 (now Jacomb Hood), 193 (now Freemantle), 198 was Drayton, 234 Rottingdean, 268 Baynards, 282 Rowfont, 293 Norbury, 463 Hove, 464 Epsom, 476 Arundel, 477 Reigate, 478 Shanklin, 479 Polegate, 480 St. Leonard's, 481 Eastbourne, 483 Victoria. Dendy Marshall has given the goods wrong. 401 to 420 have 17¼ by 26 cylinder; 421 to 432 have 18¼ by 26 cylinders. REYMOND.

[69091.]—**Accident to the Royal Train**—There was no accident of the kind "P. H. N." mentions. But in 1865 the train in question, on arrival at Hitchin Junction, found the signal off for the Great Northern line, but upon whistling the points and signals were changed: there was neither delay nor accident to a Royal train. LOCO.

[69094.]—**Midland Engines.**—In Vol. XLV. p. 155, I gave a drawing of Midland "single" engine No. 37, to which I refer your correspondent "Wooton Rivers." In addition to the single engines, the 80 to 85 class of coupled engines ran between Leicester and London from 1862 to 1870. I saw the Midland engine which was in the Welwyn Tunnel accident pass through Leicester on its way to Derby for repairs; it was No. 481, now 481A. It may interest your correspondent to know that last week the new single express engines (34 class) commenced to work the Scotch expresses between London and Leicester. Since 1867, the whole of the trains running between those points have been worked with coupled engines. Steel rails, which enable a great weight to be placed upon the driving wheels, together with the introduction of the sand-blast, will doubtless lead to the use of single engines to a large extent.

CLEMENT E. STRETTON.

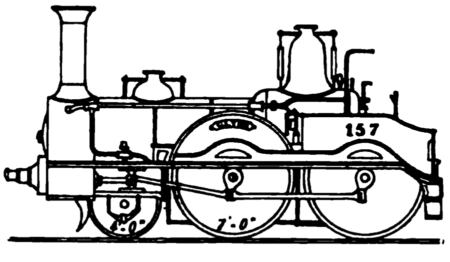
[69095.] — **South - Western Engines.**—If "P. H. N." will advertise his address, I shall be glad to send him a complete list of names. The insertion of even the 63 he asks for would, I imagine, take up too much space in the "E. M."

C. J. TAHOURDIN.

[69095.]— **South - Western Engines.** — The following is the information required by "P.H.N.":—No. 9‡ (March, 1873) Chaplin, 11† (1871) Minerva, 12‡ (Feb., 1871) Jupiter, 21* (Dec., 1871) Prince (rebuilt 1886), 26† (1872), 39* (Feb., 1874) Wizard, 40* (1874), 41* (Dec., 1874) Ajax, 43* (Jan., 1875) Milo, 56‡ Mentor, 60‡ (1866, re. 1886) Sappho, 65 (1870‡) Achilles, 83* (Sep., 1866) Siren, 91† (1868), 109‡ Rocklia, 112‡ Trent, 120‡ (1870) Heckla, 151‡ (April, 1878) Montrose, 152‡ (May, 1878) Marmion, 161 Shannon, 176‡ (1869) Storm, 221‡ Scotia, 222‡ Cambria, 223‡ Colossus, 224‡ Gallia, 225‡ Hirbernia, 226‡ Anglia, 221 to 226, all built 1866. References:—(*) 4-c. tenders, 6ft. 6in. wheels, 17 by 22 cyl.; (†) 4-c. tenders, 6ft. wheels, 17in. by 21in. cyl.; (‡) 6-c. goods, 17in. by 22in., or 16½in. by 21in. cyl. Any further information with pleasure.

Stony Stratford. REYMOND.

[69095.]— **South-Western Engines.** — No. 9 Chaplin, 11 Minerva, 12 Jupiter, 21 Prince, 26 Gazelle, 37 Arab, 39 Wizard, 40 Windsor, 41 Ajax, 42 Atlas, 43 Milo, 44 Pluto, 45 Titan, 46 Minos, 47 Taurus, 50 Buffalo, 51 Elephant, 56 Mentor, 60 Sappho, 65 Achilles, 77 Wildfire, 83 Siren, 91 Spitfire, 104 Tigress, 106 Panther, 109 Rocklia, 112 Trent, 120 Hecla, 123 The Duke, 124 Saxon, 127 Goliath, 128 Samson, 129 Albion, 130 Harold, 131 Rufus, 132 Conqueror, 133 Crescent, 134 Ironside, 135 Canute, 136 Goth, 137 Hun, 138 Vandal, 139 Lombard, 140 Gaul, 141 Celt, 142 Eugenie, 143 Nelson, 144 Howe, 145 Hood, 146 Tweed, 147 Isis, 148 Colne, 149 Napoleon, 150 Havelock, 151 Montrose, 152 Marmion, 153 Victoria, 154 Nile, 155 Cressy, 156 Hogue, 161 Shannon, 170 Cupid, 176 Dragon, 221 Scotia, 222 Cambria, 223 Colossus, 224 Gallia, 225 Hibernia, 226 Anglia, 280 Persia, 392 Lady Portsmouth. The inclosed sketch is of Mr. Beattie's 7ft. coupled-express, Clyde, built at the Nine Elms works in June, 1859.



C. F. DENDY MARSHALL.

[69101.]—**Defective Sight.**—If "W. F. P." will peruse a small work recently published by Swan Sonnenschein and Co., Paternoster-square, entitled "The Philosophy of Sight," he will derive much information and, probably, benefit, as the subject of his query, viz., "Defective Sight," is therein popularly, but exhaustively, treated upon.

R. W. F.

[69102.]—**Injectors.**—The overflow from your injectors is owing to a leak in the water-supply pipe. Examine the joint connecting the water-supply pipe to the injector, and also the valve on the same. Air is drawn in there, and the vacuum that should be formed in the injector is destroyed; consequently the overflow is caused. The water must not be too hot. If these are adhered to, all will be right. A FRIEND IN NEED.

[69116.]—**Area of Spherical Zone.**—In my reply to "Snow Cap" in last issue, I find that I have committed a silly error which is sufficiently obvious to need no comment. "J. R. C.'s" is the correct reply, and mine is useless.

Camberwell. A. H. G.

[69117.]—**Rats.**—Permit me to point out one or two slight errors, either of the pen or type, in my reply last week. "Has," in the 18th line, should, of course, be "have"; while the date to which I offered to supply the formula for "Compound Rat-attracting Oils" (viz., August 10) was partly omitted. By the way, a correspondent assures me that he finds the oils equally an attraction to fish, and therefore now always puts a little on the bait when angling. PERCY W. STANLEY.

5, Billson-street, Poplar, London.

[69122.]—**Dynamo to Light ½ Arc Lamp.**—To MR. BOTTONE.—The laminations do not seem to act any better for being insulated one from the other. Many makers dip the laminations in shellac varnish or coal tar, and then stove them; but I find that the natural scale on the sheet iron insulates them magnetically just as well. The spindle must not be wood, but good steel. If of the Pacinotti ring type, the armature should be 4⅞in. in diameter, about 3in. deep, and wound with 2½lb. No. 18. The field magnets will take about 5lb. No. 14, connected in series with armature. If the armature be of H Siemens type, one about 6in. long, 2½in. diameter, wound with about 1lb. No. 16 will meet the requirements. The field magnets will take about 5lb. No. 14. Speed of the former, about 2,000 revs. per minute; of the latter, 3,000.

S. BOTTONE.

[69123.]—**Commutator.**—Remove the collector bars, pack the hub with asbestos millboard, and separate the sections with thin sheet mica, or asbestos millboard, or vulcanised fibre. When the collector bars have again been screwed up on the hub, the commutator will probably require truing up on the lathe. S. BOTTONE.

[69123.] — **Commutator.** — Surely this querist has some temerity to undertake the repair of a dynamo without knowing how to do it. Disconnect the armature wires from the commutator and take it to pieces. Build up afresh with asbestos millboard $\frac{1}{16}$in. thick (before compression) between each segment, and a ferrule of vulcanised fibre, or similar material, to keep them from touching the shaft. When all is screwed up tight, test each adjoining pair of segments with a battery and galvanometer, and also prove that all are perfectly insulated from the spindle. It may then be turned up true, and should again be subjected to a careful test. Next test the coils of armature, and if found perfect, connect them to commutator as before. Without knowing more of the construction of the machine, this is the best advice I can offer.

W. A. WALTON.

[69126.]—**Electric Bell - Fixing.**—It is not necessary to solder joints in tubing. Use 4in. or 5in. of a size larger tube to form sockets. The wire is almost always pulled into the tube before it is fixed; but it depends altogether on circumstances. No. 20 or 22 B.W.G. indiarubber and cotton-covered is good enough for small jobs, but for large ones, a guttapercha and cotton-covered wire may be used between pushes and carbon pole of battery (generally spoken of as the copper or carbon wire), all others ordinary indiarubber covered. Carefully avoid all damp places. Cut tube off with a half-round file, and see that there is no burr left on the inside; if possible, do without joints inside the tube. SPARK GRINDER.

[69126.]—**Electric-Bell Fixing.**—It is quite unnecessary to solder the joints of the zinc tubing, though when many tubes branch into one it is advisable to wrap a piece of thin sheet lead round the joint. It is best to run the wires at the same time that the tubes are fixed, in preference to drawing them in afterwards, as unless great care is taken the insulation is liable to be frayed off. The advantages of the two methods are fully explained in my book, "Practical Electric Bell-Fitting." Guttapercha will be found to be the best insulation when the wires are run in tubes, unless the wires are situated in a place subjected to great atmospheric changes, such as being alternately dry and damp, when indiarubber-covered wires should be used. No more wires should be put in one tube than will slide through easily. F. C. ALLSOP.

165, Queen Victoria-street, E.C.

[69129.]—**Geneva Watch Repairs.**—Don't botch your watch in this way. If you cannot put in new jewel holes, send and have one put in by competent person; it requires more skill to put in a brass one than to set a jewel. You haven't your work clean, or your soft-soldering ought to stand. Clean well, apply a little zinc chloride and soft solder, holding in clear part of gas flame. To give instructions on hard and soft soldering would require quite a column; but I hope at some time to give such for the use of "young members" of the trade. Clocks should be cleaned with rotten-stone and oil, and plenty of elbow grease, and afterwards polished with whiting, wash-leather, and plate-brush.

Sheffield. EX-WATCHMAKER.

[69131.]—**Sun and Planet Motion.**—As power cannot be created by any combination of machinery, 1H.P. must be applied to crank at D to obtain a horse-power from F, friction being neglected. But the train crank C being 6in. centres, the effect of the gear in this case is, the crank D of 2in. practically makes 100 revs. per minute under pressure, with a stroke of twice (6 + 2) inches, or 1⅓ft.

Then $\frac{33,000}{2\frac{2}{3} \times 100} = 123{\cdot}5$lb. pressure referred to a piston. As the crank-pin D will describe an ellipse whose periphery $= \pi\ (8 + 4)$ inches, the mean tangential constant pressure on the crank-pin D $= \frac{33,000}{\pi \times 100} = 106{\cdot}3$lb. What would actually appear at F depends on the friction of the combination; if efficiency is ⅔, 50 per cent. more power must be applied.

Liverpool. W. S.

[69135.]—**Cold Tank.**—If "Croft" puts a siphon, similar to a lead trap, in his 1in. cold supply, his trouble will be removed, as it prevents circulation in pipe. A. HOLDAY.

[69138.]—**Series and Shunt.**—To MR. BOTTONE.—The series dynamo is the best for arc lighting; the shunt for incandescent and for charging accumulators, or for electroplating; the compound-wound for large installations with varying resistances. It is possible to have laminated F.M.'s, and in fact, the C.C. dynamo and motor are thus made but, practically, there is no advantage in this construction. Edison has given over making dynamos with long magnet cores, and unless there are separate pole-pieces (as in the Victoria Brush) there is no advantage in using more than two cores.

S. BOTTONE.

[69139.]—**Chromic-Acid Battery.**—The only objection is that if the six sets of elements are introduced into one tray, as the fluid is a conductor, you will get little or no current in the outer circuit—in other words, the battery won't act.
S. Bottone.

[69139.]—**Six-Cell Battery in One Trough.**—A similar question was put in the number for Dec. 26, 1879, and the reply of Mr. Sprague will be found on p. 416, and that of our old contributor, Mr. W. J. Lancaster, on p. 440, Vol. XXX. "Sigma" says: "It is not true that the elements will work properly in an undivided vessel; short circuits are formed from every pair to every other pair," &c. Mr. Lancaster replies: "The bichromate will not work in series," and then curiously adds: "I have never yet been able to work effectively more than ten bichromate cells in a trough." In Niaudet's "Electric Batteries," p. 224, is a description and engraving of M. Trouvé's battery made on this principle. He describes the battery as "a certain number of zincs and carbons placed in a suitable frame, held at short and equal distances apart, in such a manner as to form a single element or two elements. The frame in which the plates are placed is formed of ebonite, and held at the top by a handle. The plates are immersed in a single trough containing the bichromate liquid or mixture," adding: "There is, to be sure, a certain loss of current by the liquids; but the simplicity of the battery more than compensates the fault in question. The battery may be shaken in the solution by means of the handle; this agitates it, and contributes to the depolarisation." I hope someone who has used one of these trough arrangements will tell us of its capabilities. M.M.I.Sc.S.

[69140.]—**Leclanche Battery Construction.**—To Mr. Bottone.—Some operators copper the ends of the plates by electrolysis before casting on the lead caps; but I find that the copper corrodes more quickly than the plain lead. I generally bore three holes in the top end of the carbons, where I intend casting the lead. This gives more surface and better contact. You will find one part antimony and 10 lead, by weight, quite sufficient. Melt the antimony and lead in separate ladles, and, as soon as the antimony is melted, pour in the lead and mix. Do not cast while the metal is too hot.
S. Bottone.

[69141.] — **Products of Combustion of Petroleum.**—Depends on the purity of the petroleum. If fairly free from nitrogen compounds, and burnt with a sufficiency of air, the products are: Carbon dioxide CO_2, and water H_2O.
S. Bottone.

[69142.]—**Distillery.**—In answer to the above the writer thinks it will be difficult to find any book that treats of the arranging and cost of distillery and buildings, every maker of these apparatus having his own method. Having erected two distilleries for the distillation of strong spirit from wine, I may be able to assist "Worm," if he states what material he wishes to distil from, and what strength he wishes to make his spirit turned out from the still. J. Ramsay.
2, Colchester-road, Walthamstow.

[69143.]—**Polishing on Lathe.**—Many years ago I described in the pages of the "E. M." how famously the Indian turners give a shining gloss to their hard-wood work. I had occasion to make a set of very small file handles in a coarse kind of white wood; when they were removed from the pot of black stain they looked very unpromising, and on drying looked rough and dull. They were submitted to the simple process of friction in the lathe, while revolving at a good speed, each piece was separately treated by pressure with a thick slip of old bamboo (the outer or rind side only being used); this silicious substance has the effect of squeezing a surface, and also of producing a durable polish which can be further improved by rubbing with any transparent varnish. It is certainly twenty years ago that these handles were made, and they are still of a smooth jet-black done by the bamboo burnisher only. I used knife-edged slips for any hollow ornamentation. The Indian workmen use their lac polish, transparent and coloured, while the articles are revolving in their rude lathes, which have been described in old back numbers.
Eos.

[69146.]—**G.W.R. Named Narrow-Gauge Engines.**—The following are G. W. N. G. expresses: —380 North Star; 471 Sir Watkin; 1118 Prince Christian. C. F. Dendy Marshall.

[69147.]—**Converting Motor into Dynamo, &c.**—To Mr. S. R. Bottone.—The armature may be wound with No. 20 wire, say, about 1lb.; the field magnets with between 4lb. and 5lb. No. 24 silk covered. Couple up as shown in Fig. 29, § 32 of "Electro-Motors." This will give 3 ampères at about 48 volts; this means 3 lamps of 16c.p. The dynamo described in my book, "The Dynamo: how Made," takes about $\frac{1}{10}$H.P. to drive it. Now $\frac{1}{10}$H.P. means $\frac{1}{10}$ of 33,000lb. falling through 1ft. in one minute, or 3,300lb. falling 1ft. per minute. So to run this dynamo for two hours by a weight, you will need a tower 120ft. high, with a weight of 3,300lb. The difference between the current set up by the Wimshurst and the induction coil is twofold. 1st. The latter is of much higher tension. 2nd. And is alternate in direction instead of being continuously in one direction. Fizeau's condensers will do very well, provided the insulation is good; but this is very apt to break down. About a dozen square feet will render a man senseless if passed down the spinal column, and would probably kill some. S. Bottone.

[69150.]—**Sensitive Sound Alarum.**—If you can arrange a safety-valve, with a spring lever, to lift with the desired pressure of steam, this lever can be caused to complete the circuit between an electric bell and a battery, so that the bell will ring as long as the steam pressure is sufficient. If the sound of the bell is objectionable, one of Binswanger's "electric trumpets" may be used instead of the bell. S. Bottone.

[69151.]—**Incandescent Lamp (Edison's).**—For the Edison Swan lamps of the more modern construction you may reckon roughly that 1 ohm measured resistance corresponds to 1 volt required to send the necessary current through the lamp to light it. Hence, if a lamp measures on the bridge 100 ohms, it will require from 100 to 110 volts pressure to cause it to give its proper light.
S. Bottone.

[69154.]—**Photographic.**—Either your paper does not contain any free nitrate of silver, or your water does not contain sufficient chlorine to yield a visible precipitate. Single lenses are not usually so rapid as doublets, the aperture being so much less. Why not try? While on this subject I should like to say that I have found hydroquinone such an excellent developer that I have entirely discarded the use of pyro. With hydroquinone a snap shutter picture on an ordinary Ilford plate develops with an intensity equal to that obtained by hand exposures, whereas with pyro the picture is invariably thin. Sm.

[69156.] — **Relaxed Throat.**—Smoking has probably produced this affection of the throat. Galvanism is the proper remedy. I have known it do wonders in aphonia, or loss of vocal power. If you can afford it, go to a well-known electrical practitioner; if not, buy a Pulvermacher's chain of 50 elements, applying one pole to the back of the tongue, the other outside in the hollow of the throat, fastening it there with the tape attached, half an hour before rising from bed—again when you enter it—daily. Go to Pulvermacher' establishment, and he will instruct you and advise a suitable chain gratis. Cease smoking. Eos.

[69160.]—**Jewelry.**— You will not be able to colour brooch properly again owing to the silver solder and 9 carat catch. You will have to get your brooch gilt. Gold will not colour properly under 14 carat. For ordinary gold solder, to 1dwt. of 18-carat gold add 10gr. of silver solder, and mix thoroughly in melting. Gum Johnson.

[69160.]—**Jewelry.**—The best plan for "Three Legs" to colour his brooch will be to electro-gild it as he has put a 9-carat catch on. I suppose he will only want small quantities of solder, therefore he may find the following useful. 15-carat, or coloured gold: 12grs. gold and 4grs. silver solder; 9-carat gold: equal parts gold and silver solder. I presume he knows the proportions for silver solder, as that has been given in back numbers.
Working Jeweller.

[69161.]—**Waste Tin.**—You have only to read the article on this subject in last week's issue to see that the process is commercially a failure.
Sm.

[69163.]—**Dynamo.**—To Mr. Bottone.—For constructional details of Brush machine I must refer you to Prof. Silvanus Thompson's "Dynamo-Electric Machinery," or to Vol. XXXVI. page 517, of the English Mechanic, where you will find the required sketches. As to amount and size of wire to produce sufficient E.M.F. and current to feed twelve 16c.p. lamps of 100 volts, you will need an armature about 8in. diameter, wound with 4lb. No. 16 wire. Your No. 22 will come in for the F.M.'s, but will be of no use for the armature, as it would not carry the required current. About 15lb. No. 22 on the fields will give good results, if in shunt with armature. S. Bottone.

[69165.]—**Bunsen Cells.**—Make up a mixture of 1lb. chromic acid and 1oz. chlorate of potash, dissolved in 1 pint of water. Add to this 7 fluid ounces of strong sulphuric acid, sp.g. 1,840. When cold, place in the porous cells along with the carbon. On the zinc side put sulphuric acid 1 part, water 12 parts. If your porous cells are good, and the carbon contacts not corroded, this mixture will run your lamps for 12 consecutive hours.
S. Bottone.

[69166.]—**Lager Beer.**—I am afraid Mr. Timpson will find it impossible to brew Lager beer in the small quantity he proposes, and with the apparatus at his command. The mashing process in the manufacture of lager beer is very complicated. The fermentation is produced by an entirely different yeast to the one used in this country, and is carried on at a temperature which requires the use of large quantities of ice. He may produce a pleasant, light-drinking beer in the following manner. He will require a tub of 8gals. capacity, with a wooden tap near the bottom, the inlet of which must have a small wicker strainer secured to it to prevent the grains escaping when the wort is drawn off. He must provide himself with 14lb. of ground malt, 4lb. of flaked "rizine," and 2lb. of sugar, which may be ordinary cane, but would be much better glucose or invert sugar. He now boils four gallons of water, puts it into his mash-tub, and waits until its temperature falls to 185° Fahr., then with the aid of a thick stick stirs in his malt and rizine, taking care to secure an even mixture free from lumps. He covers the tub with a blanket or rug, and lets it stand for two hours; at the end of that time he—slowly at first, more quickly afterwards—draws off the wort into some receptacle, pours six gallons more water at 180° Fahr. on to his malt, and lets stand another hour. He now draws this off, pours hot water at 180° Fahr. on to his grains, and lets it run through until his quantity of wort amounts to 12 gallons. The whole of the wort must now be put into a copper of, at least, 15 gallons capacity, from ¼lb. to ½lb. of hops (according to taste) added, and the whole boiled vigorously for two hours. The sugar is best added a quarter of an hour before the end of the boiling process. Strain the boiled wort through a sieve to separate hops, cool down to 60° Fahr., and add ¼lb. good stiff brewer's yeast. (German yeast is not to be recommended.) Let the whole work for two days, skim off the head of yeast, and run off into cask. There should be a little over after cask is filled quite up to bung-hole, which may be put into a stone bottle. Leave the bung-hole open for a few days, remove the yeast which works out, and fill up from the stone bottle. When fermentation is pretty well over, bung up cask, keep for a fortnight or three weeks, and then tap. Take care that all utensils used are scrupulously clean. Walter J. Sykes, M.D., F.C.S.

[69169.]—**Telephone.**—To Mr. Bottone.—Two wires will be the best way to connect receiver and transmitter. You can use an ordinary electric bell in circuit, provided you have a switch to disconnect telephone. Parchment is the best. The tension can be obtained and maintained by means of a spring head like a drum head. If used with Leclanché or other battery, the rods may be soft iron; but they are usually good steel magnets. If the wire is not smaller than No. 20, six No. 2 Leclanchés would give ample power to work through the circuit. S. Bottone.

[69170.]—**Connecting Single-Needle Instruments.**—"E. E. B." should get Cassell's "Technical Educator," Vol. I., and refer to pages 369 and 401; he will soon see then where he is wrong. Almost every book on the telegraph gives a diagram. See Preece and Sivewright's, Prescott's, Langdon's "Application of Electricity to Railway Working," and many others. M.M.I.Sc.S.

[69171.]—**Speed Regulators.**—"F. C." stated the case very plainly and neatly.

$$v = \frac{2 \times 3{\cdot}1416}{60} \times N \,.\, (ac)$$

$$\therefore v^2 = \left(\frac{2 \times 3{\cdot}1416}{60}\right)^2 \times N^2 \,.\, (ac)^2$$

$$v^2 = {\cdot}010966 \times N^2 \,.\, (ac)^2.$$

$$bc \times \frac{W \,.\, v^2}{g \,.\, (ac)} = ac \times W.$$

Cancelling W and equating

$$bc = \frac{ac \times g \,.\, (ac)}{v^2} = \frac{g \,.\, (ac)^2}{v^2};$$

but as $v^2 = {\cdot}010966 \times N^2 \times (ac)^2$ as above,

$$bc = \frac{g}{{\cdot}010966} \times \frac{(ac)^2}{N^4 \,.\, (ac)^2} = \frac{32{\cdot}19}{{\cdot}010966} \times \frac{1}{N^2}$$

$$\therefore bc = \frac{2{,}935{\cdot}55}{N^2}.$$

And as g is in feet, while H is in inches, bc must be multiplied by 12, whence

$$H = 12{\cdot}6\, v = \frac{35{,}226}{N^4}.$$

Liverpool. W. S.

[69173.]—**Dynamo.**—To Mr. Bottone.—Armature 3½in. diameter, 1¼in. deep; wound with 1lb. No. 20. Field-magnet cores 1¼in. diameter, 5in. long; wound with 5lb. No. 22, in shunt, with brushes. S. Bottone.

[69174.]—**Cocaine.**—Allow me to recommend the "tabloids" of cocaine for the purpose you mention. They are far more handy than the solution, will keep indefinitely, can be carried everywhere, and one cannot make a mistake in the dose. Of all chemists. Sm.

[69174.]—**Cocaine.**—The best form of administering cocaine for sea-sickness is in doses of $\frac{1}{10}$ of a grain of hydrochlorate of cocaine to 1oz. of water, to be given every two or three hours. As one who has had some experience in the use of this drug, both in hospital and private practice, I would kindly advise inquirer to proceed in his experiments with caution. I have used cocaine, both internally and as an injection, and I am bound to say the results are very various, and in some cases, highly unsatisfactory. As an injection (hypodermic), cocaine possesses strong local anæsthetic properties, but it is troublesome to use owing to the uncertainty of its action. Administered internally, cocaine acts by producing temporary paralysis of the nerve endings in the coats of the stomach, and when given in this manner also, its action cannot be depended on, as it affects some patients very much more readily than others. Strong coffee should be at once given to a person suffering from an overdose of cocaine, which manifests itself by producing great excitability, followed by faintness and general apathy. One point more: the solution of hydrochlorate must be absolutely fresh, as decomposition very rapidly takes place, and the dose, if then administered, is highly dangerous. J. West.

[69176.]—δ **Cygni.**—In answer to "Beta" I would remark that as δ Cygni is a binary star, the angle naturally varies in different years. The angle is now about 312° and the distance 1·65″.

H. Sadler.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

68688. Making Pattern of Planer, p. 268.
68694. Naval Architecture, 269.
68700. Faulty Beam Engine, 269.
68701. Blast Fan, 269.
68715. Hot-Air Engine, 269.
68716. Piano, 269.
68720. Man and Truck, 269.
68723. Collar and Shackle Illusion, 269.
68725. Sound, 269.
68739. Organ, 270.

68890. Cutting Wheels, p. 356.
68905. Horn, 356.
68913. Locos. at Paris Exhibition, 357.
68914. Naphtha, 357.
68917. Gas-making from Benzoline, 357.
68919. Absorption and Radiation of Heat, 357.
68923. Crystals, 357.
68924. Explosives, 357.
68925. Watch Holes, 357.
68928. Leaky Boat, 357.
68929. Small Black Boot Buttons, 357.
68931. Rotary Engines, 357.
68935. Model Engine, 357.
68939. Lithanode, 357.

The plan of voting in assemblies by means of the electric current, and thus avoiding the time lost in making divisions, has been before the French Chamber of Deputies, and a report on the subject was presented by M. Montant last November. In that report the advisability of employing a machine which would indicate not only the total votes "pour" or "contre" a measure—that is to say, the "ayes" and "noes"—but also the number of voluntary abstentions from voting, as distinct from the number of absentees, is referred to. Such an apparatus has been devised by M. Le Goaziou. On every desk in front of a member is placed a small box fitted with two handles, which the member works when registering his vote. The right handle registers his "aye," the left his "no," and both moved simultaneously indicate his abstention from voting. The results are printed by means of electro-magnets in a receiver, and are visible at a glance. Provision is made for a member to recall and correct his vote during the time allowed for the purpose.

The latest novelty in military inventions is a vegetable cartridge shell, to which French periodicals are calling attention. This invention would, no doubt, become of great importance, should the results that are claimed for the same be confirmed. A Frenchman (M. Bieunait) is said to have found the means of replacing the metal shell of cartridges by one of a vegetable composition, which will be entirely consumed in firing. This cartridge scarcely weighs one-half of a metal cartridge, the price is considerably less, and its use will do away with all the drawbacks attached to the extraction of the shell after each shot. As the metal shell, however, secures the closing of the gun, M. Bieunait has invented a new contrivance, which may be easily affixed to every gun at a small expense, and which would give to his vegetable shell the same advantage as possessed by those now in use. The employment of these new cartridges would enable soldiers to carry twice the number now allowed, and thereby the difficult problem of the supply of ammunition in battle would be greatly simplified.—*Engineer*.

QUERIES.

[69178.]—**Compo.**—Will any reader kindly inform me how to make a black composition that I can run into moulds, and become hard immediately on becoming cold, and to withstand acids? I have tried several things, but they are not satisfactory.—W. H. F.

[69179.]—**Sand and Water Trough.**—I shall be much obliged if anyone will tell me how a stream of sand and water can be arranged to flow upon a stone for glass-cutting. I have tried more than once, but the sand either chokes the flow or pours down in excessive quantity. To rotate paddles in the vessel to keep the sand in suspension would probably succeed, but would be too inconvenient.—C. C. E.

[69180.]—**Blowpipe Lamp.**—What is the best substitute for Bunsen burner where gas is not available?—Prac. Chem. Student.

[69181.]—**A Patent Telescope.**—I have been a reader of "Ours" ever since the fifth or sixth vol., and read almost everything it contained, either astronomical or optical, up till now, but do not remember seeing anything about a patent telescope. Last night a friend of mine asked me to look at a telescope which he bought at a sale about two months ago, and on examining it I at once confessed my total ignorance as to its uses, or why it was patented. If I try to describe it, our kind "F.R.A.S." or some other optical or astronomical reader may be able to enlighten me and my friend. It is 10½ long, and contains, as far as I could see, three lenses and two plane reflectors. The object-glass is about 1½in. in diameter, fitted into a tube which tapers off and carries a smaller lens at about 2½in. behind the o.g., and just behind this small lens is reflector No. 1, which does not completely fill the tube, but allows some of the rays of light from the o.g. to pass by it, which passing through another small lens (at the eye end) are intercepted by reflector No. 2, and thrown out through a hole in the tube to the observer's eye. What are its uses? On the outside tube is engraved, "C. Varley's Patent Graphic Telescope."—The Optical Bricklayer.

[69182.]—**Flute.**—I have a flute which I believe to be a good one. It is cocus-wood, with eight keys and tuning slide. Now, I have been trying to play it for six months without satisfying myself. For instance, I never can feel sure that the note E, second octave, will come true, and I have never got lower C out—the one which is actuated by the lower of the two keys which are worked by fourth finger of right hand (lowest note on instrument). A little help on this point from any of our readers who have had experience would be greatly esteemed. I should like to know which kind of flute is best, ordinary or Boehm, and why. Also please say which is the best book on the construction and playing, one which goes thoroughly into the subject.—F. Rowley.

[69183.]—**Pearson's Orrery.**—Could any of your readers inform me in what book I could obtain full information about the construction of this well-known orrery, the number of wheels used, and how? Also number of teeth in each wheel, and the respective trains, and the results obtained from the several movements.—Orrery.

[69184.]—**Boring Holes in Wood.**—I have a lot of ⅜in. holes to bore in wood sideways 10in. deep in the lathe. I have a best American twist bit, but cannot keep it straight. If it meets with a hard place it goes crooked and spoils the work. The bit doesn't seem strong enough. The hole is no guide, as the bit diminishes. Would the Morse drills cut wood? Endways they look very strong and regular in size.—Twist Bit.

[69185.]—**Incandescent Lamp.**—I have one of Mr. Bottone's 5c.p. lamps, and one of the terminals has broken off level with the glass. Is it possible to mend it, and the best means of doing so?—T. S.

[69186.]—**Engine.**—Would any reader kindly let me know what would be the power, at 30lb. pressure, of a steam-engine of 4½in. cylinder, 12in. stroke, and flywheel 4ft. diam., and about 2½cwt.?—Reader.

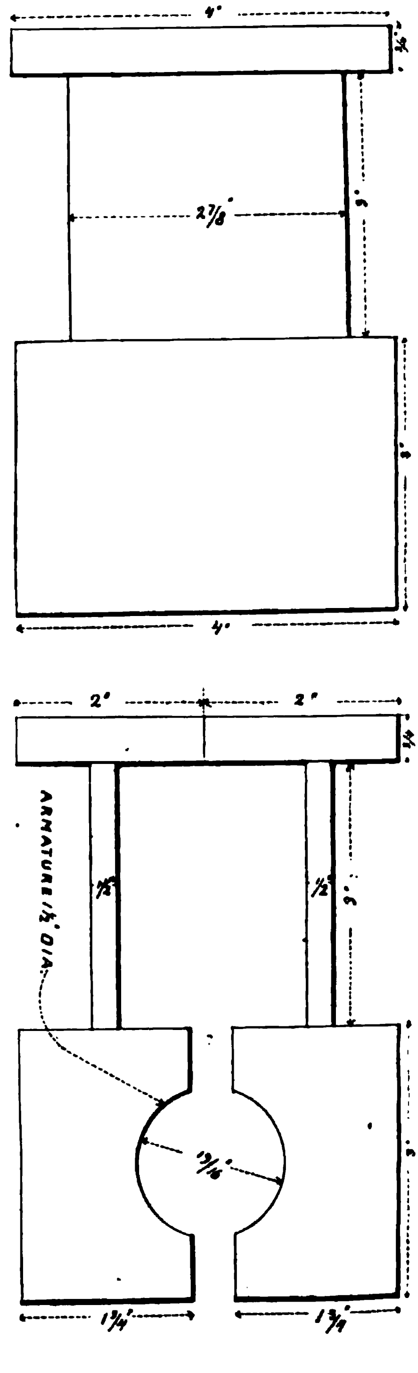
[69187.]—**Polarised Light.**—In a recent discourse at the Royal Institution, Prof. Silvanus Thompson stated that a film of indigo-carmine polarised light nearly as well as a slice of tourmaline, at a cost of a fraction of a penny. As a good tourmaline costs £2 or £3, the films in question will be a boon to students. Can any reader give information respecting indigo-carmine, and the preparation of the polarising films? Thirty or forty years ago, Dr. Herapath, of Bristol, discovered polarising films (named after him Herapathite) made from sulphate of quinine and iodine. These acted admirably. I succeeded in making some fine films; but could not preserve them. They slowly dissolved in the Canada balsam in which they were mounted. Has any improvement been made in the preparation and mounting of these films?—E. W.

[69188.]—**Condensing Exhaust Steam.**—In what way can I best and cheapest render to water the exhaust steam of a h.p. steam pumping engine, which it is proposed to fix 300 yards below surface in a colliery? The quantity of steam will be that resulting from about 2,000c.ft. at 60lb. super-pressure in its fresh state, or some 8,000c.ft. at atmospheric pressure. To convey it to the surface in this form would be expensive and inconvenient; nor is it contemplated from want of room to use an ordinary air-pump and condenser. The water which the engine will pump about 200c.ft. per minute, may be used either before or after passing the pump, but all back-pressure must be avoided. If a measure of vacuum could be obtained it would be all the better. What amount of cooling surface, supposing the water to or from the pump, passed through a series of small tubes placed in a chamber, into which and around the tubes, the exhaust steam is injected, would be necessary, the water being of about 60deg. Kind advice will oblige.—M.

[69189.]—**Mean Stroke and Pressure.**—The vibrating radial piston of a steam-engine working in an inclosed segment of a circle, is 20½in. long from boss to outer working periphery, 24in. from vibrating centre, and 12in. wide, thus the working area is 246 sq.in. The periphery moves 12in., and the point at boss 1½in. per stroke. At what point in this working length of 20½in. is the mean stroke to be taken? Supposing steam being used of 20lb. pressure per square inch, and non-expansively, would it be correct for foot-pounds of work per stroke, to multiply this mean stroke by area of piston as above, and by 20lb.?—M.

[69190.]—**Lap and Lead.**—The lap on the steam side of a slide-valve is 1⅛in., that on the exhaust side is ⅛in., and the lead is ⅛in. Find the opening for exhaust which the valve gives at the lower port when the piston is at the top of its stroke. How can this be found when the travel of the slide and the width of the steam ports are not stated?—K. Ruder.

[69191.]—**Electric Motors.**—Would Mr. Bottone give advice on following? I have set of castings, size of sketch inclosed. I wish to know what size wire to wind them: what battery to use, and what power to expect from same as a motor. Also, if used as a dynamo, what wire and quantity I should wind same? What lamps it would light, and how to connect-up to get best results? What power will it take to work same as dynamo?—J. L.



[69192.]—**Deodorising Carbon.**—I shall be glad if any one can advise me of some means whereby I can deodorise white carbon, such as is used by the Albo-Carbon Light Co. I want to use it in preparing an æsthetin composition; but find the odour very objectionable. Spermaceti would do; but it is too expensive. Any other substance of a similar nature to white carbon would do.—G. Cowper.

[69193.]—**Chromic-Acid Cells.**—Many thanks for kind answers to my query re Paraffining Carbons. Would Mr. Bottone kindly give me the numbers of the "E.M." in which his papers on electo-motors appear, as unfortunately I have not got back numbers. May killed spirits not be used in soldering connections? I think I have heard that rosin is the proper thing. What would be the E.M.F. of a battery in which, say, one half of the number of cells have an E.M.F. of 1·5 volts, and the other half [illegible] volts: and what would the [illegible] in each cell be? What is the best [illegible] an [illegible] candle-[illegible] would 3 pint chromic-acid cells give with a suitable motor: and what power would 3 quart cells give? Supposing a battery of six cells (three cells only of which are used at a time) driving a motor, how could a self-acting switch be made to turn the current off the spent battery to fresh one? That is to say, when one battery is spent the connection would automatically be broken, and made good with the reserve battery.—Electric.

[69194.]—**Electro-Motor.**—To Mr. Bottone.—I have made a motor as described in Feb. 8, article IV., and cannot get it to work. I would like to know if it is wound right. I have wound both magnets same as bell magnets are wound, and wish to know if they are right.—T. S.

[69195.]—**L.N.W. Tanks.**—Will some one kindly give a sketch and dimensions of 3079, a small 4-coupled tank, with outside cylinders, as used in working small branches, such as Leighton Buzzard, Newport Pagnell, Stony Stratford; also of engine and crane combined, as used in Wolverton carriage works.—Reymond.

[69196.]—**Specula.**—Is it worth while for a private individual, who wishes to grind a speculum for Newtonian, to try also to cast his own glass? If so, are there any books on the subject, or other means of gaining the information required?—Speculator.

[69197.]—**Magnet.**—In the "E.M." of June 14, page 323, appears an article on a strong electro-magnet; the wire used was No. 14 American wire gauge. Will somebody kindly say with which No. of the B.W.G. this corresponds?—Holland.

[69198.]—**Dry Battery.**—What is the white substance which is between the zinc and carbon in Dr. Gassner's patent element?—And what is its composition?—Holland.

[69199.]—**Launch Engine and Boiler.**—To "T. C., Bristol," or Others.—Have bought small engine and boiler (second-hand) for launch, and am rather in the dark with several things. The engine is vertical, screwed to boiler, 5in. stroke, 3½in. bore. The ports appear to have been altered: so should be very pleased if you would give me measurements to get best results at 80 to 85lb. boiler pressure; the eccentrics throw ¾in. The boiler is vertical, 3ft. 2in. by 1ft. 9in. inside, firebox 16in. by 16in., with one cross tube 4in. dia., and has four vertical tubes suspended in fire, made as follows:—about 3in. of 1in. pipe screwed in firebox crown, then an enlarging coupling, with 8in. of 2in. piping and plugged. Are these of any use, or would annular tubes be better? If so, kindly say how they are made and put in? I find in the chimney, which is 6in. dia., a 4½in. cast-iron pipe, with the space between well rammed all round with borings or cement, making the funnel quite an inch thick. What purpose can this be for, as it goes right down to firebox crown. Is it of any use? If our friend will kindly give his valued opinion on the above, it will be of great service to—Launchy.

[69200.]—**Observatory.**—Having received no advice as to the construction of a small observatory at the top of a London house [query 69051], I beg to bring the matter again before the readers of the "English Mechanic." True, "C. M" said it was of no use erecting one on account of the vibration, as no power over 60 could be used—a good reason for not erecting one at all. But as I find an open window of a house in a row running nearly N and S. so inconvenient that even for that low power, an uninterrupted view would be a gain, I shall be glad if some one who has such an observatory in London or some other town, would furnish me with the necessary details to construct one at a small outlay. At night there is little traffic in the immediate neighbourhood; but if the distant traffic affects all the buildings in London, even then I shall not be worse off than I am on that score at an open window as far as vibration is concerned.—G. G B.

[69201.]—**Pills: Mechanical Assistance Wanted.**—I want to make an arrangement for filling small boxes with pills. Receptacle holding, say, ¼lb. in tin box, with outlet tube diameter of pills, and about 9in. long. Pills must fall out of hole in single file down the tube. Have difficulty at the neck where tube joins body of tin. Mechanical device for letting pills through without any choking up will greatly oblige.—Pills.

[69202.]—**Ozonised Water for Mouth Wash and Offensive Breath.**—What is it? Details will oblige.—Pills.

[69203.]—**Secondary Battery.**—I am constructing a secondary battery. Could any of the readers of the "E.M." guide me in the construction of it? Is it surface of secondary lead, or greatest quantity of lead, that gives the greatest amount of ampère-hours capacity? If I had four sheets of lead to the pound, 2in. broad, and 4in. long; then say I had sixteen sheets of lead to the pound, the same breadth and length, which of the two sets would I get the greatest number of ampère-hours out of? If it is surface, and not quantity, why use such thick leads in large secondary batteries? I, as well as others, would be very much obliged to any who could explain this.—A. W. J.

[69204.]—**Vulcanite Polishing.**—Will some reader please give particulars of the process by which the black vulcanite stems of tobacco pipes are polished; and if the same process could be made applicable to general vulcanite work?—Vupobi.

[69205.]—**Electric Light Battery.**—Can any electrical friend please tell me how many quart cells of a Fuller battery will be required to light sufficiently a 6-volt 5c.p. lamp; and if double the number will be required to light two such lamps. Zinc with sulphuric acid in porous pot, and two carbons with bichromate and sulphuric acid in outer.—Old Subscriber.

[60206.]—**Malt Vinegar.**—Can any of your readers give me particulars of how I can make malt vinegar (say 250 gallons), and whether I should require a license?—Very Sour.

[69207.]—**Balance.**—Can anyone tell me of a publication which will clearly explain the system of balancing commercial books and method of drawing balance sheets by the complete double-entry system, and also by the universal system of keeping accounts without a general ledger for entering the monthly totals of the subsidiary books?—Quill.

[69208.]—**Stained Glass.**—When I was at York Minster, I was told (by the person showing me round) that the sun's rays after passing through the old stained windows, do not show any colour, whereas modern stained windows do produce colour. Is this a fact?—Spire.

[69209.]—**Barometer.**—I have an instrument of the wheel type, but it is rendered useless as the mercury has become detached in several places. How can I get the little sections to unite? Does the mercury require cleaning? Is it possible for me to put it right, or must I take it to an optician? What should be a reasonable charge?—Atmosphere.

[69210.]—**Deodorising Fish Oils.**—I should be greatly obliged to any of your readers who can inform me as to the best method of deodorising and refining fish oils for the purpose of soap-making.—Polo.

[69211.]—**Measuring Steam.**—As I supply several tenants with steam from my boiler, I am at a loss to know the best way of charging the same, so as not to err much on the one side or the other. Is there such a thing as a meter or other register to indicate the quantity passing through a pipe?—J. T.

[69212.]—**What is a True Elizabethan Twist?**—Is it correct to call any kind of twist Elizabethan? How are twists made in quantities? I have just seen specimens of twisted balusters, which I was told were simply done by hand, and do not take long. Would not an engineer's slide lathe with a revolving cutter do them much quicker?—F. A. M.

[69213.]—**Ginger Beer.**—What is the percentage of spirit in ginger beer? What is a ginger-beer plant? I have just seen one which looks like soaked tapioca, in a jug—some pieces of ginger, sugar, and water are added every day. It produces a jug full of liquid which appears like ordinary ginger beer. Is this wholesome? The plant grows, and some has to be thrown away every week? What is this plant, a fungus? Does it furnish the ferment?—F. A. M.

[69214.]—**Bell Indication.**—Would a reader kindly suggest ways or means to effect the following? The door of my shop is left open all day. At different periods of the day my work is situated in a room behind. When in this room I am so situated that I cannot see my shop door, the structure of the shop inconveniently hiding it. If possible, I want to construct a bell or any other ingenious article, so that the moment a person enters, it might be indicated in the room inside.—J. L. S.

[69215.]—**Reproducing Photographs.**—I frequently see advertisements running as follows:—"Six cabinet photos. for 3s. Send cabinet, which will be returned uninjured." How are these done? Is the original photograph taken off the mount (if so, how?), and a paper negative taken from it, or how? Also by what method are the miniatures similar in size to postage stamps done, of which 50 can be had for about 3s.—Photo.

[69216.]—**Model Locomotive.**—I have a boiler, 4in. diam. 9in. long, which I want to make into a model locomotive. Can any reader tell me what size cylinders I would require?—Locomotive.

[69217.]—**Odourless, Colourless Disinfectant.**—Wanted as above, if one is known, or one suitable to be added to soap—must not stain.—Epicer.

[69218.]—**Odour of Decomposition.**—Can any of our readers inform me of a chemical giving off an odour similar to the decomposition of flesh?—wanted for attracting flies for a fly-paper.—Epicer.

[69219.]—**Dynamo.**—To Mr. Bottone.—Would Mr. Bottone please state how many ordinary bichromate cells would be necessary to work the small dynamo he advertises to light two 6-volt lamps? Would a small model engine be of sufficient power, or could he suggest some cheap motive power? Would the said dynamo charge small accumulator? If so, of what size?—Lux.

[69220.]—**Silent Alarum.**—I wrote last week in the Mutual Aid Column of the *Weekly Times and Echo* about a silent alarum, and was told this paper would be the best to gain information from. Will some one kindly tell me if there is such a thing as a silent alarum? What I mean to say is, one you could fix some way so as to keep from waking others up, as I have to get up very early.—W. W.

[69221.]—**Lathe Matters.**—I have been fitting a set of iron change wheels to 5in. lathe, and find the teeth so hard it is impossible to turn their edges. How is this overcome? What sort of cutter-frame and what kind of cutters are used for fluting taps and cutting teeth in gun-metal change wheels? Being desirous of making a cutting frame for these purposes, I should be glad of a description or reference to back numbers. Many have been described in the last few years, but some have gear wheels, which would be beyond my capabilities, while the others may be only used for purposes for which I should not require them.—F. M. C.

[69222.]—**Discharge from the Ear.**—Will anyone kindly tell me how to cure an obstinate discharge from the ear? I have had local medical advice, but do not get relief; no pain. Have used glycerine and borax, gallic acid, &c. Doctor says it is a perforation, which makes me deaf. I don't mind that if I can stop the discharge. Have the teeth anything to do with it, because they are decayed, but have been stopped.—Barum.

[69223.]—**Steam Launch.**—Would any of "ours" kindly give full particulars of engine (vertical type preferred) and propellor suitable for driving a launch, 21ft. long, 5ft. beam, and 15in. draught, at a speed of eight miles an hour, and against a stream running, say, four miles an hour?—Taupo.

[69224.]—**Medical Coil.**—I have a coil wound to give primary shock only. It has a 1in. core, and outside diam. of coil 2¾in., wire No. 18. Could I not get a greater shock if I rewound it with three layers of No. 18, and the rest No. 32, 34, or 36? Please state which is best, and could the present diameter of coil be profitably exceeded? Length 4½in.—A. Hobday.

[69225.]—**Electric Lamps**—During the winter months business takes me out driving a great deal during the night, though probably never more than four hours on one journey; but driving over commons and waste places, I require extremely good lights. I have been advised to have a pair of 5-candle lamps, and a bichromate battery. I am told the solution costs next to nothing, and, in fact, my first adviser says all will work most perfectly, and cost very little more than the lights I have hitherto used. My next adviser says anything will give more satisfaction than electricity for my purpose. He says the lamps themselves will last only 40 hours, and to replace them the cost will be 4s. each, and that the jolting of the cart will be most injurious to the light, &c., &c. Will some practical electrician advise me? 1. Cost of two 5-candle burners (they will, of course, be fitted into my present lamps), and how long will they last. 2. Cost of charging battery. How many hours will a charge last, and how much would the battery weigh? 3. Is there any possibility of seeing anything of the kind before purchasing (near London)?—E. W.

[69226.]—**Electro-Plating.**—I have commenced electro-plating, and use the bichromate of potash battery. At first I had a deal of trouble to keep up a good current. I had a three-pint cell, with flat plate of zinc 7in. long, and thick carbon 7in. long. Being told that the carbon is the strength of the battery, I got a rough bit of carbon from gas-works, about 9in. by 2in. by ½in.; also a round stick of zinc, and fitted them to a larger glass cell. Now, after the battery has been working for several days, if I add ¼ oz. of B.P., and almost same weight of sulphuric acid it will work straight off for, say, fourteen or fifteen hours, or more, and deposit 4dwt. or 5dwt. of silver. Please, is this according to the experience of others? Also can I further improve it? Would a larger carbon give out more power? If so, I can get pieces 3lb. or 4lb. in one weight. If one large cell gives such good results, how is it that often three, four, or even twelve cells are joined together?—for it is well known that the weakest cell will level all the others to its own power, so that if one cell fails, all fail with it. The weakest link is the strength of the chain. It seems to me that many cells mean many dangers, and much trouble and expense. If I am wrong, I wish to be set right.—W. M.

[69227.]—**Perihelion.**—Would "F.R.A.S." kindly furnish me with the longitude of the perihelionic points of Mars, Jupiter, and Saturn; and also say if the motion of their lines of apsides is progressive or retrogressive?—W. Godden.

[69228.]—**Water Purification.**—I was much interested in Mr. Davis's very intructive paper on water purification, and should be obliged if some reader would give more information concerning its adaptability for domestic purposes. Would the salts he names be at all injurious for water habitually used for drinking purposes; or would the Porter-Clark process be more suitable for this purpose, and what treatment would be best for the Thames water, as supplied by the companies to the S.W. districts, with the number of grains to be used per gallon.—J. H. A.

[69229.]—**Air Gun.**—Will some reader who understands the construction of the air gun, please inform me what to do to stop a bad leakage from the valve in butt? Any hints on the subject will be appreciated.—G.

[69230.]—**Cement.**—Can any of your readers give me a recipe for any kind of cement that will stick to polished iron, and smooth wood, that will not chip off, or crack with age. Or can pitch be mixed with anything that will prevent it chipping off and losing its adhesive properties when old?—E. Wright.

[69231.]—**Pyrotechny.**—Would Mr. W. H. Browne or some other reader give me the following information? Can I make a firework shell mortar for 3½in. or 5in., shells from stout boiler tube? I have hitherto used paper mortars, but I require something more permanent, and these iron mortars are rather expensive things to buy from the professionals.—T. Pearce.

[69232.]—**Batteries.**—I have several accumulators which are used to light an incandescent lamp, and I charge them singly with two large Bunsens? I wish to give nitrate of soda a trial, and should be obliged if some practical person can tell me how to use it to get the best results. Also whether it is better as a depolariser than nitric acid. The cells are never left on open circuit; always at work or else empty. I have tried chromic-acid solutions of various strengths. They have not the lasting power of nitric-acid, and the E.M.F. drops off very much, besides being more expensive.—Spark Grinder.

[69233.]—**To Mr. Bottone or Others.**—I have seen a dynamo made by Golden and Trotter. A Gramme pattern. The A. was about 9in. diameter, wound with No. 16, or not larger than 15, wire, B.W.G. The A. coil was a single wire connected in the ordinary way. The F.M. coils were of No. 18, and connected in shunt with A. It gave 56 volts, 40 am., charging accumulators from 8 till 4 o'clock, and did not get hot. Will you please explain to me the reason of this machine giving such a heavy current for so small a wire on the A.? Where is the secret?—Anxious.

[69234.]—**Petroleum Boiler.**—Can any of your readers give particulars of boilers used for evaporating oil instead of water? I have heard of some being used to great advantage on a steam yacht, and should be glad to know the dimensions and kind of boiler used.—Inquisitive.

[69235.]—**Melting Brass.**—Will some practical reader kindly describe an apparatus for use with spirit for melting in a crucible about 2lb. of brass? Gas not available, and pocket not well supplied with cash.—F. Allen.

[69236.]—**Rock Oil.**—Referring to your article on "The Origin of Rock Oil" (p. 447), will anyone kindly inform me where I can read details of any of the four processes for the synthetic formation of saturated hydrocarbons mentioned (middle of second column)?—J. Ch. Sauer.

Captain F. Watkins, of the Inman line steamship *City of Paris*, according to the *Marine Journal*, says that fore-and-aft canvas is of no assistance to a fast steamer, not even for steadying purposes. Instead of increasing the speed, he says the spars and sails frequently retard them as much as a mile an hour. Within a few years he expects to note the absence of both canvas and spars from all the ocean fliers.

CHESS.

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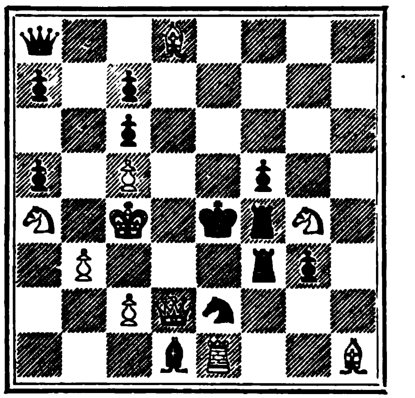
All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLX.—By A. Bolus.

Black.



White. [10 + 12

White forces Black to mate in two moves.

Solution to 1,158.

White.	*Black.*
1. Q-R 3.	1. Anything.
2. Q, R, or Kt mates.	

Also 1. R-Q 7.

(Seven variations.)

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,158 by R. T. Hood (2), Litho (2), J. C. B. (2), A. Dean, Janus, Mendelssohn, Fr. Fernando (2), J. Kistruck, H. C. H., J. Kilbee (but if 1. Q-K Kt sq., P takes B, and if 1. K-Kt 3, P-K 6; to 1,157 (by Muzio (3 duals), W. Jay (triple and two duals), Janus (ditto), A. Dean (but variation 1. K-B 3 omitted, and errors such as 2. K-B 3 or K 4 if 1. B-Q 3 or Q Kt 3, or if 1. Kt-Kt 4, &c.), and J. C. B. (triple and two duals).

We must again request correspondents not to send telegrams, as one shilling extra has to be paid for porterage.

A. Anderson.—If in 1,157, 1. Kt-Q B 5 (ch), K-Q 4; 2. R-K B 5 (ch), B-K 4, there is no mate.

W. Jay.—We ought to have credited you with triple and dual in 1,154.

J. W. Read, and Vernon R. Cockerton.—If in 1,158, R takes B, Kt-K B 7.

Juno.—Thanks for the problem, which would be a good one but for the second solution, 1. Q-K Kt 5 (ch).

In the *Sheffield Independent* Tourney there is to be a selecting competition, in which the selectors are to send in what they consider to be the first, second, and third best problems, which in turn will be awarded three, two, and one marks respectively; and the prizes are to be awarded to those problems receiving the greatest number of marks in their order. Prizes to be awarded to the selectors whose selections are placed similar to the prize problems. But the selecting competitions will be confined to those solvers who have either won at least four problem or solution tourney prizes, or have scored at least half the possible full number of marks in four solution prizes in connection with that column. These regulations are, as far as we know, original, and they appear to us excellent.

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⁂ It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

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Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

Yes, the Ruptured will still find Dr. SHERMAN at his London Office, 64, Chancery-lane, where his wonderful success draws the afflicted from all parts of England, and where you and all others should go who entertain the hope of ever being cured. Send for his books, English and American, post free, 6d., and inform yourselves.—[Advt.]

ANSWERS TO CORRESPONDENTS.

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⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 31, and unacknowledged elsewhere:—

G. H. King.—H. R. H.—R. Shaw.—Vindex.—H. G.—Vooght.—W. T. K.—Engineer.—G. W.—Logarithms.—British Mechanic.—F. H. Blomfield.—Globe Trotter.—Arthur Hart.—E. Parr.—S. White.—W. R. Waugh.—W. H. Browne.—W. Carrington.—T. W. Cannon.—A. C. Griffiths.

E. M. (Full particulars as to the method of joining any of the learned societies can be obtained from their respective secretaries. As a rule, the candidate must be proposed by two or more members (generally more); but two at least should have some personal knowledge of him. The address of the Royal Meteorological Society is 30, Great George-street, Westminster, S.W.)—Enid. (It is only in suitable positions and in favourable seasons that chrysanthemums will bloom in the open ground. They are usually kept in pots—that is, those wanted for Christmas blooming—and protected by old window sashes or scrim canvas stretched on a frame. There are early-blooming varieties—flowering, say, from the end of August to the middle of October; but with the old-fashioned varieties, which bloom generally in November and December, in only about one season out of ten is the weather favourable. Exhibition blooms must be protected in all seasons on account of the rains.)—Inorganic Chemistry. (A Daniell would probably be the most useful battery for experiments "in chemistry"; but you really must give some idea of the purpose for which it is required before a satisfactory and trustworthy answer can be given. For what purpose "in chemistry" do you want an "electric battery"?)—A. G. Hutton. (The "Lessons on Chemistry" referred to are in Vol. XIV. The Nos. have been out of print for some years. There are plenty of textbooks of chemistry on sale, and any bookseller can procure them. If you gave some idea of your object we might be able to help you, though we do not care to recommend books.)—Chicken. (We thought we had almost exhausted the subject of incubators. See No. 1195 and No. 1211 for a home-made affair, and Nos. 935, 1007, 1009, and 1075 for much useful information.)—A. Answer. (You will find advertisements of "soda-water" machinery in the proper columns; but we do not think you will get what you apparently want at the price named. However, procure the catalogue issued by Barnett and Foster, Niagara Works, 25a, Eagle Wharf-road, New North-road, London, and you will get an idea of the "bearings" of the subject. There are other advertisements, if you will take the trouble to look for the information you require. 2. As to the estate agent, the only thing is to get the business to do.)—Laborious. (You could have the MSS. photographed; but if only two copies are required, it would be cheaper to employ someone to write them out. Anyone who advertises to do type-writing would make as many copies as you require.)—An Amateur. (See indices. The carbon-plates are cut from the gas-retort scurf, but others are moulded up under hydraulic pressure.)—Bernard Hanson. (Various suggestions have been offered to prevent sea-sickness; but not one is successful in all cases. See the indices.)—Haslingden. (What pickles! However, all that is necessary is to dry the vegetables as much as possible without injuring their form and colour, and then soak in a strong solution of acetic acid, which is vinegar. If it is necessary to boil the spices, it would be better to do that in a little water rather than boil all the vinegar, because you can add acetic acid to the water, whereas if vinegar is boiled it loses its strength. Any bookseller can supply you with a book of recipes.)—And. Bowers. (It takes a long time to get even valuable inventions adopted—the Bessemer process and the Gramme dynamo, for instance. 2. The substance sent is probably refuse from the bleaching liquor and the china clay used to load the paper; but we do not undertake analyses.)—Musicus. (Leather valves are sufficient at the top of the wind trunks. A safety-valve is not needed, but one is easily fitted. The Sourdine closes the large valve at the bass end, and permits the wind to pass through a small hole only, which can be regulated by the "button" to which you refer. The consequence is, that from a deficient supply of wind the bass notes are softened.)—Collector. (Impossible to say. It should be submitted to an expert.)—Succeed or Bust. (If you cannot refer to back volumes, procure Clerk's "Gas-Engine," Longmans. You can see that and our back volumes in your free library.)—Country Millwright. (We illustrated and described Taylor's engraving machine in No. 1147, more than two years ago. Perhaps it may be something new to which you refer; but we do not know the paper mentioned.)—J. Wood. (We do not see how we can further help your endeavours.)—Meddyg. (Go to Mr. W. Wray or Mr. G. Calver; you will find their addresses in our advertisement pages, and will be perfectly safe in the hands of either.)

Rupture Sufferers should call at the MEDICAL BATTERY COMPANY'S INSTITUTE, 52, OXFORD STREET, LONDON, W. (corner of Rathbone-place), and inspect Mr. C. B. Harness' valuable Hernia Appliances, which have been so strongly recommended by the medical profession. An experienced and skilful surgeon attends daily, and examines patients free of charge. Pamphlets gratis and post free.

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Wanted, Portable Forge, Anvil, Surface Plate, 1H.P. Vertical Boiler, for new Domestic Machine or Oil.—Monkhouse, East-street, Bromley, Kent.

Printing Press and Type, &c. What offers? Bicycle, Harmonium, or Drapery.—*Eagle* Office, Daventry.

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Manganese, about 70lb., 1½d. per lb. Will send sample per post. Exchange.—H., 42, Charteris-road, Tollington Park, London, N.

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Will exchange good **Model Engine**, 2¼in. stroke, for 4in. centre Headstock, Poppet, a Rest, and Mandrels.—C. Evans, Market-street, Clay Cross.

Will give several recent spare numbers "Journal Society Telegraph Engineers" for two six-volt, five candle power Incandescent Lamps.—James, 72, Cambridge-street, Birmingham.

1H.P. Engine and Boiler wanted in exchange for Exhibition Electric Machine, complete with patterns, and all requirements, value £20.—Carter, Electrician, Lichfield.

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What offers for Rev. J. Platt's "**Commentary** on the New Testament," half calf, complete, four vols., good condition, worth 15s.—4, Lower Stafford-street, Wolverhampton.

What offers for the **Works** of Rev. J. Fletcher, complete, eight vols., in good condition, useful offers.—Lower Stafford-street, Wolverhampton.

What offers for "**Dwight's Theology**," complete, five vols., nearly new, worth 15s. Above all genuine. Not a bookseller.—H. Robbins, Lower Stafford-street, Wolverhampton.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, AUGUST 9, 1889.

ELECTRIC-BELL CONSTRUCTION.—XII.

By F. C. Allsop.

The Magneto Bell.

ALTHOUGH the chief field of the magneto bell is in telephony, where the resistance of the circuits is very much higher than those employed in ordinary electric-bell work, yet instances frequently occur in electric-bell fitting where it will be found far cheaper and much more satisfactory to erect magnetos. When the two places between which it is desired to signal are far apart, the resistance of the circuit becomes high, even though an earth return is used; and if an ordinary electric bell with battery is employed, the expense of putting down the number of cells necessary to get the required E.M.F. becomes an important item. The magneto generator (by being specially wound for that purpose) can be made to furnish a current at a high E.M.F., and ringing a bell between London and Edinburgh is considered no out-of-the-way feat in telephony.

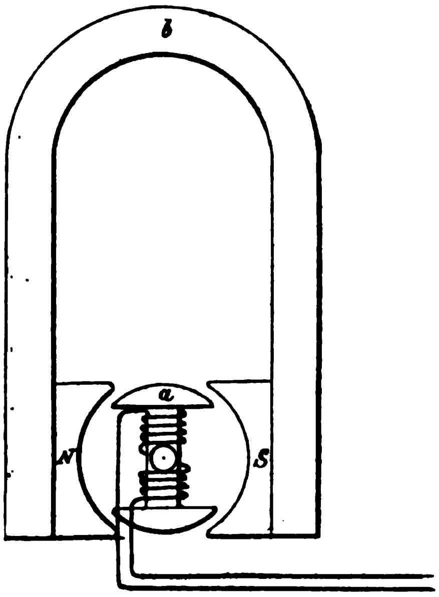


Fig. 65.

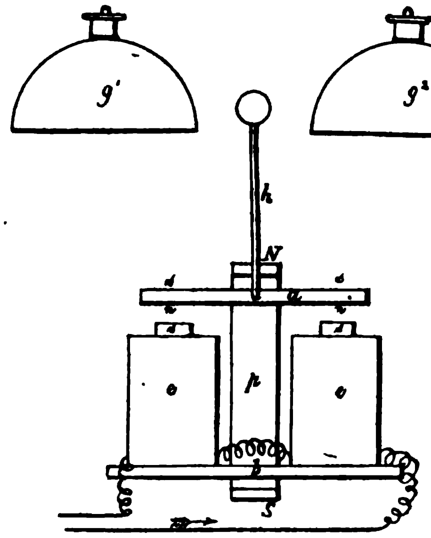


Fig. 66.

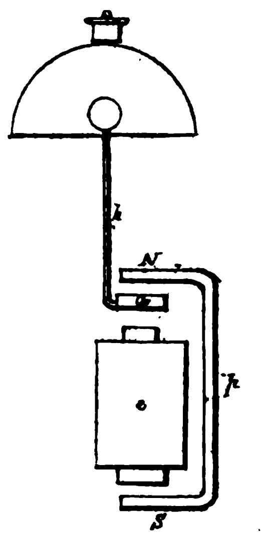


Fig. 67.

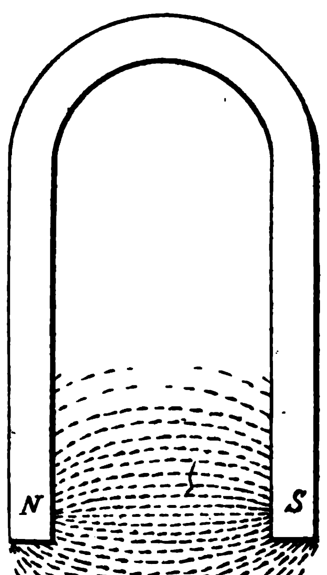


Fig. 68.

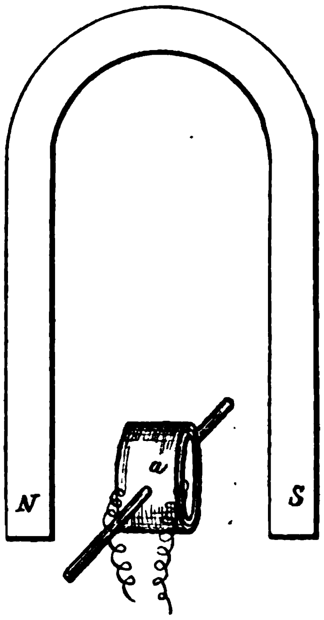


Fig. 69.

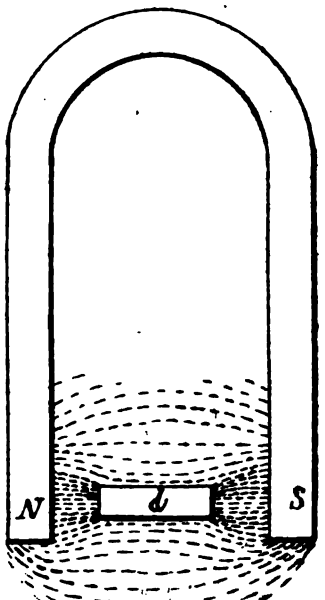


Fig. 70.

The apparatus required for signalling between two places by the above-mentioned method consists of two parts—the generator or magneto inductor, and the bell. The generator transmits the signals, which are reproduced at the other end of the line by the bell.

The generator—which is, in fact, a small alternating-current dynamo—is shown diagrammatically in Fig. 65. It consists, essentially, of two parts the armature *a*, and the permanent magnet *b*, with the two polar extensions N and S. The armature, which is generally, though not necessarily, of the Siemens H form, is so mounted as to be capable of being rapidly rotated between the poles of the magnet *b*.

The principle on which the generator acts will be better understood by reference to Figs. 68, 69, and 70. If we take a horseshoe magnet such as is shown in Fig. 68, and, laying it flat on the table, place a sheet of glass on it, we find that, if iron filings are scattered on the top, that they will arrange themselves, when the glass is gently tapped, in certain lines or curves similar to those shown in Fig. 68. The space all round the magnet in which its influence is felt is called the "magnetic field" of the magnet, and the lines as designated by the iron filings show the direction of the field or magnetic force. These lines are called "lines of magnetic force," or, for short, "lines of force."

Now Faraday discovered that *by moving a wire or other conductor near the pole of a magnet in such a manner as to* *cut lines of force, a current of electricity is generated in that wire.* Thus, if we take a coil of fine insulated wire, such as is shown by (a) Fig. 69, and having mounted it on a spindle connect the two ends of the coil to a sensitive galvanometer, we find, on placing it between the poles of the magnet and twisting it sharply from the position shown into one at right-angles to it, that the needle of the galvanometer is deflected to a number of degrees, showing that a current of electricity was momentarily generated in the coil. Twisting the coil, in fact, caused it to alter the number of lines of force passing through it, giving rise to a current.

On further experimenting with this coil and magnet we find out four things in connection with the coil. 1st. That no deflection of the needle is obtained unless the circuit is complete, 2nd. That the sharper we swing the coil the greater the deflection of the galvanometer needle. 3rd. That we can also increase the deflection of the needle by putting more turns of wire on the coil. 4th. That if we turn the coil right over so that the upper part is now at the bottom and then twist it, the needle is deflected in the opposite direction. This shows us four things in connection with the coil which represents the armature of the generator. 1st. That unless we have a closed circuit no current will be generated. 2nd. That the quicker it rotates the higher will be the E.M.F. 3rd. That we can also increase the E.M.F. by putting more turns of wire on the armature. 4th. That the direction of the current from the generator is reversed twice in each revolution. There is also another thing we find by experimenting with our coil and magnet. If we fasten inside the coil a piece of soft iron rod, and then twist the coil, we find that everything takes place as before, only in a more intensified manner. Whereas, when before we twisted the coil the needle swung but feebly, it now swings violently; the slightest movement of the coil causing it to swing. Placing the iron in the coil has increased the effects. The reason for this we shall see if we go back again to our horseshoe magnet with the sheet glass and iron filings. If we slide between the poles of the magnet a piece of iron rod as shown by *d* in Fig. 70, we find if we now gently tap the glass that the character of the magnetic field has changed, the iron rod has altered it, it will appear as shown in Fig. 70. The lines of force in passing from pole to pole of the magnet, take by preference the iron rod, as iron offers much less resistance to the lines of force than air. Thus placing the iron in the coil increased the effects by concentrating the lines of force through the coil. The presence of iron in the armature, in fact, increases the E.M.F.

The armature of the generator, it will be seen, is of the Siemens H form, and soft iron pole-pieces are attached to the magnet so as to better inclose the armature. When the currents of electricity are induced in the armature, the armature becomes for the time an electro-magnet, and the currents in the armature are always in such a direction as to oppose the motion. This will become apparent on slowly turning the armature of the generator, when it will be found to move in a jerky manner if the circuit is closed, and comparatively freely if the circuit is open. As the direction of the current is reversed at each half-revolution of the armature, we see that the current given out by the generator is an alternating one, the rapidity of the alternations depending on the speed at which the armature is rotated.

This alternating current is not adapted for working the ordinary form of electric bells, as these are designed to work with a current that flows always in one direction, such as is given out by a battery, so a different form of bell is used. The first forms of the magneto bell were similar to the Siemens polarised relay, the armature being a permanent magnet, and working between two electro-magnets. It had many faults, however, the chief of which were its sluggish action and the liability of the armature to lose its magnetism. The great improvement of the modern magneto bell over the old form consists in the substitution for the polarised steel armature of a soft iron one inductively magnetised by a permanent magnet placed in close proximity to it. Figs. 66 and 67 show a diagrammatic view of the modern magneto bell, Fig. 67 being a side view of Fig. 66, with the right-hand gong removed. The bell, it will be seen, consists of the electro-magnet *e*, opposite the poles of which is the armature *a*. This armature is pivoted at the centre, and from the centre also springs the hammer *h*, which works between the two gongs g^1 and g^2. The electro-magnet *e* is of the horseshoe form, the piece of iron *b* joining the two legs of the magnets. Close to the electro-magnet *e* is the permanent magnet *p*, the north pole, N, of which comes close to the top of the soft iron armature *a*, and the south pole S close to the bottom yoke of the electro-magnet. The effect of this is that the north pole N of the permanent magnet *p* magnetises by induction the armature *a*, causing it to exhibit on the top a south polarity, but on the lower side a strong north. The south pole S of the permanent magnet similarly magnetises the cores of the electro-magnet, causing its poles to exhibit a south polarity.

The action of the bell is as follows:—When no current is flowing round the electro-magnet both ends of the armature are attracted alike, and the hammer will remain against either gong if once placed there. This is how the bell is shown in Fig. 66: No current is passing through the coils of the electro-magnet, and the magnetism shown by the small letters *s* and *n*, both in the armature and cores, is that due to the permanent magnet alone. But if a current from the generator flows through the bell in the direction shown by the arrow, the left-hand pole becomes south and the right hand north, the left-hand pole powerfully attracting one end of the armature and the right-hand repelling the other, throwing the hammer (*h*) against the gong (g^1). When at the half-revolution of the generator armature the direction of the current is reversed, the left-hand pole of the electro-magnet becomes north and the right-hand south, throwing the hammer against the gong (g^2). The armature of the bell, it will be seen, acts just as if it were of north polarity throughout, the south polarity on the top being so feeble and much further off from the pole of the electro-magnet as to but slightly impede it. As the armature of the generator is rotated very quickly, the reversals of the current are very rapid, and the ringing becomes similar to that of the ordinary trembling bell. In some forms of the magneto bell the bottom pole of the permanent magnet is in actual magnetic contact with the bottom yoke of the electro-magnet instead of being supported off from it; but in either case the effect is the same, viz., to give a south polarity to the poles of the electro-magnet.

In the next article the construction of a magneto generator will be described and afterwards that of a bell to work in conjunction with it.

A MODEL LOCOMOTIVE.—XV.

Valve-Gear.

BEFORE commencing to describe in detail the fitting of the valve-gear, I propose to look at the elements of the motion, in order to gain clear ideas of the action of the gear as a whole, without which the description of disconnected parts would be confusing to those who do not happen to have given attention to the subject. Hence the outline diagrams here shown of some of the successive stages, and relationships of the valve-motion will be an aid, and serve for reference presently. In order to reduce error, I have laid down these diagrams from a model. The subject of valve-gears and valve diagrams can be fully studied only in the treatises specially devoted to the subject; it must suffice for us simply to note the cardinal features of our own special gear, in order to the better understanding of the details to follow. Though to the uninitiated even these elementary figures may perhaps appear as a puzzling network of lines, yet when we analyse the motion, and take the parts in detail, the mutual dependence and relationship of each will be clear.

In all the figures A represents the eccentric sheaves for forward or fore gear, B those for backward gear; C is the centre of the axle, D the rods for fore-gear, E those for back gear. These operate the valve rods, and valves G, through the medium of the slot links H. J is the connecting rod, and K the piston rod. The purpose of the slot links H is the reversal of the motion of the engine, and the regulation of the expansive action of the steam, as follows:—

In the position of the crank-pin X, shown in Fig. 75, the piston P is at one end of stroke, the crank-pin X is on dead centres farthest from the cylinder, and the relative arrangement of eccentrics, eccentric and valve rods is such that the valve G connected therewith is slightly open to lead on the forward gear; admitting steam at the commencement of the return stroke, and causing the crank to revolve in the direction of arrow, and steam is exhausting from the opposite end of the cylinder, By the time the crank has moved to X in Fig. 76, the inlet port is fully opened to steam, and the eccentric A then begins to cause the return of the valve to close the port, so cutting-off steam supply, which event occurs at about three-fourths of the piston-stroke, Fig. 77, the steam during the remainder of the stroke operating expansively. Shortly before the termination of the piston-stroke, the exhausting port becomes closed by the inner edge of the arch of the valve, and the piston, still travelling forward under the impulse of the expanding steam, compresses the steam inclosed in the right-hand end of the cylinder nearly, or quite, up to the point of the initial pressure. This cushions the piston, and helps to bring it to rest. Shortly afterwards the arch of the valve begins to open the left-hand steam-port to the exhaust-port, so releasing the expanded steam, and at the completion of the stroke, Fig. 78, nearly one-half the width of the port is opened to exhaust, and the opposite edge of the valve is opened to lead, beginning to admit the live steam for the return stroke. The sequence of events on the return stroke is similar to that just described.

If there were no outside lap of the valve, the the live steam would coutinue to enter the passages right up to the termination of the piston stroke, and there would be no advantage derived from the expansive property of the steam. If there were no lead, steam would not enter the cylinder until the return stroke had actually commenced, and the piston would have travelled some little distance before the full steam-pressure would come upon it. Moreover, the steam admitted by the lead opening, in conjunction with the compressed steam, forms an elastic cushion, or buffer, serving to bring the piston momentarily to rest, and prevent concussion. The inside lap given to the arch of the valve assists this result, because by closing the exhaust some little time before the termination of the piston stroke, which occurrence happens in the interval between Figs. 77 and 78, the effect is to compress or cushion the exhaust steam left at that time in the cylinder. How much compression may be judiciously permitted without resulting in injurious back-pressure depends upon the class of engine, and the speed at which it is running. Fast-running engines bear, and will require, more cushioning than slower engines.

To reverse the engines, the slot-link H is lifted by means of the reversing handle, and the levers pivoting around the weigh-bar W, thus bringing the valve-rod into line with the back-gear eccentric rod E, Fig. 79. The crank being, we suppose, on dead centres as before, the lead of the valve admits steam, thrusting the piston in the direction of the arrow, and turning the axle and wheels in the reverse direction to that in the previous arrangement of the gear.

The slot link not only affords a ready method of rever[illegible]ine, but also of varying the

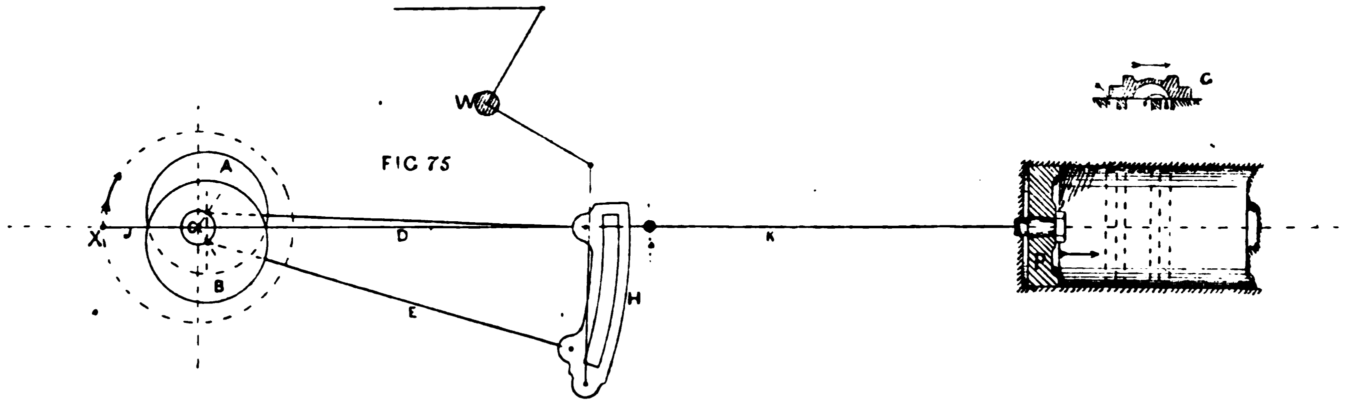


FIG 75

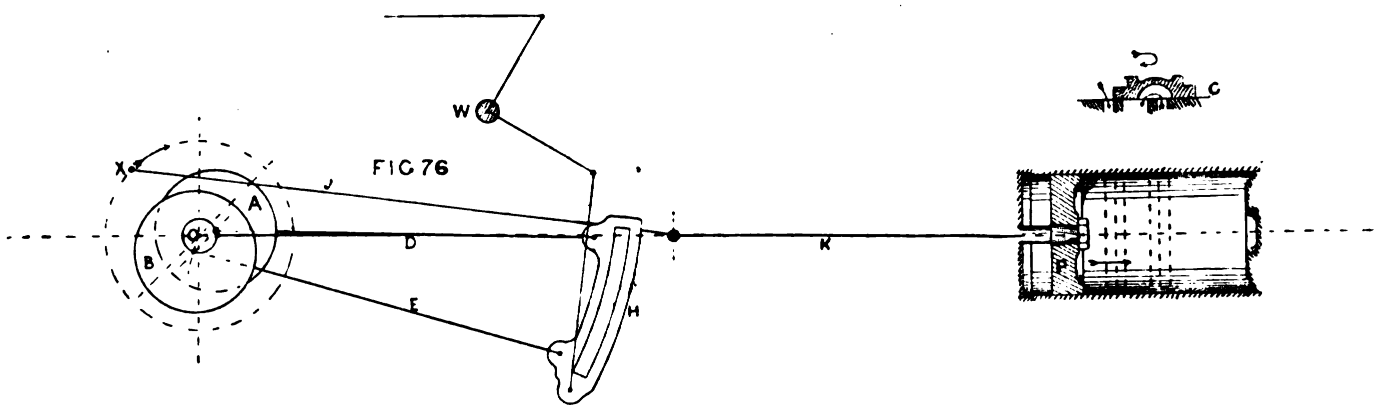


FIG 76

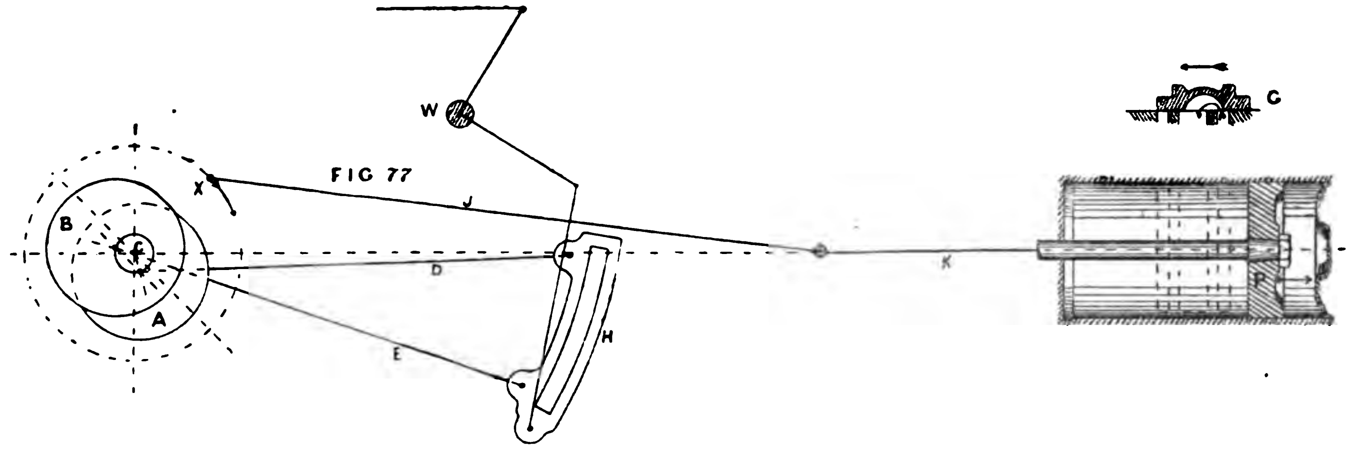


FIG 77

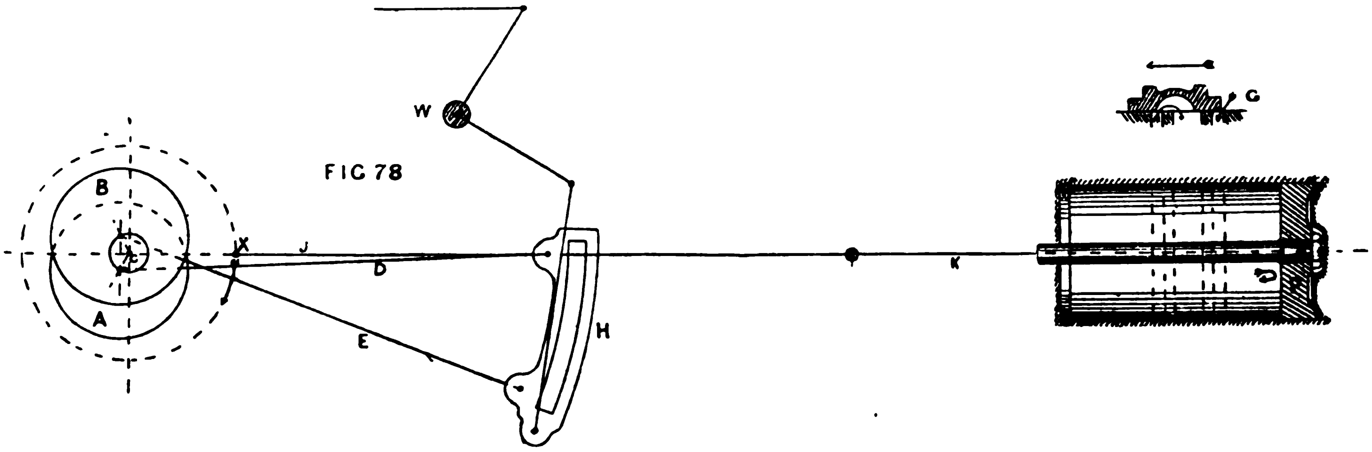


FIG 78

points of cut off, and of consequent expansive working of steam. If we take the most extreme case possible, and put the die block in mid-gear as in Fig. 80, the engine will not work at all, because, though the inlet steam port is uncovered, it would on the turning of the crank immediately close, so that the width open for the preadmission of steam is the maximum opening of which the arrangement is capable. This is clear from Fig. 80, and it is also clear that but for the lap and lead there could be no motion of the valve at all in mid-gear. Hence, when an engine is stopped, or is getting up steam, this position of mid-gear is the one in which the reversing lever should invariably be locked, and then, if the regulator were accidentally left open, the engine could not run away.

If, however, the link is lifted or lowered in relation to the die-block, so bringing the latter into positions intermediate with the extreme limits afforded by the eccentric-rod pins on the one hand, and the centre of the link on the other, the effect is to shorten the stroke of the valve, and so produce an early cut-off and increased grade of expansion of steam, and these effects are greater the nearer the die-block approaches to the centre of the link. This also has the effect of increasing the lead, as in Fig. 81, and this increase of lead with a slow-running engine would be an evil, as producing an injurious amount of back-pressure. But since the motion is only linked up when an engine has gained speed, and as the advantages of increased

FIG 79

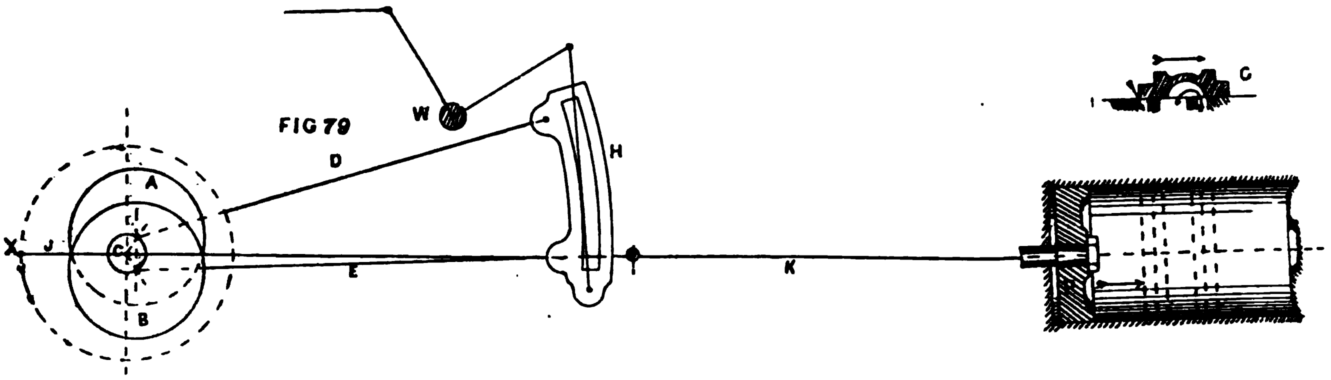


FIG 80

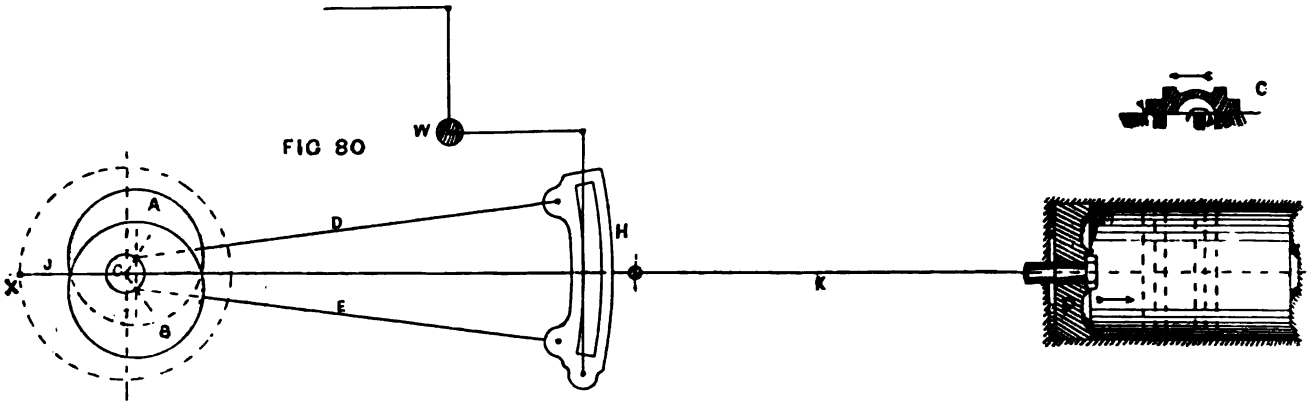


FIG 81

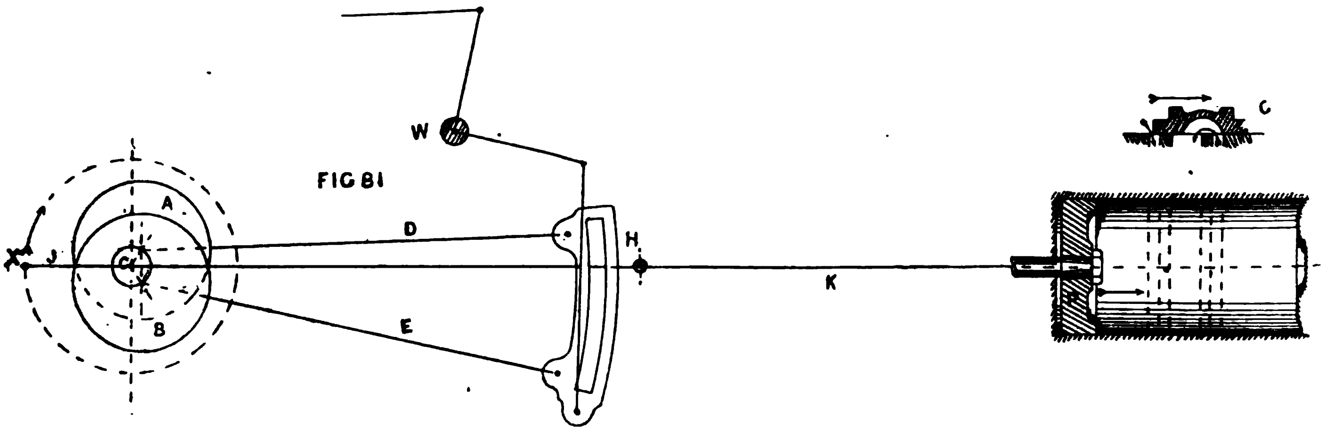


FIG 82

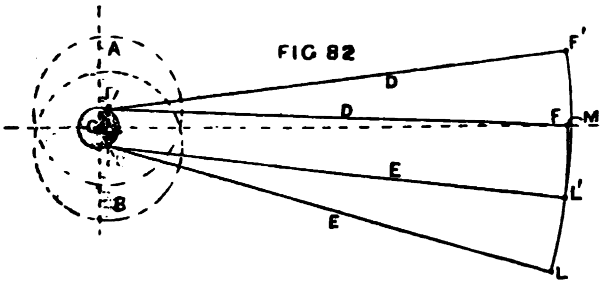
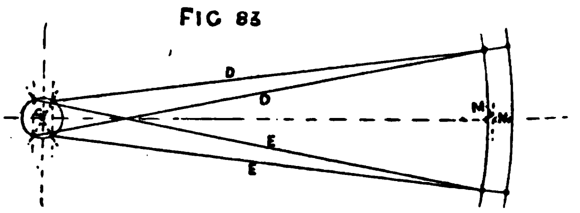


FIG 83



lead are greatest with quick-running engines, there is no objection to this effect, unless it happens to become excessive in amount.

Some valve-motions are arranged with the maximum amount of lap and lead in full gear, in which case the lap and lead given to the eccentric sheaves is the same as that for a direct gear without the intervention of a link. But sometimes also the motions are arranged for a lap and lead at one-third or one-half of the range of the movement of the die-block, and then the sheaves are marked out for that amount, and the arrangements modified to suit. Then the lap and lead will be diminished at full gear, and only slightly increased towards middle gear. Much depends on the class of engine for which the gear is being designed—a fast-running passenger engine taking more lead than a heavy goods engine. In a fast train the full motion of the valve is only utilised in the act of starting away, and then immediately the link is presently notched up for expansive working. In our model, where the opening to lead at full gear is only $\frac{1}{32}$in., we cannot adopt so minute a refinement, but simply design the motion for full gears, and let the lead increase, and be slightly unequal at opposite ends.

In the gear here illustrated the rods are alternately "open" and "crossed"; but they are termed "open rods," because set open when the full of the sheaves is between the axle and the eccentrics, as in Fig. 75. They cross when the full of the eccentrics is on that side of the axle farthest from the link, as in Fig. 78. By the crossing of the rods, their radius is practically shortened, and the lead becomes greater at one end than the other. The increase of lead towards mid-gear and the increase due to the crossing of the rods can be better understood if illustrated by outline diagrams, and with these, therefore, I will conclude the present article.

The reason of the increase towards mid-gear is evident from Fig 82. Here the same reference letters indicate similar parts as in the previous diagrams. When the engine is in full gear forward, the centre of the pin of the fore eccentric rod, which is coupled to the link, is at F, and that of the back-gear rod is at L. If the link is brought into mid-gear each eccentric rod describes an arc of a circle around its own sheave, and in consequence of the curvature of the link, the effect is to throw the central portion of the link farther away from the axle than when in full forward or backward gear, and this increase by the distance M in Fig. 82 is the amount by which the lead of the valve is affected by the movement to mid-gear, the centres of the pins being then at F' L'.

At the opposite end of the piston-stroke the lead is increased by the crossing of the rods, as is clear from the Fig. 83, where the amount of lead due to crossing is shown at M, the distance N being equal to twice the lap and lead.

It is easy to see that these differences will be diminished by increasing the length of the rods, and it is for this reason that they should be as long as convenient and practicable. It is also clear that the shortening of the distance between the centres at which the rods are attached to the link, and, moreover, the lessening of the throw of the eccentrics, will have a like effect in minimising the increase of lead, and the differences in its amount at opposite ends of the travel of the valve.

If the eccentric-rods were arranged to cross each other when the centres of the sheaves were between the axle and the link, then the placing of the link in mid-gear would diminish, or quite obliterate, the lead of the valve—an obvious disadvantage. J. H.

COMPOUND FOR PROTECTING BOTTOMS OF SEA-GOING VESSELS.

THE invention patented by F. J. Binns, of Ripon, and R. J. Paris, of Liverpool, has for its object to provide for navigable vessels and other like structures a covering and protecting composition, which can be easily applied to the surface it is desired to protect, and which when applied will adhere thereto, and prevent the adhesion of marine growth. The essential constituents of the composition are metallic zinc and carbon or charcoal.

When a plate covered with these materials is placed in salt or sea-water, the chemical action that takes place is probably similar to that which goes on in a galvanic battery. To the electrical currents which are set up may be attributed the fact, that the matter which collects on a ship's bottom coated with the composition is caused to fall or drop off, or is prevented from collecting, or the protective action may be due to the chemical action which takes place, the zinc being gradually dissolved by the salt. In practice they generally prefer to combine the ingredients in about the following proportions:—Metallic zinc powder, 60 to 80 per cent.; carbon, 20 to 40 per cent. These proportions may, however, be varied. The form of carbon they propose to use is graphite; but gas carbon or other material could be employed. Colouring matter may, if desired, be added, and in order to give cohesion, they add any suitable pigment. The ingredients are ground to a powder and mixed with a suitable vehicle, such as oil, tar, or varnish, so as to form a paint or covering composition of the proper consistency.

PROTECTIVE COMPOSITION FOR IRON PLATES.

AMONGST recent patents for protective or preservative coatings for iron and steel plates we note the invention which has been patented by Mr. A. Andrews, surgeon, of New Southgate, and which is thus described:—The composition is composed of a mixture of methylated spirit and shellac, boiled linseed oil, and oxide of iron, or other suitable material, for giving body and colour to the mixture. Various proportions of these ingredients may be employed according to circumstances—for example, the following proportions give good results:—Methylated spirit, 16 parts; shellac, 6 parts; boiled linseed oil, 1 part; and oxide of iron, 2 parts. The shellac is first dissolved in the methylated spirit so as to form a shellac varnish, the boiled oil is then added, and, lastly, the oxide of iron, the mixture being stirred or agitated until the ingredients are thoroughly incorporated. The patentee sometimes uses along with the shellac a small proportion of gum mastic, and along with, or instead of, the oxide of iron a proportion of graphite—for example, the following ingredients and proportions may be employed:—Methylated spirit, 34 parts; shellac, 12 parts; gum mastic, 1 part; boiled linseed oil, 4 parts; oxide of iron, 4 parts; and graphite, 4 parts, all by weight. The shellac and gum mastic are first dissolved in the methylated spirit, the boiled oil is then added, and, lastly, the oxide of iron and graphite, the mixture being stirred or agitated as before until the ingredients are thoroughly incorporated. The use of the boiled oil in the above-described compositions gives a certain amount of elasticity to the shellac varnish, and prevents it from scaling off the surface to which it is applied. The oxide of iron and graphite give body and colour to the mixture; either or both of these latter substances—namely, the oxide of iron and the graphite—may be replaced by one or more of any of the other well-known and suitable materials that will give body or colour, or both, to the composition or varnish.

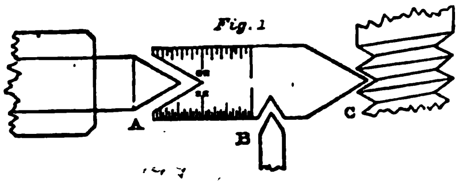


Fig. 1

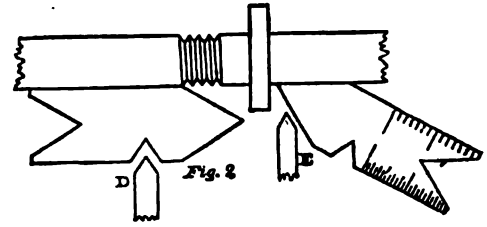


Fig. 2

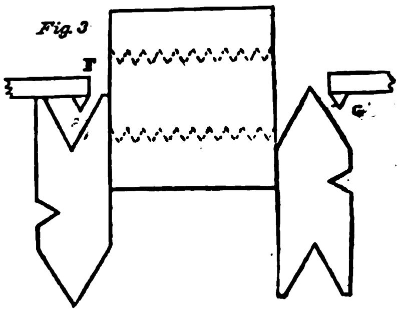


Fig. 3

GAUGE FOR GRINDING AND SETTING SCREW TOOLS.

THE simple gauge, the applications of which are shown in the annexed illustrations, has been introduced by Messrs. Darling, Brown, and Sharpe, of Providence, R.I. The angles used in this gauge are 60°. The four divisions upon the gauge of 14, 20, 24, and 32 parts to the inch are very useful in measuring the number of threads to the inch of taps and screws. The following parts to the inch can be determined by them—viz., 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 24, 28, and 32. In Fig. 1, at A, is shown the manner of gauging the angle to which the lathe centre should be turned; at B, the angle to which the screw-thread cutting tool should be ground; and at C, the correctness of the angle of a screw-thread already cut. In Fig. 2, the shaft with a screw-thread is supposed to be held between the centres of a lathe. By applying the gauge as shown at D or E, the thread tool can be set at right angles to the shaft, and then fastened in place by the screw in tool-post, thereby avoiding imperfect or leaning threads. In Fig. 3, at F and G, the manner of setting the tool for cutting inside threads is illustrated.

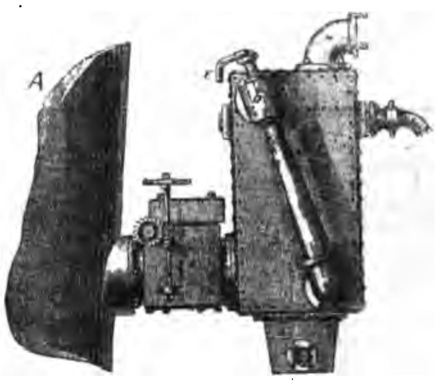
There is a table on the gauge used for determining the size of tap drills, which shows in thousandths of an inch the double depth of thread of taps and screws of the pitches most commonly used. This table is made up by dividing 1·732, the double depth of thread of a screw that is one pitch, by the number of threads of the various pitches. For instance, the decimal ·433, representing the double depth of thread of a screw that is four pitch, is obtained by dividing 1·732 by four. In the same manner the double depth of thread of pitches not shown in the table may be readily obtained. The double depth of thread of a screw that is two pitch, for instance, is one-half of 1·732.

Sometimes in obtaining the double depth of thread of pitches not given in the table, it is more convenient to multiply or divide some of the decimals there given. For instance, the double depth of thread of a screw that is 2 pitch may be obtained by multiplying the decimal ·433 (4 pitch) by 2, and that of 40 pitch by dividing ·087 (20 pitch) by 2. In obtaining figures in this manner it should be borne in mind that the ratios are inverse, the greater the number of threads to the inch the less the depth, and, conversely, the fewer the threads to the inch the greater the depth.

As the double depth of thread represents the difference in diameters of a tap and a tap drill, to obtain the diameter of a tap drill of any desired pitch it is only necessary to subtract the decimal showing the double depth of thread of that pitch from the diameter of the tap. For example, if the tap is 4 pitch and 1in. in diameter, subtract ·433, the decimal showing the double depth of thread of this pitch in the table, from one, and the result, ·567in., is the size of the tap drill, which would allow a sharp thread in the hole. The customary allowance may be made for the extent to which it is desired the threads should be flattened.

CARVER'S PATENT FIRE-EXTINGUISHING APPARATUS.

IN the annexed engraving is illustrated a novel appartaus for extinguishing fires in ships' holds with an atmosphere of the products of combustion drawn from the funnel of the vessel's boiler. From this source there can be obtained a practically inexhaustible supply of gases incapable of supporting combustion, and always ready for application. In the illustration, A is the funnel. It is connected by a branch to the valve box B, which is in communication with the cooling chamber C. This latter is divided by a vertical partition, and in both parts a constant shower of cold water can be maintained by the hose-pipe F. D is a steam jet which sucks the fumes from one compartment of the chamber C and delivers them into the other. They have thus to pass twice through the shower of cooling water before they emerge through the delivery branch H, whence they can be directed to any part of the ship. So effectual is the cooling that the terminal temperature is only 80° or 90° Fahr. The heat is carried away by the water which escapes at the trap G. After the fire has been extinguished, and sufficient time has elapsed for its heat to become dissipated, the valve B is turned to shut off the gases and admit fresh air, which is then forced into the hold, and quickly displaces the heavy gases, enabling men to enter with safety. The Liverpool underwriters are having the apparatus fitted to the steamer *Hyæna*, belonging to the Liverpool Salvage Association, for the purpose of dealing with cargoes which arrive in a burning condition—no infrequent occurrence with cotton-ships. The use of this apparatus is not confined to steam-vessels. Every sailing ship of any size is now fitted with a boiler for working the winches, and this, if not very small, will supply plenty of gases.



To demonstrate the efficacy of this system of extinguishing fires a series of tests, repeated on several days, were made at the East Brunswick Dock in Liverpool. A fire, consisting of about a ton of wood well sprinkled with petroleum and tar, was laid near one end of a floating pontoon about 70ft. long, 10ft. wide, and 5ft. deep, and after it was well alight the furnace fumes from a multitubular boiler, 4ft. 3in. diameter by 12ft. 3in. long, were injected into the pontoon through a flexible hose, at a distance of about 50ft. from the fire. During the tests an oval manhole 18in. by 12in. was kept open over the fire, and usually a similar manhole, between the fire and the point where the fumes were admitted, was also kept uncovered. The flames were extinguished, we are informed, in four to six minutes from the time of commencing to inject the fumes; but the supply was maintained for thirty or more minutes on each occasion, in order to quench the embers and allow them to cool. While the pontoon was full of fumes, burning petroleum and phosphorus were extinguished instantly by immersing them in the atmosphere of the pontoon. On the conclusion of the fire-extinguishing test in the pontoon, the apparatus was set to work as a ventilator, and the atmosphere of the pontoon was respirable with safety within seven to ten minutes after turning off the fumes.

THE CARE OF OAK.

OAK is a wood which calls for an unusual and unceasing care in its manufacture. The tendency of oak, from the moment an axe is planted in the side of a tree, is to split, crack, and play all sorts of mean tricks on the owner. Such tendencies can be held in hand, and almost absolutely obviated, by the following certain rules: A thick coat of waterproof paint applied to the ends of the logs is a wise expenditure; it prevents the absorption of moisture. Oak, when piled, should have the ends protected, so as to prevent absorption of rain and moisture, followed by the baking process of a hot sun. Alternate moisture and heat is the prime cause of checks and cracks, and when such defects begin in oak they are bound to increase and ruin otherwise perfect stock. Oak should be stacked as fast as sawn. It is a mistake to permit it to lie in a dead pile even for a single day. It is a wood that contains a large amount of acid, which oozes to the surface as fast as the lumber is sawed, and if the stock is allowed to remain piled solid, it is apt, even in a few hours, to cause stain on the surface. The lumber should be stacked in piles not over 6ft. in width. The bottom course should be raised 2ft. from the ground, and a space of 5in. left between the pieces. It is advisable to follow this rule up to the fifth course, when the space can be gradually diminished to 2in., and continued to the top of the pile. In this way air has free circulation through the pile, and the lumber will dry readily. The pile should cant towards the back, so that rain will follow the inclination.

Broad sticks not over 3in. wide should be used, the front stick placed so as to project ½in. beyond the lumber. Other sticks should be placed not over 4ft. apart, and in building the pile the sticks should be exactly over one another. By this plan warps, twists, and sags are avoided. It is advisable to pile every length by itself. This rule permits more systematic piling, and in shipping, consignments can be made of lengths precisely as wanted. Thickness in piling should never be mixed. Twisted stock is sure to be the result if this advice is ignored. The sap should be placed downward, the draft upward, and any practical lumberman can readily observe the advantage of this advice. Every pile should be well covered with sound culls, the covering so placed as to project beyond all sides of the pile; raise it a foot from the top course. The piles should not be nearer than 20in. apart, 24in. is better.—*Mississippi Valley Lumberman.*

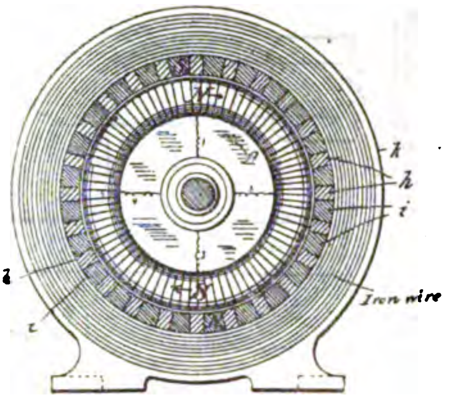


FIG. 1.

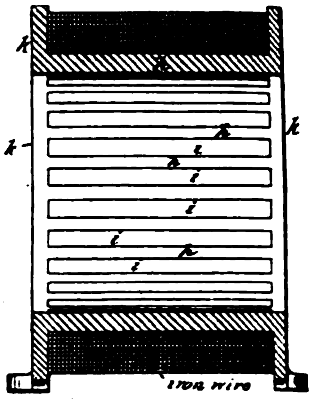


FIG. 2.

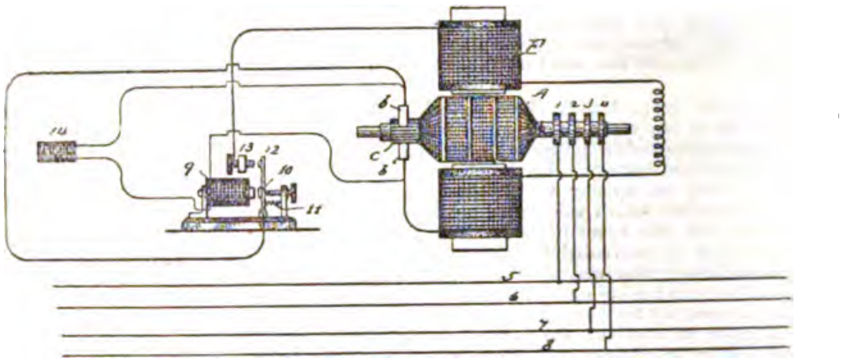


FIG. 3.

IMPROVEMENTS IN ALTERNATING CURRENT MOTORS.

TWO recent patents obtained by Mr. C.S. Bradley, of Yonkers, N.Y., deserve notice. Both are for alternating current electric motors, and may be be briefly described as follows:—Figs. 1 and 2 represent transverse and longitudinal sections of the motor, which in this case is driven by means of two independent alternating currents of different phase. The patentee says:—"In dynamo electric machines and electric motors generally it has hitherto been considered essential to successful operation either to have the field-magnet positively energised by means of a current or currents circulating in insulated conductors wound upon the field-magnets, or else to have the field-magnets made of steel and permanently magnetised. It has always been generally considered advisable to laminate the pole pieces of the field magnets for the purpose of preventing the generation of the Foucault currents therein. I have discovered, on the contrary, that such currents may serve a useful purpose in the motor or machine, and they may be so concentrated and directed as to form the sole energising current of the field-magnets, and such discovery forms the basis of my present invention.

"The field magnet is constructed of alternate iron and copper bars with copper heads, and this structure is wound with iron wire on the outside. The bars of copper, together with the copper heads, form circuits of very low resistance for the eddying currents which are to be utilised. The armature is a plain Gramme ring with closed winding, which at four equidistant points is connected to four conducting rings on the shaft having brushes connecting them to the two independent supply circuits. These circuits supply alternating currents, the current of one being one-quarter of a phase behind the other, and the result is to produce a rotation of the armature so long as the currents are supplied, and are substantially one-quarter phase apart in their time periods, and in producing the rotation of the armature the two consequent poles, N and S, set up in the armature rotate around in its iron body at a rate exactly corresponding to the speed of the generator. Suppose, now, the speed of the generator, which is of corresponding impulses, is 1,000 revolutions per minute, then the poles N and S will traverse the armature circularly 1,000 times per minute, and we will suppose the motion of the poles N and S to be right-handed, as shown by the arrows at N and S. As they rotate they induce poles in the iron of the field-magnet; but these induced poles N^2 S^2 drag behind slightly, and as opposite poles attract, the armature moves in a left-handed direction as shown by the arrow at A. Meantime the N and S poles in the armature have moved to the right in direction and the motion of armature continues, and if not doing work obviously it will rise in speed until its speed nearly equals that of the generator, and the relative motion of the poles N S and N^2 S^2 becomes so slight as to be practically negligible. Now, if work is put upon the armature (the generator being maintained at constant speed) its speed falls, and while the relative rotation of its N and S poles remains unaltered with respect to the armature body, the absolute rotation with respect to a point in space changes accordingly; or, to put it in figures, suppose the speed of the generator is 1,000 revolutions per minute, then the poles N and S travel 1,000 revolutions per minute relatively to the armature body. If the armature speed were 1,000 revolutions, the poles N and S would stand still with respect to space, *i.e.*, their absolute rotation would be *nil*. If, now, load is added sufficient to drop the speed of the armature to 900 revolutions, obviously the poles N and S, while still travelling 1,000 revolutions per minute relatively to the armature body will have an absolute rotation, with respect to a point in space, of 1,000—900 = 100 revolutions. The direction of this absolute rotation is, as indicated by arrows at N S, the same as the direction of relative rotation of these poles N and S; but as this absolute rotation of the poles N S is 100 per minute, it necessarily follows that there is a movement of the induced poles N^2 S^2 in the field-magnet following the movement of poles N S, and the speed of this movement is 100 per minute, and each section of the mass of the field-magnet is in turn the seat of a rotating polar line, and is cut by lines of force.

"Therefore, Foucalt currents are set up, and their value depends upon the resistance they meet with. The position of the field-poles N^2 S^2 induced by these eddy currents, is always behind that of the poles N S, the exact position depending upon two things—the load and the resistance in the metal of the field-magnet. The greater the load the greater the lag of the poles N^2 S^2, and, on the other hand, the less the resistance offered the eddy currents, the smaller will this lag become in proportion.

"The result of my invention is that the iron pole-pieces and iron winding or body of the field-magnet become highly magnetised without any current being directly taken from the armature-circuit for that purpose, and in this manner the loss in a motor or dynamo as ordinarily constructed, due to the circulation of these Foucault currents, is readily utilised as a factor in the successful operation of the machine."

Fig. 3 is a diagram illustrating another invention of great practical value.

Concerning this invention the patentee says: "In motors of this type it has been found that where the field-magnet is directly energised by currents flowing through the coils upon it, which seem to be necessary in order to obtain an adequate mechanical out-put from the motor, it is practically impossible to get the armature up to normal speed if the field-magnets are energised at the moment of starting. If the field-magnet circuit be left open at the moment of starting the armature by the alternating currents and so continued until the armature has reached its normal speed, the field-magnet circuit may then be closed and the full mechanical output obtained from the motor without causing it to fall back in speed, as would be the case were the field-magnet circuit closed at the moment of starting. This may be explained in various ways. If we take a given pole of the field-magnet and consider that a rotating pole of the armature, which we will suppose an N pole, is approaching the said field-magnet pole, the latter would become an S pole, and strongly attract the said armature pole, and motion of the armature would be produced: but if the field-magnet were surrounded with its usual coils closed, the setting up of magnetism in the given field pole would cause an induced current to flow in the coil, which would partially or quite annul the polarity of said S pole of the field-magnet. Therefore the result of these two opposing tendencies is that the armature will not start if the field-magnet circuit is closed.

"A is the armature of an alternating current motor, and in this particular instance it is shown as a drum armature with continuous winding, from which at four equidistant points connections are made respectively to the insulated contact rings 1, 2, 3 and 4, which are connected by suitable brushes to the respective mains 5, 6, 7 and 8. Mains 5 and 6 supply an alternating current, and mains 7 and 8 supply another alternating current which, in this particular instance, differs in phase from the former by one-quarter of a wave-length. Armature A at the other end is provided with a commutator *c* and brushes *b* in the usual manner, for taking off a continuous direct current into any circuit connected with such brushes in accordance with the principles set forth in U.S. patent, No. 390,[illegible] dated October 2nd, 1888. Whenever a current is admitted from the circuits 5, 6, 7 and 8 into the armature A, if the field-magnet circuit is open, the armature will immediately start into motion, and gradually rise in speed until it substantially synchronises with the generator supplying currents to circuits 5, 6, 7 and 8; but if the field-magnet circuit is closed, the armature will not start and rise to its normal speed. I therefore proceed as follows. I arrange an electro-magnet 9 in a suitable position and placed in front of it a pivoted armature 10, having a retractile spring 11, and on the arm which carries the armature 10 I arrange a contact 12.

"In front of such contact I arrange a corresponding contact 13, as shown. The field-magnet circuit is closed at all points except the contacts 12 and 13, and my object is to accomplish the closing of these contacts at the moment when the armature A has arrived at its normal speed. The electro-magnet 9 is included in a branch circuit taken from the brushes *b*, and including by preference a choking-coil 14, which is constructed to have a high coefficient of self-induction and moderate resistance. This, however, is not essential to the performance of the apparatus. Thus constructed the action is as follows:—The armature A being at rest, the two alternating currents entering the circuit of the armature cause a rotation of the poles of the latter and set it in motion, and at the same time, by reason

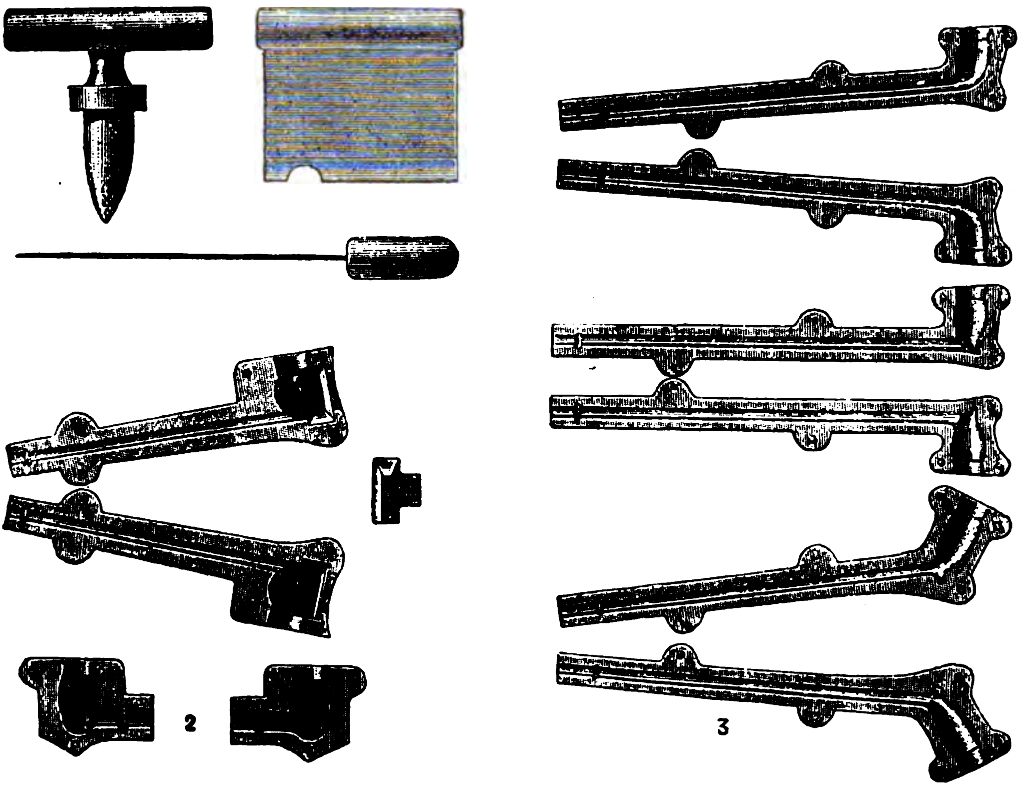


Fig. 1.—Pipe Moulder's Tools.

of the stationary brushes *b*, an alternating current passes through the branch circuit, including the coils of magnet 9. This single alternating current is due o and corresponds with the rotation of the N and S poles set up in the armature A; but the current s not of such character as to cause the attraction of he armature 10 against the force of spring 11. As he armature rises in speed, the rotation of the oles N and S of the armature become slower and lower, the waves in the branch circuit become onger and longer, and straighter and straighter, nd the relay hammers slightly on its back-stop ntil finally, when the speed has reached its normal ate, the current passing through the coils of the agnet 9 is a continuous current in one direction, nd the armature 10 is attracted, causing the contacts 12 and 13 to close firmly together and remain here so long as the armature A is rotating at its ormal speed. It is thus readily seen that the field-agnet circuit remains open until the armature as arrived at its normal speed, and at that instant e field-magnet circuit is closed, and the motor in condition to exert a maximum mechanical nergy."

HOW CLAY PIPES ARE MADE.

THE clay pipe, like the needle, has to undergo a large number of operations before reaching e state in which we find it in commerce. The anufacture of it requires much manipulation, and, espite the progress of mechanics, the machine has ot been introduced. The advent of the clay pipe France dates back to 1560, the epoch at about hich Jean Nicot imported tobacco. Then nothing t the pipe was smoked, in imitation of the vages. Since that period the clay pipe has passed rough every form and every colour, and, after rving to caricature certain persons, it to-day reproduces the features of the men of the day with eat accuracy. For the manufacture of pipes, all ays are not equally utilisable. Use is made of astic and usually white clay, and sometimes of y coloured by metallic oxides. Such clays are t met with in France in a sufficient state of rity. They are found only in the Belgian Arnnes.

Cleaning.—These clays always contain impurities, nsisting of oxides, sand, fragments of rock, &c., variable proportion. The first operation that the aterial undergoes is consequently a cleaning, which done partly by hand by children, and is finished a washing of the clay and allowing it to deposit basins of large dimensions.

Mixing.—The second operation is the mixing of e earths in definite proportions. As each clay has lifferent property, the mixing of several kinds is cessary in order to obtain products that vary as colour, hardness, &c. This mixing is one of the incipal secrets of the manufacturer, and an operan that requires no end of study before giving such such a product as may be required by commerce. is performed in pug-mills actuated mechanically, d identical with those used in ceramics. The clay comes from the mill perfectly homogeneous, and in a state of medium plasticity. It is then carried by an elevator to the rooms of the rollers in the upper part of the building. It is distributed in blocks over wooden tables, around which are seated twelve or fifteen-year-old children, who are called "rollers," and who take a block of proper size in each hand and form it into a ball by rolling it on the table in different directions. Then, exerting a pressure with the hand upon a part of the ball, and giving it a backward and forward motion, they very quickly give it the form of a pipe whose bowl and stem are in the same axis. They have produced a "roll." The roll made, they bend up the head of it slightly, and place it alongside of them upon a board. These boards, containing a definite number of rolls, are carried to the moulders. The moulder's tools are—a mould of one or more pieces; a compressor; a long needle; a steel knife; and a press. The mould for simple pipes consists of two pieces of hollow steel, fitting together very accurately. For ornamented pipes, it is of several pieces of chiselled bronze held together in a steel case. The compressor is of steel, and is mounted upon a handle, and has the internal form of the bowl. The press is an ordinary vice fixed to the edge of the table.

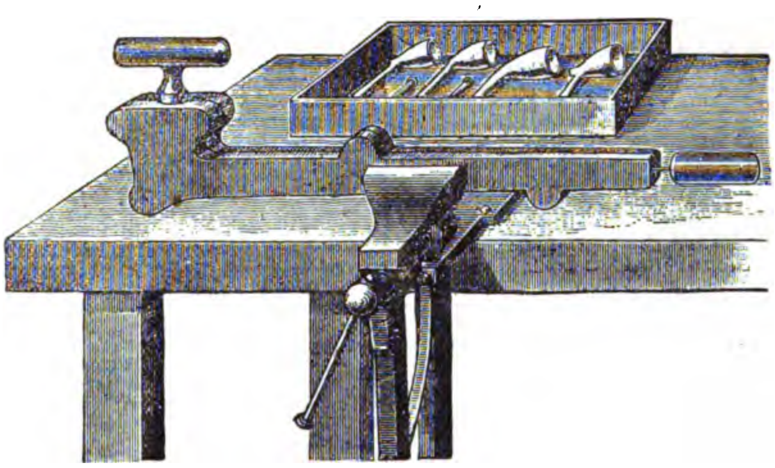


Fig. 2.—Pipe-Moulder's Table.

When the roll reaches him, the moulder places his open mould before him, and then taking a roll, the head of which he places upon a special support, he thrusts his needle into the centre of the tail of the roll and pushes it up to the head, guiding it with two fingers of the left hand, so as to keep it exactly in the centre. An inexperienced person who should try to shove the needle into the roll could not advance more than half an inch without pushing it through the side, while the workman performs the operation in a few instants on pipes 15in. in length and 0·15in. in diameter in the thickest part. This operation is performed in the same way upon pipes of all sizes. The roll thus pierced, and still containing the needle, is placed in the mould, and the latter is closed and put in the press. Then the workman takes his compressor and pushes it into the open part of the mould until he meets with the extremity of the needle that enters the bowl. The clay is thus compressed and the excess is removed by means of the knife. The moulder then removes his tool, opens his press, and then his mould, takes out the pipe and passes his knife over it so as to remove the traces of the junction of the two parts of the mould, takes out the needle, and places his pipe upon a board alongside of him. The pipes are arranged with care upon these boards, with their stems resting here and there upon small sticks or else upon very fine sand.

When these boards are full they are delivered to the finisher, who allows the pipes to harden a little before finishing them. The finisher begins by passing another needle into the stem, then scrapes off the seams, and removes the lines or scars formed on the stem by the various parts of the mould, and, with a copper tool, indents the figures that are to appear upon the pipe. He then arranges the pipes upon other boards, and leaves the needle in them so as to prevent a curvature of the stem during drying. The boards, holding a gross of pipes, are taken to the driers, whose temperature is very high. When the pipes are sufficiently dry, workmen polish them with tools analogous to those used by burnishers, and which are manœuvred in the same way. The pipes are then carried to other workmen, who verify them, reject the defective ones, and proceed to put the perfect ones in the saggers. These latter are terracotta boxes, in which the pipes are arranged in circular beds, the bowls placed downward, and the stems united above by a defective stem in order to prevent them from getting out of place during carriage. When the saggers are full they are carried to special furnaces, and are superposed as in pottery furnaces. In large manufactories the operation of baking is the same as in potteries. The furnaces are in batteries of three: while one of them is being fired another is in process of cooling, and the third is being charged. Each furnace bakes about 600 gross of pipes per day. The duration of the baking varies according to the clay, but it is at least five hours, and sometimes reaches eight or nine.

After the baking the furnace is allowed to cool for about twenty-four hours, then the saggers are taken out and the pipes removed. The latter are then examined, and those that are well baked are polished anew. Although the pipe is finished, it has yet to undergo another operation before it can be used, and that is dipping. The object of this is to remove the porosity of the clay, which, without this, would stick to the lips. For this operation the pipes are taken and dipped one by one in a hot bath of soap-water and wax, and then drained and dried. The manufacture of the common pipe is at length finished, but, before being delivered to the trade, certain other operations are necessary: it must be labelled, and certain styles be wrapped up, and all must be packed. The packing is done in wooden boxes filled with straw. The pipes are arranged alongside of each other in the boxes, and the intervals between them are filled with fine straw. The workmen must have some experience, for, if the packing is too tight, the jolting that the box receives will be transmitted to the interior and break the pipes; and, if it is too loose, the pipes will strike against each other and pieces will get chipped off. This operation must be carefully performed, as some boxes go to America, others to Australia, South Africa, and even to Northern Siberia.

All the operations above described are applied to the wholly white pipe. If the pipe is coloured it necessitates several new operations. After the pipes have been baked they are carried to the glazing-room. The operators in this latter are usually women, each of whom has in front of her a series of cups containing liquid glazes of various colours, and each cup provided with a small stick. Each pipe is taken up by the operator, who, with the stick, puts a glaze upon it either in the form of dots or bands. It is in this way, dot by dot, that that the pipes that are styled glazed are finished. These pipes are remarkable for the finish that they exhibit. The pipes thus ornamented are arranged upon plates and put in furnaces raised to a high temperature, wherein they undergo a new baking that vitrifies the glazing. Then, after being labelled and wrapped up, they are packed.

So much for the manufacture of pipes properly so-called. With such manufacture is incorporated an accessory one—that of moulds. The moulds are of steel and bronze. Moulds for plain pipes are of steel, and those for ornamented pipes are usually of bronze chilled internally. If the pipe represents a head or a complicated subject, this part of the mould is made in several pieces in order to allow of the removal of the object. In this case, the mould is always complicated, and is made with difficulty, for all the parts of it have to fit accurately, and without leaving any seams on the figure.

The workmen who make these moulds must know how to sculpture very well, and must also possess some skill in the reproduction of complicated subjects, and know how to divide and arrange their moulds. These moulds are very costly. Some of them, which furnish true works of art, have cost as much as 600dol.

We said in the beginning that mechanics could not be applied to this industry, and the reader has now seen that the only operation that could be performed mechanically is that of moulding. The clay pipe industry is remarkable from more than one point of view. Aside from the difficulties of manufacturing, we find the division of labour pushed to its extremest limit, and this permits of a cheap production and of selling prices as low as one-fifth, two-fifths, and three-fifths of a cent, after passing through three hands—those of the producer, the wholesaler, and the retailer. It is remarkable in that it gives employment to an entire family, and that, too, without occasioning a fatigue disproportionate to age or sex. This manufacture is essentially French, and its importance is daily increasing, despite the formidable competition of wooden pipes and of cigarettes, our products being much superior to those of other countries. A pipe manufactory occupies an area of about 100,000sq.ft., and gives employment to from five to six hundred persons, exclusive of children less than twelve years of age. The annual product is 120,000 gross. The number of styles is infinite, and is daily increasing, as the dealer is continually asking for new models. —*Les Inventions Nouvelles.*

HEAT-ENGINES OTHER THAN STEAM.—III.*

I HAVE shown you how it is possible, by stopping the inflow of the working agent to the cylinder of the engine, at an early part of the stroke of the piston, to obtain an increased useful effect from the steam which is used. We have now to consider this question of expansion in its application not only to steam, but to other gases, such as are commonly used in heat-engines for power purposes. The diagrams which I showed you are the theoretical diagrams for the various points of cut-off which I then stated, these diagrams being calculated out according to one law governing the expansion of gases.

If you will remember, when dealing with the question of the specific heat of gases, I pointed out to you that this specific heat varied according as the pressure or as the volume was kept constant. Of the two laws governing the expansion of gases, the first—propounded in 1662 by Robert Boyle, and commonly known as Boyle's law, or sometimes as Marriott's law—may be briefly stated as follows:—

That the pressure of any given quantity of a gas varies inversely as its volume (in other words, as the space occupied), providing the temperature is kept constant; or put in another way, with any given quantity of a gas the product of the multiplication of volume and of pressure is always the same; for if volume is decreased pressure is increased, or vice versâ, always providing, as I have already said, the temperature is kept constant.

James Watt was one of the earliest who applied this law to demonstrate the expansion of steam, which may be called the "gas" of water. In the year 1782 Watt took out a patent, No. 1321, for "Certain new improvements upon steam or fire-engines for raising water and other mechanical purposes." In this Watt gave a diagram illustrating the economy to be derived from the use of expansion.

This diagram was shown inside the steam cylinder, and not outside, as is usual now. The length of the stroke of the piston was divided by horizontal lines or ordinates into twenty equal parts, so that the vertical lines represented movements of the piston, the horizontal lines, or ordinates to the expansion curve, representing, by their length from the side of the cylinder (which is the base line), the pressures existing at various portions of the stroke. At each of the ordinates there is printed (in the original drawing) the estimated pressures existing at these portions of the stroke, and Watt shows in his patent that, taking the initial pressure as unity, the sum of all these is 11·562, which, divided by 20—the number of the ordinates—gives, approximately, ·58 as the mean pressure of the steam during the whole stroke. Watt's statement of the advantages which are obtained is in these words:—"Whereby it appears that only one-fourth of the steam necessary to fill the whole cylinder is employed, and that the effect produced is equal to more than half the effect which would have been produced by one whole cylinder full of steam, if it had been permitted to enter freely above the piston during the whole length of its descent." You will of course realise that if the steam were cut off earlier in the stroke, say at ⅛th, a greater percentage of effect would be obtained from the same quantity of steam, for the expansion curve would be carried on to a lower point. The value of expansion has been understood from the earliest days of the steam-engine, and it serves the purpose of illustrating Boyle's law, propounded some 120 years before the date of Watt's patent. Let me re-state this law to you in other words, giving further illustrations. It is "that the pressure of any given quantity of gas varies inversely as its volume, the temperature being kept constant"—that is to say, if you compress a given quantity of gas, so that the space occupied by it is only equal to one-half that which it had occupied before compression, its pressure will be doubled; or if you expand a quantity of gas, so that the space occupied is doubled, then the pressure will be halved, always providing that the temperature is kept constant. Further, please remember that these laws which govern the expansion of gases, are similarly operative when a gas is compressed. A curve of expansion, such as that shown in Watt's diagram—calculated, as it is, according to Boyle's law—is called an "isothermal curve," the meaning of the word "isothermal" being "unvarying temperature."

But you will tell me I have already stated, when considering the big-gun diagram, that if mechanical work is done by a gas in expanding, some of its heat is transformed into this work, and that, therefore, unless some means are provided for maintaining the temperature of the expanding steam constant, in Watt's engine, the curve of pressure could not possibly be one of "unvarying temperature," such as he has shown, but that curve of pressure must be lowered by the amount of heat representing the value of the work done.

Watt had realised this, for his cylinder is surrounded by a steam jacket, into which the free steam from the boiler was admitted; by this means he proposed to keep up the heat of the expanding steam in the cylinder—heat being transmitted from the boiler steam in the steam jacket to that which was doing work in the cylinder. Thus, the true isothermal curve which he has shown was theoretically possible.

It is hardly our business to go into the question of the advantages of the steam jacket in a steam-engine, but I think, from what I have already told you, and from what I am about to tell you, you will realise that it is an advantage, not because it directly increases the efficiency to be obtained from any given quantity of steam, but because it enables a given quantity of steam to do more work in a smaller apparatus, offering, therefore, less opportunity for loss by radiation, or by contact with the cylinder walls.

But the question of the lessening of the total quantity of heat in an expanding gas, due to its transformation into mechanical work, brings us to the second law governing the expansion of gases—the law propounded by Chasles (and practically at about the same time by Gay Lussac and also by Dalton), somewhere about the years 1801 to 1803. This law of Gay Lussac tells us that the pressure of a gas, occupying a given space, will vary directly as its absolute temperature; and it further tells us (and this is a mere corollary of the other statement) that the volume of a gas which can expand—that is, which is not restrained from expanding—will vary directly as its absolute temperature.

The diagrammatic curve of expansion, which assumes that in an expanding gas no heat can pass away from it through the sides of the vessel in which it is contained, and also that the total quantity of heat contained in the given quantity of gas shall only be lessened by the quantity turned into work due to its expansion, is called the "adiabatic" curve, the meaning of the word adiabatic being "not to pass through." Let me try to illustrate this to you.

Assume that we have a given volnme of gas at a given pressure, contained in a vessel absolutely impervious to heat, but whose capacity we can increase at will, and assume that we allow this gas to expand; then, as according to our assumption none of its heat can be lost by radiation, or in any other way except by conversion into work, say, in displacing the atmosphere, the curve of pressure will be the "adiabatic" curve.

It was necessary for our purpose that these laws should be stated, and the two curves should be shown, because when we come to consider the diagrams of energy obtained from various forms of heat engines (especially those where some of the work done by the expansion of the gas is absorbed by the subsequent compression of the gas, for the succeeding stroke, previous to its ignition) we must be, to some extent, familiar with these two forms of curves.

Now, having spent all this time in dealing with the theoretical curves of expansion, I am going to tell you that in a real heat-engine these theoretical curves are neither of them practically realised. The curves really obtained, although they may approximate to these, do so for reasons with which time will not allow me now to trouble you, and the curves obtained in practice vary in accordance with the construction of the engine, with the nature of the working agent employed, and with the work really done by it.

Still, it was necessary that we should briefly consider these laws with the theoretical expressions of them in the diagrams, because when we come to compare the actual diagrams obtained from the various sorts of heat-engine, we shall find that the rudimentary knowledge which our brief consideration of these laws has given us, will enable us more fully to estimate the value of the results which are achieved in practice.

Now the engineer, although he can construct by calculation the theoretical diagram, which should be obtained in any given engine when he knows the initial pressure and the point in the stroke where the inflow of the working agent at full pressure ceases, yet he has had—from the very earliest days of the steam-engine, and due to the genius of James Watt—an apparatus which he can attach to any engine, and which will enable him to tell that which is occurring in the cylinder.

Through the kindness of Mr. Wollaston Blake, of Messrs. James Watt and Co., the successors of the original firm of Boulton and Watt, I have here for you to see the actual instrument made and used 104 or 105 years ago (judging from the date upon it) by James Watt.

Let me explain this apparatus to you. All of you can realise that if a pipe were connected to the space between one side of the piston and the cylinder-cover of any engine, and that if in that pipe there was another smaller cylinder, having a piston in it capable of movement, that smaller piston would be subjected, during the whole length of the stroke of the main piston—both away from, and back again towards, the cylinder cover—to the same pressure as existed in the main cylinder. Now, if to the small piston you attach a rod, capable of moving as the piston moves, and if to that rod you fasten a pencil, so that it will make a record on a piece of paper, the small piston being normally kept in position by a spring, and only being moved when the pressure existing in the main cylinder comes upon it and against the resistance of the spring, the position to which the small piston moves at any portion of the stroke of the main piston will, if the strength of the spring is known, give us exactly the pressure existing in the main cylinder at any time.

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* Extracted from the Cantor Lectures delivered by Mr. H. Graham Harris, M.Inst.C.E., before the Society of Arts.

If we cause the piece of paper on which the pencil makes its record to move backwards and forwards in accord with the movement of the main piston, and if we put the pencil in contact with the paper, we shall have a diagram produced, the length of which will bear a relation to the stroke of the main piston, and the height of which will show exactly the pressure existing at any portion of that stroke; in fact, it will tell us what the pressure is which exists at any moment in that end of the main cylinder of the engine to which it is attached. And this is exactly what the indicator does for us.

The principle underlying the Watt indicator is the one which governs the various indicators now in use. The most important improvements which have been effected consist in making the piston of the small cylinder of a definite area for all indicators; in only allowing this piston to have a slight movement for a large variation in pressure; and in making the various moving portions of the apparatus as light as possible, so as to eliminate the evil effects of momentum. The small movement of the piston is multiplied by means of some kind of parallel motion to something largely in excess of the movement of the piston itself.

In order to obtain motive power from any working agent, you will realise from that which I have told you, that it is necessary there should be a lessening of the heat existing in that working agent; that is to say, the temperature of the working agent at the time when it enters the engine must, if work is to be obtained from it, be in excess of its temperature when it leaves the engine. From this we gather that in order to transform the heat in a working agent into mechanical work, it is a necessity that a series of changes or operations should be gone through; and it follows, if the transformation is to be continued, that this series of operations must be repeated.

In the steam-engine, if it is double-acting, such a series of operations is usually completed in each revolution of the engine for each end of the cylinder; that is to say once for each end, or in one "in" and one "out" stroke of the piston. The engine at the commencement of one stroke, say the "out" stroke, receives the steam; the piston moves forward; the steam is cut off, and, the piston still moving forward, the steam expands; the piston getting towards the end of its stroke, the exhaust valve or port, is opened (connecting with the condenser, if it is a condensing engine); the piston completes the stroke, then moves backwards till the "in" stroke is complete, and steam is again admitted.

This succession of operations is called a "cycle." We shall see that the cycles of different forms of heat engines vary considerably. In all indicator diagrams the "cycle" is represented by the continuous line inclosing a space, whose height, as I have said, at any point represents the pressure existing at that part of the length of the stroke.

As I shall have to compare the relative performances of some of the various kinds of heat engines used for power purposes, it will be as well that I should give some description of the mode which is adopted in making tests of these performances. For a thoroughly complete and detailed account of such a series of tests, it seems to me that I cannot do better than refer you to the report of the judges on the electric motor trials, published in the *Journal* of the Society for the week ending the 15th February last (No. 1,891).

I will not trouble you with the description of the mode adopted in making a complete test of a steam-engine (this mode being practically based on that used by Sir Frederick Bramwell and Mr. Anderson at the trial of engines made for the Royal Agricultural Society at the Cardiff meeting many years ago), but will ask you to examine the trials of gas engines, as being more germane to that which we have to consider. Trials of such engines as these, to be satisfactory, must give an absolute record of the quantity of gas consumed in the engine itself, and, in the case of those engines using gas for the ignition of the explosive mixture, this should also be measured, and, if possible, separately. Samples of the gas should be taken at frequent intervals during the trial, which samples should be afterwards analysed, so that the calorific value may be accurately ascertained. The pressure and temperature at which the gas is supplied to the engine must be measured; indicator diagrams should be taken at frequent intervals throughout the "run"; the power given forth by the engines should be absorbed by some reliable brake, the load which this puts upon the engine, or, in other words, the resistance which this opposes to the motion of the engine, being accurately ascertained; the temperature and quantity of the cooling water must be measured, not only as this water flows to the motor cylinder, but also as it leaves it; the number of revolutions of the engine throughout the whole run should be recorded, and the average number per minute, at frequent intervals during the run, must be taken as a check; the run must occupy a sufficient length of time to eliminate any errors arising from heating up the mass of metal of the engine; and, lastly, every instrument used throughout the trial should have readings taken from them at very frequent intervals, and these instruments should all be calibrated and tested for accuracy, both before the trials are made and after they are concluded.

Further than this, a trial of sufficiently long duration should be made with the engine running with its utmost load on—i.e., exerting the utmost power which it is capable of exerting; another trial should be made with the engine running at about half-power, and a third with the engine running "light," the above records being taken for each trial, and the results of each used to verify or check those obtained in the other trials. The exact diameter of the cylinder and stroke of the piston should be obtained, and any peculiarities in the construction of the engine or in its working during any one of the runs should be recorded. Experiments should also be made to determine the value of the control of the governor when the work is suddenly taken off the engine.

Having run your trials, and obtained all the information here suggested, and anything else which you can possibly think will be of the slightest value, the question arises how to state, so as to be readily comprehended, that which has been learnt, or, in other words, how to "boil down" the mass of information thus obtained, so as to make the performance of the engine readily comparable with that of other engines.

The commonly-accepted way of doing this nowadays is by showing the results of the performance of the engine on a balance-sheet—i.e., you debit the engine with so many units of heat delivered to it (these units being contained in the quantity of coal used to stoke the boiler furnace, or in the number of cubic feet of gas which your gas-meter tells you has been supplied to the engine during the trial), and you credit the engine with the number of units which have been turned into work, with the number of units passing away in the exhaust, with the number of units passing away in the jacket water in a gas or petroleum engine, and with any other loss which there may be; and by this means you are able to tell exactly, and at a glance, what proportion of the total heat units delivered to the engine has been effectually utilised by it, and what proportion of the total heat units represented by each particular head of loss.

In the motor trials for the gas-engines, the judges adopted the plan of calculating for each explosion, or for each working stroke of the engine, its proportion of the total heat units, and they turned these into their value in foot-pounds of work, and then compared these with the foot-pounds per explosion, represented by the indicator diagrams; those represented by the heat rejected in the jacket water, and those represented by the heat passing away in the exhaust; coupled with the slight amount due to other losses, these three principal heads of use and loss represent the total heat units per revolution supplied to the engine.

Turning these into percentages, it will be found that in the Atkinson gas-engine (of which we shall have to speak later on) the heat turned into work, as shown by the indicator diagrams, was 22·8 per cent.; the heat rejected in the jacket water was 27 per cent.; and the heat rejected in the exhaust, lost by imperfect combustion, and otherwise unaccounted for, made up the balance of 50·2 per cent. In the Crossley engine the heat turned into work was also 22 per cent., and in the Griffin engine was practically as much—that is to say, is represented by the red cube which we used last week.

A PAPER on "The Relations between the Fractures in the terrestrial Crust of a given Region and the Seismic Movements of the same" is published in the *Comtes Rendus* by M. A. F. Noguès. The author's comparative study of earthquakes in various parts of the world has led him to detect certain relations between these disturbances and the break of continuity in the surface of the earth. In the present paper he shows that, in a given seismic region offering a complicated system of fractures and faults, varying in direction, size, and depth, the underground convulsions are correlated with some one of these systems, and entirely independent of the others. His illustrations are drawn mainly from the seismic zone of Andalusia, extending from Seville to the frontier of Murcia.

THE Clothworkers' Company has offered a Scholarship of thirty pounds a year, tenable at Cavendish College, Cambridge; and the Fishmongers' Company has made a grant of fifty pounds to the same College.

SCIENTIFIC NEWS.

THE comet discovered by Mr. Davidson (see p. 480) is coming rapidly north. It is *e* of 1889. Barnard's comet referred to on same page last week is *c* 1889, not *e*.

Dr. Oppenheim has computed elements for Brooks's comet *d* of 1889, and makes the perihelion August 3·40 G.M.T.; probably a short period.

Barnard's comet *e* 1888 has a position (Berlin midnight) on August 14, R.A. 19h. 15m. 3s.; S. Dec. 5° 45·7′; while his comet *b* 1889 has on same date and time a position R.A. 4h. 56m. 23s.; N. Dec. 7° 35·4.

The death is announced, at Plymouth, of Mr. C. Spence Bate, F.R.S., the well-known naturalist. He was the author of the "Report on the Crustacea Macrura dredged by H.M.S. *Challenger* during the years 1873-76." He was also the author of the "Catalogue of the Specimens of Amphipodous Crustacea in the Collection of the British Museum"; and of a work on "The Pathology of Dental Caries." In conjunction with Mr. I. O. Westwood, Mr. Bate wrote "A History of the British Sessile-eyed Crustacea."

The Rev. Miles Joseph Berkeley, vicar of Sibbertoft, near Market Harborough, for more than twenty years, and a student of science all his life, died at his residence on July 30, full of years and honours, for he was born in 1803, and his initials, "M. J. B.," have been well known to all interested in horticulture and botany for many years. The Rev. M. J. Berkeley was born at Oundle, in Northamptonshire, and after being educated at Rugby and Christ's College, Cambridge (being scholar of his college, and afterwards honorary fellow), he became curate at Margate, where he made the acquaintance of Mr. Hoffmann and Mr. Tucker, the latter a gardener, but both remembered for the work they did in explaining the nature of Yeast and the life-history of the Vine mildew (formerly known as Oïdium Tuckeri). His recommendation of the sulphur treatment proved eminently successful, and seems to have directed his attention to the subject of plant diseases, and his valuable papers, commenced more than thirty years ago, are still the most useful we have on vegetable pathology. In 1863 the Royal Society conferred on Mr. Berkeley (who was not then a Fellow) one of the Royal Medals for his researches in cryptogamic botany, especially in mycology, and all the world over he has long been recognised as one of the greatest authorities on a subject he made his special study. It is not usual in this column to speak of the social qualities of a deceased scientist; but in this case we may say that the Rev. M. J. Berkeley was a devoted parish priest, a friend to all, and as much loved in that walk of life as he was looked up to and respected in the world of science.

Admiral Sir Robert Spencer Robinson is also dead, having reached his eighty-first year. He was elected a Fellow of the Royal Society twenty years ago, and was well known by his writings on the Navy and by a treatise on the steam-engine for marine purposes, published several years ago.

Only recently we have heard of the death of Charles Fasoldt, of Albany, one of the most distinguished of American opticians. He was a chronometer-maker by trade, but exhibited marvellous skill in the special work he took up, his machine for ruling fine lines being a triumph of ingenuity. Mr. Fasoldt was over seventy years of age.

It is stated that Prof. James Thomson is about to resign the professorship of Civil Engineering and Mechanics in Glasgow University, on account of failing health.

The title of Emeritus Professor of Engineering and Mechanical Technology has been conferred on Prof. A. B. W. Kennedy, F.R.S., by the Council of University College, London.

The Photographic Convention of the United Kingdom is to be held at St. James's Hall, Piccadilly, from August 19 to 24, Mr. Andrew Pringle president. Particulars as to space for exhibits, &c., can be obtained of Mr. J. J. Brigginshaw, hon. sec., 128, Southwark-street, S.E. This is the Jubilee year of photography, and it is expected that the exhibition (or convention) will be a remembered event in the annals of the art. The International Congress of Photography is being held in Paris, closing on the 17th inst.

Referring to the method of making artificial silk, illustrated and described on p. 294 as the invention of M. de Chardonnet, Mr. J. W. Swan states that the essential features are identical with his patented invention of 1884 (No. 5978), some of the results produced by which he exhibited in 1885 at the Inventions. The point of the process, he says, is the production of a filament by squirting from a jet a coagulable filament-forming liquid into a setting or coagulating liquid.

According to an American paper the secret of a method of obtaining aluminium has died with Mr. F. J. Seymour, of Wolcottville, Connecticut. It seems that the various processes are covered by patents, but strangely enough there was a secret, or an alleged secret. "From remarks made by the chemists and other employés at different times it is gathered that the clay, after being ground in water and treated with various chemicals, is treated to a heat of 1,500° in large retorts until it has become thoroughly fused. When it has reached the crowning temperature, the precious metal is separated from the mass by the addition of a certain chemical in specific quantities; but the name and nature of this chemical is not disclosed in the letters patent, nor has anyone employed about the works ever discovered it. It is this secret that has gone down into the grave with F. J. Seymour. It had been his invariable custom to await the critical moment when the fluid mass had reached the right stage, and then all the employés were excluded from the room, the doors were locked, and all alone he went through the mysterious processes of the laboratory, adding a chemical that no one knows the name of, has never seen, and in quantities that cannot even be guessed at." It is tolerably safe to conclude that there was no secret at all.

The *Teutonic*, the first of the armed merchant cruisers, has been a subject of much interest during the past week. She is one of the new White Star liners built by Harland and Wolff for Messrs. Ismay, Imrie, and Co., and is probably the safest vessel afloat, as she is divided into so many water-tight compartments, both transversely and longitudinally. She is fitted with twin screws; and the whole of the machinery, engines, boilers, and coal for working either screw are shut off completely from their neighbours by a fore and aft bulkhead, which extends from the after end of the engine-room to the forward end of the foremost coal bunker, and, in fact, intersects the six largest of the twelve watertight compartments made by the eleven ordinary transverse bulkheads. This fore and aft bulkhead is pierced by only one locked door, the key of which is held by the chief engineer. The doors between the engine-rooms and the stokeholes are in every instance duplicated, and the duplicate door is in every case under the control of the captain on deck. When liberated they close by their own weight, but by an ingenious contrivance their descent is freed from violence. Ascending from the door is a rod surmounted by a piston, which works in a cylinder 4½in. in diameter filled with glycerine. When the door is allowed to descend, the whole of this glycerine has to pass through a ½in. hole in the piston, and the sluggish liquid thus prevents a rapid and dangerous descent of the massive door. In the event of water finding its way into the vessel to a certain extent the doors will be automatically closed, a float being used to trip the catch.

A scheme for the "rapid transportation of mails" is being introduced, or is proposed to be introduced, by the Post Electric Company in the United States. It is stated that the scheme has been exhibited in Boston, and has been explained by Prof. Dolbear, of Tufts College. Two hundred and thirty miles an hour is the estimated speed, which seems rather too definite. If more than 200, why not 250?

The French Government has instituted a number of international congresses, in order that the opportunity may not be lost of considering the progress that has been made since the last Exhibition was held. The arts of mining and metallurgy are to have a special congress, the object of which is not only to facilitate the study of the various exhibits, but to direct the attention of scientific men and of manufacturers to the problems which have been most actively studied of late years. This congress will begin on September 2nd, under the presidency of M. Castel, Inspecteur-Général des Mines. A certain number of *membres d'honneur* have been appointed by the commission, among whom are, for England, Sir F. Abel, Sir I. Lothian Bell, Sir H. Bessemer, Sir George Elliot, Prof. W. C. Roberts-Austen, Sir B. Samuelson, and Sir W. W. Smyth. All the principal countries of Europe, as well as the United States of America, appear to be as strongly represented as is this country.

An interesting article on "Some Remarkable Recent Developments of Microscopic Marine Life," by Mr. W. H. Shrubsole, appears in this month's *Leisure Hour*.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE BELGIAN ROYAL OBSERVATORY—FAITH (?) OR SIGHT—FINDING THE POSITION OF THE MOON OVER THE EARTH'S SURFACE: LONGITUDE ACCORDING TO DIXON—THE MOON'S "CHANGES"—DAYLIGHT OBSERVATIONS—WHAT DO WE SEE?—PENDULUM—DISCOVERY OF THE EARTH'S ORBITAL MOTION—SUN DIAL—THE LUMINIFEROUS ETHER—THE WHITE SPOT ON SATURN'S RING—SNOW AND METEORITIC DUST ON THE MOON—DIRECTION OF LIGHTNING—VARLEY'S GRAPHIC TELESCOPE—PERIHELIA OF PLANETS—THE ENDOWMENT OF RESEARCH.

[30220.]—I HAVE, on more than one occasion in these columns, referred to the transfer of the Royal Observatory of Belgium, from Brussels to Uccle, and in letter 29353 (Vol. XLVIII. p. 197) I spoke of the fine suite of buildings there as "rapidly approaching completion." In the light of a most remarkable article in *L'Etoile Belge* of July 23rd, however, it would seem that, in so speaking, I was (what the classical American author called) "too previous," inasmuch as the whole affair would appear at present to be in a state of chaos. The site was originally selected by MM. Houzeau, Stas, and Liagre, and the architect chosen was M. Van Rysselberghe, whose plans were examined in detail by the three gentlemen just named, and approved by them; and in 1881 the erection of the structure began. A building for a spectroscopic observatory and laboratories was first erected, as were two houses for the officials, with the understanding that the remaining ones should be completed year by year, as the money was voted by Parliament. Now, no one will deny that no more competent man than Houzeau ever lived to decide upon what was best and most essential in the design of an observatory; and it would seem only consonant with common-sense that the plans for which he was responsible, and which had so far been carried out, should be completed in their integrity. But the successor of the great Belgian Astronomer apparently thought that he knew better; and M. Van Rysselberghe received orders to abandon all his plans, and to devise, or agree to, new ones. So then they set to work to demolish part of Houzeau's building and to erect fresh ones; but scarcely had these been raised ere in turn they had either to be pulled down or done all over again. Two meteorological pavilions were placed in a position surrounded by buildings in such a manner as to render all observations made in them useless. They will have to come down. The dome which was to cover the Great Equatoreal (as I stated *loc. cit. sup.*) was constructed in England, of course from measurements furnished from Belgium; and now that is found to be useless, and another one will have to be made. "Nouvelle note à payer," says the Belgian article. After this it seems almost surplusage to add that it is stated that the library is too small, and in other respects inconvenient, and that in the buildings destined for offices for the employés the chimneys were forgotten! But some have been ordered. £1,200, too, was spent upon plantations for a park, which has been abandoned. It has been said that we English are too fond of washing our dirty linen in public; but it is long since such a specimen of incompetent muddling away of public funds as all this reveals has been the subject of public comment on this side of the Channel. More than £20,000 out of the original £72,000 voted for the Belgian Royal Observatory would thus seem to have been practically wasted. Well may the writer of the article which has formed the text of these remarks exclaim: "Peut-on s'imaginer pareilles incohérences et pareils gaspillages?"

I have no access to the pedigree of the Mr. Stoddard quoted by Mr. Sadler in letter 30170 (p. 454); but, judging from internal evidence, I think he *must* have been a proximate descendant of a Baron Munchausen, who flourished towards the end of the last century.

Colonel Tupman is—merely as a matter of course—absolutely right in what he says (in letter 30174, p. 454) concerning the futility of taking fractions of seconds into account in predicting the position of the moon's centre. For "Ruric's" purpose, that of plotting the moon's path over the earth on a terrestrial globe, I might have used much "rounder" numbers; but as decimals came out in the calculations I left them. Mr. Dixon, who is obviously eaten up alive by his estimate of his own calculating powers, and is always (what *Punch* calls) "on the pounce" to catch me tripping in a figure, has now, for the second time, made himself ridiculous by a blunder. Let me commend to his notice the aphorism of the Sage of Fleet-street, that "The inhabitants of vitreous structures should abstain from the projection of lithic missiles."

Mr. Nicolls (letter 30176, p. 455) might really have spared himself the trouble of extracting the vulgar definition of the moon's phases from such writers as Lardner and Norie. Every old washerwoman talks of the "changes" of the moon. What I want to know is, in what *way* our satellite changes when in her syzigies and quadratures, that she is not changing in every other portion of her orbit?

In reply to the question with which "Lavant" concludes letter 30177 on p. 455, I may say that in my experience the sky is decidedly clearer during the early morning hours. If he wishes to observe Solar detail let him begin as soon as ever the sun is high enough. I have had views of the sun's surface about 8 a.m. such as I never could obtain two or three hours later.

I am not sure that your excellent correspondent Mr. Monck and I are so far apart as we seem. We must, however, be careful rigidly to define the sense in which we employ the terms we use, or we shall be in danger of drifting into logomachy—or metaphysics, which is, of course, the same thing. Does Mr. Monck intend to convey (in letter 30192, p. 459) that we see with the brain? Because, if so, I am entirely with him. The apparatus of the eye and the optic nerve are simply the means by which the vibrations of the æther are ultimately made to set up molecular motion in the brain. The "rods and cones" behind the retina proper exercise selective action on light of different rays of refrangibility; the impression thus induced is communicated to the fibrous layer, in turn to the optic nerve, and thence to the brain. Now, the retinal image is only a single link in a catena of phenomena; and I fail to perceive that we have any right to predicate that we *see*, what, in truth, is only one incident in the series which make up vision. Let us take an illustration from another of our senses—that of hearing. Suppose that we have a musical box playing in an empty room. If we use the word "sound" in its legitimate sense, then, of course, there can be no sound from our hypothetical box, inasmuch as the undulations set up in the air by its action must enter an ear, human or other, before ever they become *sound* at all. Up to that instant they are mere pulsations of the air. Very well; these pulsations enter the external ear, pass through the auditory meatus, impinge on the tympanic membrane, set the tympanum itself in vibration, as also the tiny bones known as the malleus, the incus, and the stapes, which in turn excite motion in the perilymph of the bony labyrinth and cochlea, and so the vibration irritates the ends of the vestibular and cochlear divisions of the auditory nerve, when only, and not until then, do we *hear* anything. Now, what is it that we hear? Is it the original undulation of the air surrounding the musical box? Is it the vibration of the tympanum, or what? Because it seems to me that it would be just as correct, neither more nor less so, to say that it is the vibrations of the tympanic membrane that we hear, as it is to say that it is the image of an object on the retina that we see. If we look at the inverted image on the ground glass of a camera, unquestionably we do see that, because we have an eye behind it; but where is the eye behind the retina?

In reply to "Tempus" (query 69124, p. 465), he may take the length of a pendulum to beat sidereal seconds in the latitude of London, between the point of suspension and the centre of oscillation, as 38·92in. With reference to the second question he puts, Ganot gives the coefficients of the linear expansion of cast iron as 0·000011250; of wrought iron as 0·000012204; of untempered steel as 0·000010788; of tempered steel as 0·000012395; and of zinc as 0·000029417 for every 1° Centigrade (= 1·8 Fahr.), between 0° and 100°.

In connection with query 69148 (p. 465), it may suffice to state here that Aristarchus of Samos, who flourished some 280 years B.C., taught that the earth went round the sun, for which he was accused of "impiety." As this happened 1400 years before the date of Omar Khayyam's poem, I am a little afraid that, in the matter of priority of proclamation of the true place of our earth in the solar system, "the poet-astronomer of Nishapur"—if I may employ a vulgar colloquialism—"wasn't in it" with the old Samian philosopher.

All the information I can profitably give here to "F. C." (query 69155, p. 466) is this: The sloping edge of the gnomon of every dial whatsoever must be rigidly parallel to the earth's axis; hence, in his case, that edge must make an angle of 39° 17′ with the vertical, and the plane of the gnomon one of 57° 30′ with that of the dial. The division of the hours is made according to the following formula:—Turning time into arc at the rate of 15° for one hour, and calling H this true hour angle, H′ the angle to be inscribed on the dial plate, and l the latitude of the place where the dial is to be erected, we say: $\tan. H' = \tan. H \times \cos. l$. This is obviously as applicable to a dial facing to the east or west of south as to one facing due south; save that, in the former case, *the angles are not measured from the noon line*, but from some other one. If "F. C." will take my advice, he will go to the nearest secondhand bookstall, where he is certain to pick up one of the very numerous works on dialling which appeared during the 17th and 18th centuries, whence he may obtain the whole of the details he requires. Among likely books to be so found I may mention Blagrove's or Leybourne's "Art of Dyalling," Wright's "Arte of Dialing," Foster's "Art of Dialling," and Ferguson's "Mechanical Exercises." "Rees's Cyclopædia," too, contains an elaborate illustrated article on this subject, in which my querist will find everything he wants.

"J. E. G." invites my opinion (in letter 30199), on p. 481, on the vexata quæstio of the medium in which luminiferous undulations are propagated. I do not think that we are at present in possession of sufficient data to justify anyone in making a categorical affirmation on this subject. I would, however, demur very strongly to the supposition that a continuation of our atmosphere, or anything analogous to it, pervades space. Such a medium, however tenuous, *must* exercise a retarding influence on the planets in their orbits, of which no trace whatever is perceptible. I am very far indeed from believing in the infallibility of the authors of "The Unseen Universe," which work I regard as the veriest *reductio ad absurdum*. "J. E. G." will find some pregnant remarks on the possible constitution of the ether in Sir John Herschel's discourse on "Light," in his beautiful course of "Familiar Lectures on Scientific Subjects."

I much fear that the hypothesis of "Phos. Bron." (letter 30201, p. 482) will scarcely hold water. *Imprimis*, the discrete revolving particles of Saturn's ring must pass your correspondent's imaginary limit of change, or of light and darkness, far too rapidly for such action as he postulates to take place. Did anything of the sort occur, the effect must be cumulative, and the spot get brighter as its distance from the edge of the shadow increased. But what seems to me to be even more fatal to "Phos. Bron.'s" idea than this is that the phenomenon which he seeks to explain is admitted to be only a temporary one.

In connection with letter 30203 (p. 482), my remarks will be very few. First, I would ask why, if the moon is covered with snow, does there exist upon her entire surface one solitary little peak possessing the reflective power due to that substance? Next, I must reiterate my question why meteoric dust should so persistently fall *in identically the same patterns* on the lunar surface? And, in the third place, I would once more ask why, assuming that the meteoritic dust were removed from the lines of electrical discharge by repulsive action (I should have thought myself that it would have been attracted, but this is a detail), why, I say, the next shower of dust did not cover over the lines so denuded? How long does Mr. Peal think that such a disturbance of electrical equilibrium as he imagines would last?

There is an aphorism which counsels you to "never to believe anything you hear, and not more than half what you see"; but the perusal of letters 30204 to 30209 inclusive (pp. 482 and 483), the writers of which, one and all, I hereby thank, has certainly helped strongly to confirm my abiding impression that, after all, I did see the lightning strike upwards from the earth into a cloud on the occasion to which I referred in my original letter. A remark in Mr. Ranyard's letter (30209) induces me to add that such lightning must have been very distant; inasmuch as it was on the horizon, above which my eye was elevated 846ft.

The telescope of which "The Optical Bricklayer" speaks in query 69181 on p. 488 was, in effect, a camera lucida for drawing objects at a distance. The instrument was so directed that the object to be drawn was seen in the reflector outside the eyepiece, this being so placed that the image was reflected upwards into the eye of the observer. Below the eye-end of the telescope a sheet of white paper was placed, and—both eyes being kept open and the telescope properly focussed—he saw the image of the object projected on the white paper, and could, with a very little practice, trace over it with a pencil. If the reflector at the object-end of the tube were removed, the focal image at the eye-end would be reversed right for left, like type, or a wood-engraving on the block. I seem to have heard, or read, that this Varley's graphic telescope was used by Hornor in painting that famous panorama of London, which, in my childhood, formed the leading attraction of the Colosseum in the Regent's Park.

In reply to Mr. Godden (query 69227, p. 489), I have no access at the place whence I write to tables of Mars, Jupiter, and Saturn; so can only say, on the authority of Prof. Young ("General Astronomy," p. 529), that on Jan. 1, 1850, the longitude of Perihelion of Mars was 333° 17′ 54″; of Jupiter, 11° 54′ 58″; and of Saturn, 90° 6′ 38″. Sir John Herschel gives these quantities on Jan. 1, 1801, as 332° 23′ 56·6″, 11° 8′ 34·6″, and 89° 9′ 29·8″ respectively, whence it appears that the motion of the lines of apsides is direct in each case.

To such credulous people as are deluded by the clamour of the scientific cadger for "the endowment of research," I would commend the study of the following sentence from an excellent and instructive article on "Earth Worms," in the current number of *Knowledge*. "You will almost universally find," says its author, "that a parasitic animal has become degraded from what is believed to be his original position in his class. Somewhat in the same way as an endowment or an assured position has been the ruin of many a man who might have turned out a fine specimen of humanity if he had had his own way to make in the world; so when your animal gets a great deal of the work of procuring and preparing food done for him, he gets lazy and sinks lower in the scale of animal life." As an illustration of the tendency of endowment, I can only regard this analogy as an admirable one.

A Fellow of the Royal Astronomical Society.

COMET BROOKS.

[30221.]—Observations of the new comet discovered by me on July 6th were secured this morning. They were the first observations possible after an interval of twelve days, in which the clouds and moonlight have interrupted work. I directed the 10½in. equatorial by the circles to the point in the heavens where, from my early observations of its direction and rate of motion, I had computed the comet to be, and had it at once in the field. Its position was: July 21st, 13h.; R.A., 23h. 57m. 50s.; declination south, 7° 48′.

My previous observations, including the discovery place, are as follows:—

July 6	12h.	30m.	R.A.	23h.	44m.	30s.	9°	10′
,, 7	14	00	,,	23	45	30	9	05
,, 8	14	00	,,	23	46	20	8	59

Dr. Lewis Smith reports to me an observation July 9, 14h., in R.A. 23h. 47m. 15s., 8° 51′.

The mean daily motion of the comet for the period since discovery has been remarkably close to that first announced, being east 1m. of time, and north 6′.

It will be noticed that the apparent motion is exceedingly slow—in fact, the comet did not move out of the wide telescope field of discovery in over five days.

The comet is "faintish," but seemed to me a little brighter this morning than when discovered. I would here request that readers of "Ours" having good telescopes observe the comet, and publish the results. **William R. Brooks.**

Smith Observatory, Geneva, N.Y., U.S.A.,
July 22.

BARNARD'S COMETS.

[30222.]—The comet (*e* 1888) discovered by Mr. Barnard on Sept. 3, 1888, was seen here last night at 12h. 15m., the position being approximately R.A. 19h. 40m., S.D. 4° 16′. Barnard's comet (*c* 1889) was also seen subsequently in Perseus, near the position given in the "E. M." of Aug. 2 (p. 480); but this latter is extremely faint.

Hendon, Aug. 6. **P. F. Duke.**

STELLAR EVOLUTION.

[30223.]—Dr. Croll has emitted the very probable hypothesis that the primitive nebula of any solar or other system may have owed its existence to collisions of bodies moving very nearly in opposite directions. This has been thought so highly improbable by Sir William Thomson, amongst others, I believe, as not to deserve any consideration, which might be the case if we only considered a comparatively small portion of space and time; but we have really infinite space and infinite time, in which two infinites we might expect an infinite number of such collisions if the small sample of the universe under the view of our telescopes is anything like the rest. It is only where such collisions have occurred that we can expect sentient beings to arise capable of considering such questions. It appears quite a gratuitous assumption that the initial temperature of a nebula should be *nil*; any degree of temperature is *à priori* quite as probable as another.

With regard to our own nebula, such a temperature must be initially assigned as will be needed for the various evolutionary processes requisite for the present state of things, as, indeed, has been remarked by Mr. Croll. But as regards vortex motion, Mr. Croll has, I think, discovered a mare's-nest, for which our old friend and mischief-maker, Centrifugal Force, is partially responsible. As "J. E. G." says, it is scarcely credible that Sir W. Thomson, not to speak of Helmholtz, should have forgotten the "centrifugal force." In fact, vortex motion having been shown by Helmholtz to be in accordance with the properties of frictionless fluids and the general laws of motion, as it satisfies the differential equations founded thereupon, no more need be said, notwithstanding the "centrifugal force." We may, however, be sure, that if two particles, A and B, press upon one another, the pressure exerted by A upon B is exactly the same as that exerted by B upon A; and if, through B moving in a particular manner, the pressure upon A be increased, the pressure exerted by A upon B will be increased by precisely the same amount. Further, the "resistance offered to the passage of the atom as a whole" does not depend upon the pressure, but upon the frictional terms in the equations of motions of fluids; but such terms by hypothesis do not exist. **W. C. E.**

METEOR HEIGHTS.

[30224.]—Thanks to Mr. Booth for his letter (30178) in issue of July 26th giving information *re* meteor heights. I find there are several errors in Prof. Herschel's paper in Vol. XXV. R.A.S. *Monthly Notices*—viz., on p. 254, line 17, in formula y_1 should be z_1, and z_1 should be y_1.

Line 19 $y_1 = 35·3$ should be $y_1 = 28·02$
$z_1 = 57$,, $z_1 = 51·0$
Line 21 $Y_1 = 29·9$,, $Y_1 = 26·2$
Page 255, line 3 74·6 ,, 76·5

The apparent radiant will then be about—

$$\alpha = 75·7 \qquad \delta + 45·6$$

I do not see how the two upper lines in Mr. Booth's diagram are obtained. I presume it is the earth-point. All that appears definite to me is the point of disappearance, and in this case the planes are *very far* from being coincident.

Chas. Grant.

COMET v. CABHORSE.

[30225.]—Permit me to correct a statement made by "W. G. P.," under above heading, in issue of Dec. 7 last, p. 302. "W. G. P." there gives as the velocity in perihelion of Halley's comet 2,063 miles per hour. It is almost obvious that this must be the aphelion velocity. Using slightly different data, the perihelion velocity comes out = 34·696 miles per second = 124,906 miles per hour. "W.G.P." (loc. cit.) gives a formula for calculating the lunar velocity at any point of an elliptic orbit; but it is one that involves the perpendicular from the focus upon the tangent at the point, and this is a factor not to be found ready to hand in the text-books.

Here, then, is a formula equally simple and accurate, and at the same time far more comprehensive and easily applicable, for it involves quantities that may be at once extracted from any work on astronomy.

$$v = \frac{2\,\pi\,m}{t}\sqrt{\frac{2m - r}{r}}$$

where v = the required velocity
π = 3·14159 . . . . as usual
t = the periodic time
r = the length of radius vector
m = the semi-major axis.

Esne Carolita.

DIRECTION OF LIGHTNING.

[30226.]—It may be of some help to "A Fellow of the Royal Astronomical Society" if I send you a description of a recent experience in Toblach, Austria, as to recognising the motion of a flash of lightning.

I was watching the flashes from the hotel door when a long zigzag flash came out of a cloud and struck the ground. The hotel is on one side of a valley, and the hill on the other side is rather more than a mile off, and at least 600ft. high from the foot to the top. The flash appeared to come from a cloud some 200 to 400ft. above the hill, and struck the ground apparently close to the foot of the hill, so that it must have traversed a vertical distance of 800 to 1,000ft., and, owing to its zigzag course, the actual distance traversed must have been much greater.

The flash appeared at first high up, and seemed to come down with gradually decreasing velocity. It appeared to be about 1½in. wide, and to preserve the same breadth throughout its length, till near the lower end, where it seemed to taper off a little, the extreme lower end being about ½in. wide, or perhaps less. It is quite possible that these phenomena may be only optical illusions.

When watching for the flashes I was looking at the top of the hill, or rather in the direction where I knew it was (it was too dark to see except when it lightened). The upper part of the flash would consequently be seen at once clearly, whereas the lower part would only be seen more or less indistinctly, it being beyond the angle of distinct vision. The weaker impression thus produced on the eye by the lower part of the flash may perhaps give the sensation of gradual development or motion of the flash; the weaker impression may be, and probably is, realised at a later period than the stronger one, supposing that both occur simultaneously. The apparent gradual decrease of velocity would correspond with the gradual advance beyond the angle of distinct vision into an area of gradually increasing indistinctness.

A. Gray.

"HOW LONG DOES A FLASH OF LIGHTNING LAST?" AND SOLAR PERIHELION.

[30227.]—I was rather surprised to see, in connection with this subject, Mr. R. A. Proctor's having taken exception to "F.R.A.S.'s" observation. I have observed the same so many times—viz., that of ascending lightning from earth to clouds—so often that I have taken it for granted that it was quite common and accepted by all. I have seen it in the most favourable positions for such an observation, and where the flashes are so long that one cannot doubt the direction of the flash—viz., on the Gympie Range of Mountains, Queensland, the Blue Mountain Range, New South Wales, and off the coast of Java and New Guinea. The storm that was so noted for its vivid lightning last June (I think) here in London was most uncommon in this country for such a display of ascending lightning. One thing in particular I have always noticed, and that is in nine times out of twelve the upward flash strikes the tail end of the storm clouds, and always a few seconds after the discharge from the head or centre of the cloud. Also in storms where the ascending lightning is seen the duration of the storm is about double.

The grandest display that I have ever seen in my life was on the prairies of the great North West Territory, North America. It was in the month of August, 1884. I then saw three separate storm-clouds, at about equal angle in direction from each other, rise gradually from the horizon to the zenith, and when about mid-way whirl round each other, the brilliancy of the lightning and awful rumbling of the thunder surpassing anything that I have ever seen or heard, and so the whirling round each other went on for about 20 minutes, giving the idea to the observer of an electrical naval battle, until at last the motion became so rapid as the clouds neared the zenith, that the clouds seemed to absorb each other, and then the storm was over, quietly sailing away towards the south, like three enemies who had now settled a hot party argument.

Will "F.R.A.S." or any of "Ours" tell me when the last solar perihelion happened, and what is the probable date of the next?

Globe-Trotter.

LIGHTNING—CRAM—ET DE QUIBUSDAM ALIIS.

[30228.]—R. A. Proctor was certainly wrong in maintaining that the path of a flash of lightning was traversed so instantaneously that the eye could not realise its course or direction. On the Rigi, in the end of September last year, I saw a thunderstorm raging in a mass of cloud a thousand feet below me, and frequently I saw a flash fully four miles long, beginning not far from Brunnen, and reaching nearly to Lucerne. Of course these towns were invisible, but their whereabouts could be easily guessed. Further, this lightning was distinctly pink. I have seen long flashes of the same kind at another time, reaching for miles along Lake Maggiore in Italy, near the town of Stresa.

The results of Cram may be as "F.R.A.S." alleges, that the successful have not always become possessors of sound or full knowledge. But this I can say from my own experience as a man much in contact, by reason of the nature of my daily business, with young men in public offices who have obtained their situations after competitive examinations, that they are, as a whole, infinitely more obliging, more intelligent, and more anxious to help on the work of the public than their predecessors, the selections and kinsmen of judges and M.P.'s.

I cannot guess what is the source of the encyclopædic learning of "F.R.A.S.," to whom we all owe so much for his interesting letters, and I am glad to find my surmise as to the mysterious "jargoon" borne out by his more accurate knowledge.

As to the theory of vision, he has a tough customer to break a lance with in Mr. W. H. S. Monck. From my knowledge of this gentleman, I venture to say there is not a man in Europe with a fuller knowledge of what has been said and written on this subject, beginning with Epicurus and ending with Bain. Mr. Monck used to be better known as a metaphysician than a natural philosopher. In both sciences he is now a man of mark.

Vindex.

THE AMERICAN ORGAN.

[30229.]—Kindly allow me to reply to a few statements put forth by your correspondent "Alphion," on p. 437. This correspondent says that he does not think "the American organ is especially deceptive in the matter of stops when compared with harmoniums." As a practical man, I beg to differ from him. By what means (may I ask?) are stops multiplied in American organs? This question is easily answered. To a single-row (61 reeds) organ we can put as many as seven stops. Five out of these seven stops would be practically useless. A mute, or stop, could be applied to every octave of reeds. This would make five register stops, if we like to call them such. These five stops, with a forte and vox humana, would make seven stops in all. The vox humana (if a good one) is far superior in effect to the ordinary tremolo. The forte stop would do the same as the knee swell—viz., raise the swell, and thus increase the power. Another method of increasing the number of stops in American organs is by raising the mutes partially, the register stops opening the mutes to the full extent. I have seen a few organs in which some of the "dummy" stops merely pulled out the stop rods, the stop rods in this case not being attached to any part of the inside mechanism. Octave couplers, whether straight (that is, either coupling up or down throughout) or divided (coupling up in the treble and down in the bass), are valuable additions to any organ or harmonium containing not less than 1½ row of reeds. Every practical man knows that it is not customary for any manufacturer to multiply stops in the harmonium like it is done with regard to the American organ. For my own part, I care nothing about "dummy" stops, as, beyond the matter of being entirely useless, they are, in my opinion, of no use or ornament, and the more stops can be dispensed with the better. An unnecessary multiplication of stops may please the ignorant purchaser, and that is all that can be said in favour of "dummy" stops.

Now, with regard to harmonium stops, it is seldom we find any "dummy" stops in harmoniums except the forte stops. The sourdine stop is, to some extent, a useful stop; so is the grand jeu, which does the same to the harmonium as the left knee swell (as it is called) does in the American organ—viz., it opens all the register stops at the same time, and thus you obtain the full power of the instrument. As regards the harmonium tremolo, this could not be called a "dummy" stop, as it produces a marked effect or palsy speech of the reeds it controls; but I do not care for it myself. If forte stops in harmoniums are required to be effective, the necessary means of making them effective must be taken. It is of no practical use to attach stop-rods to mere strips of wood, which are merely intended to slide over the top of the keyboard.

Swansea. **G. Fryer.**

AMERICAN ORGAN v. HARMONIUM.

[30230.]—It was only to be expected that Mr. Casson's trenchant letter appearing in your issue of the 5th July would bring our friend "Organon" into the field, and rather more than usually savage. His letter in your issue of the 26th ult. satisfies me that he has yet to learn the magnitude of the gulf which separates the best American organ ever made from one of Mustel's artistic instruments. Were it otherwise, he would not have written so contemptuously of the communication in your issue of July 19 signed "998."

"998" is quite right. To get the full benefit of Mustel's exquisite blowing, the soles of one's boots are a nuisance. When alone, I invariably play without my boots, and at other times with the thinnest-soled shoes I can get. It is then one gets that grip of the pedal which enables one to play upon any note almost as a violinist upon his strings. Upon the American-organ pedals clogs would matter not, so far as any delicacy in blowing is concerned. Still, "Organon" puts a pertinent question in his letter No. 30188. If I understand him quite rightly, he asks why the expression stop is never added to the American organ? The answer is simple—the reeds would not stand the blowing. The sweetness of the American organ, according to some of your correspondents—its "eunuch" voice, according to Mr. Casson—is owing in very large measure to the excessive thinness and tenuity of the tongues of the reeds—so thin, indeed, that they may not be exposed to any direct blowing—the blowing must be first tempered by passage through the windchest.

It is, emphatically, a case of tempering the wind to the shorn lamb.

I may, perhaps, be pardoned for giving here the programme of a most delightful musical evening at my own house a week or two ago. I give it for two reasons: (1) that it may be seen how great is the value of the Mustel in home music; and (2) I think some of your readers may be pleased to be introduced to some of the music.

1.	Trio	Air and variations, Septett. Violin, piano, and organ.	Beethoven.
2.	Solo, piano	Largo e Mesto. Seventh Sonata.	Beethoven.
3.	Duet	Reverie, Vieuxtemps. Violin and piano.	
4.	Solo	Mustel organ (Extempore).	
5.	Trio	"Meditation." Violin, piano, and organ.	Bach-Gounod.
6.	Vocal quartette	"Blessed are they."	Costa.
7.	Trio	"Nocturne." Violin, piano, and organ.	Behr.
8.	Solo, piano	"Fifth Nocturne."	Chopin.
9.	Duet	Air in G. Piano and violin.	Rode.
10.	Solo, piano	Lyric Studies.	Grieg.
11.	Trio	(*a*) Andante C Major Smphny. Violin, piano, and organ.	Beethoven.
		(*b*) Andante 1st string trio.	Mendelssohn.
12.	Quartette	Largo. Violin, piano, organ, and celesta.	Handel.

Now, besides the purely organ part written for Nos. 1, 5, 11 (*a*), and 12, the cello part in No. 11 (*b*), and the flute part in No. 7 were taken upon the Mustel, and with, I make bold to say, as much pleasure to the listeners as though those parts had been taken upon their proper instruments. Where, *in the country*, do you find performers who can play such music absolutely in tune, giving to each phrase its proper expression, its proper nuance? And how, I ask, could such music possibly be given on the American organ? I, for one, should never dream of attempting it upon any American organ I have ever played upon; nevertheless I would be prepared to try it upon any really good harmonium of two complete sets of reeds only. No, after much consideration I have come to the following conclusion: Where there is sufficient determination really to master the artistic use of the instrument, its blowing, and the proper use of the expression stop, the harmonium will yield infinitely better ultimate value; where, however, the modest result desired is the playing, say, of Moody and Sankey's hymn tunes, or even perhaps a *very* sustained organ accompaniment—such, for instance, as that in No. 5 of the programme—*there* the American organ has its place.

It follows, of course, that the American organ is, and is bound to be, the favourite with the feminine members of our households. It is to captivate them, I fancy, that we see the elaborate and gaudy cases, the shelves for knick-knacks, the hypocritical pipe tops, the so frequently appalling array of utterly useless stop-knobs, &c., which sicken the soul of your humble servant,

Country Solicitor.

[30231.]—In reply to G. Fryer, my experience with the American organ dates some years back. I have of recent years seen none but the cheaper class, which, in my opinion, are simply imitations of pipe organs, and, like the latter, are not designed for effective expression. For many years my early instrument was an imitation Mustel; six sets of reeds and sourdine to each set for solo playing with accompaniment. Recently I have obtained a real Mustel, with eight sets reeds treble, six sets bass, Dawes' melody attachment, independent forte expressif to treble and bass, 20 stops. I use this almost exclusively for the reproduction of vocal parts with accompaniment, sonatas, and string concertos, and I know no other instrument on which these can be rendered perfectly by a single player. I have no back numbers, so cannot read the letter referred to.

998.

A NEW DISINFECTOR.

[30232.]—I beg to submit to your notice—if I may so far intrude upon your time and patience—a new disinfector for use in flushing cisterns. By its means any closet, &c., served by a flushing cistern may be thoroughly disinfected and deodorised at a cost of about one penny per week: say, a three or four-gallon flushing cistern, a larger cistern, of course, requiring a larger supply. The sample sent with this contains 2oz., and will last a fortnight, and as a convenient unit for is safe to say that 1oz. of disinfectant will last one week, 2oz. will therefore last two weeks, 4oz. four weeks, and so on to any convenient size for the size cistern mentioned above.

The principle of its construction is as follows:—Permanganate of potash—the disinfecting agent used—requiring sixteen times its own quantity of water to dissolve, it is consequently very slowly dissolved if only a small quantity of water is permitted to come into contact with it. This condition is obtained in the following manner: The disinfector practically consists of two chambers, separated by a movable plate. The crystals are placed in the upper or larger chamber, and the disinfector is hung in the flushing cistern so that about ¾in. of its lower part is under the surface of the water. The water coming first through the small hole in the lower chamber, and thence round the edge of the movable plate, is brought into contact with the crystals, a small portion of which is dissolved, and the solution thus formed is reserved in the lower chamber or reservoir. While the water is at rest in the cistern the solution issues from the reservoir in very small thread-like rings, hence there is little used during the night; but when the water is drawn from the flushing cistern the sucking action of the water draws the solution out of the reservoir into the cistern, and the agitation mixes and converts the whole into dilute disinfecting fluid of a uniform colour, which is discharged into the closet pan.

This mode of disinfecting being perfectly automatic, and the disinfectant employed quite inodorous, will be preferred to other means, saving, as it does, not only trouble, but dispensing with the use of vile-smelling compounds, which, after all, only doubtfully effect their object. On the score of economy it has no rival.

It may be tried in a basin, or other vessel, provided a siphon or tap, or the like, is used to draw off the water. **Geo. H. King.**

101, Ashmore-road, Paddington, W.

TAIL-STOCKS OF LATHES.

[30233.]—Is there any reason why the tail-stock should have a set-over? and are engine lathes so very nice that they require repeated adjusting? Many I know advocate the placing of the two centres exactly in line; then take a long piece and turn, say, 1in. in length on each end, exactly the same diameter; then move the carriage and tool close to the head-stock, to prove if the tool will touch at each end alike. If found correct, they advocate drilling and reaming a hole somewhere in the two parts, which slide one over the other, and then fit a steel pin. This is done so that when the tail-stock is set over, the pin can be replaced, and the lathe is in position for turning straight. If it were possible to make all parts of a lathe so that there need be no adjustment, then a great mechanical feat would be accomplished. In all the matter which has been written upon this subject, one point has been overlooked; that is, the dead centre, or the centre which fits in the spindle of the tail-stock, has to be hardened, and, as a result, it is sprung more or less; and, as is often the case, the centre is not marked so that it may be replaced in the same position. Now, it is not every shop that has a device for grinding the centre true after hardening, so it has to be placed in the spindle in a bad condition. Now those who advocate a lathe made so that the tail-stock cannot be adjusted, or who think that a pin is essential, can readily see what trouble is in store for them. Again, it is not every lathe hand who will place the dead centre in place twice alike. It will thus be seen that if the tail-stock had been adjusted to turn straight in one place, and the centre was removed and not replaced exactly in the same position, the lathe would turn tapering. Still again, another obstacle presents itself. As is well known, there is a device upon the tail-stock used to clamp and hold the spindle firmly. Some workmen will set the lathe to turn straight, without binding the spindle; another will squeeze the binding-screw as tight as his strength will permit; the result is, that the spindle is forced down and the lathe turns tapering. Again, it is well known that, with a large number of lathes, there is trouble from the ways of the bed being wider in some places than others; also, that the bed or ways are bowing—high in the middle and low at the ends. It is seen that if the tail-stock is set true for one length, then, when moved a longer or shorter distance, it will turn tapering; so it will be seen that it is next to impossible to make a lathe turn straight in every position.

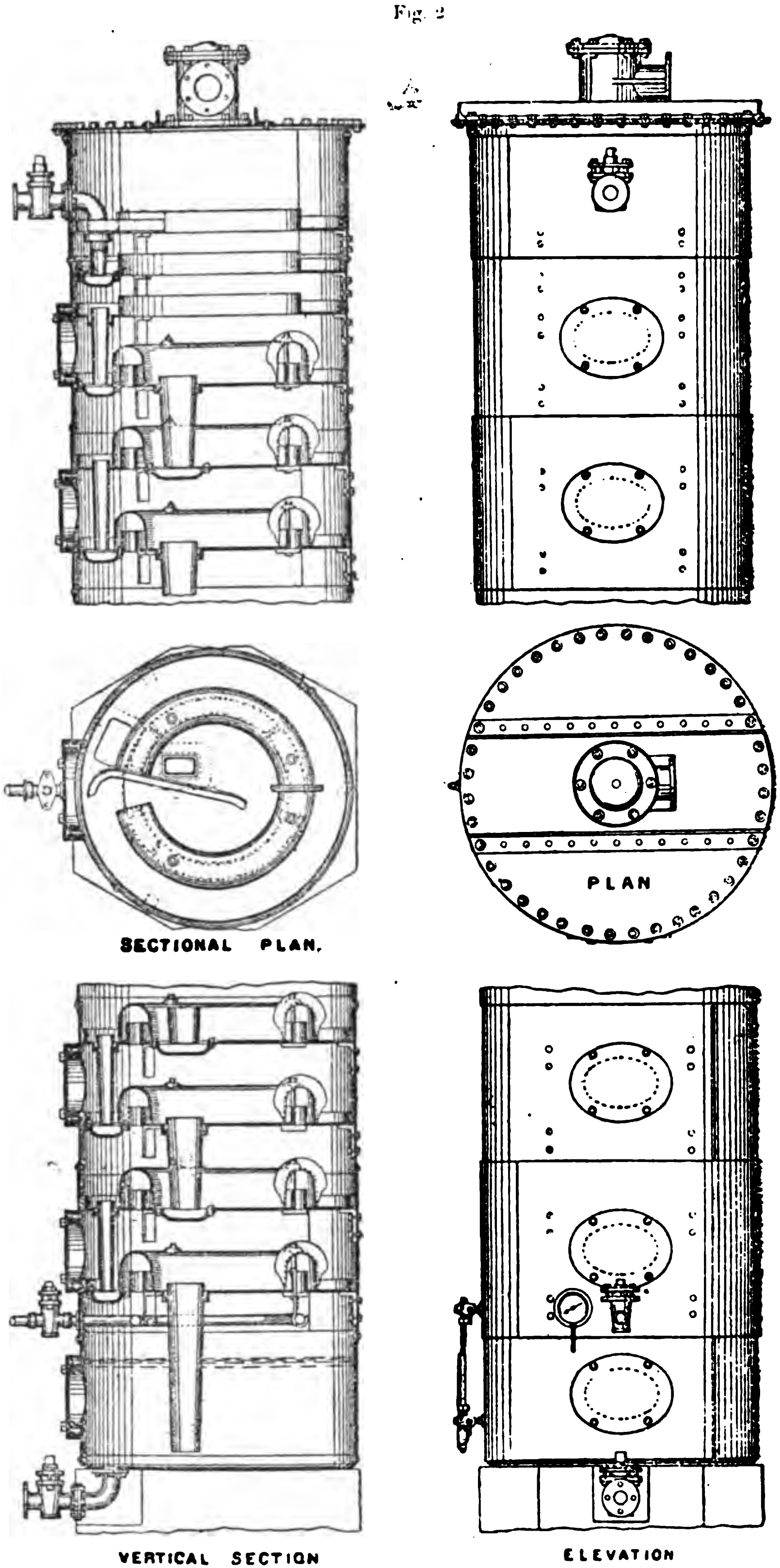
O. H. M.

PARAFFIN AND PARAFFIN OIL.—II.

[30234.]—Most of the oil works convert their ammonia water into sulphate of ammonia. It is used, as I have mentioned, for cultivation, so, therefore, it does not need to be quite pure. In the time of Mr. James Young, the ammonia water produced in his works was run into the nearest ditch and considered to be a nuisance, but now it is counted a valuable product of shale. If it were not for clever scientific men who have done so much for the improvements in plant, oil works would have soon come to an end owing to the importation of petroleum from America. The black tar obtained by the treatment of the oils with sulphuric acid, which before had gone to waste, is now utilised by washing it with water, which extracts the excess of sulphuric acid in it, and leaves the tar swimming on the surface. The sulphuric acid obtained in this way is not pure, owing to its holding some of the bases in solution out of the tar, but it serves the purpose of neutralising the ammonia water to obtain the sulphate. The tar, after being washed, is utilised in a similar way by using it to heat up the stills to distil the oils.

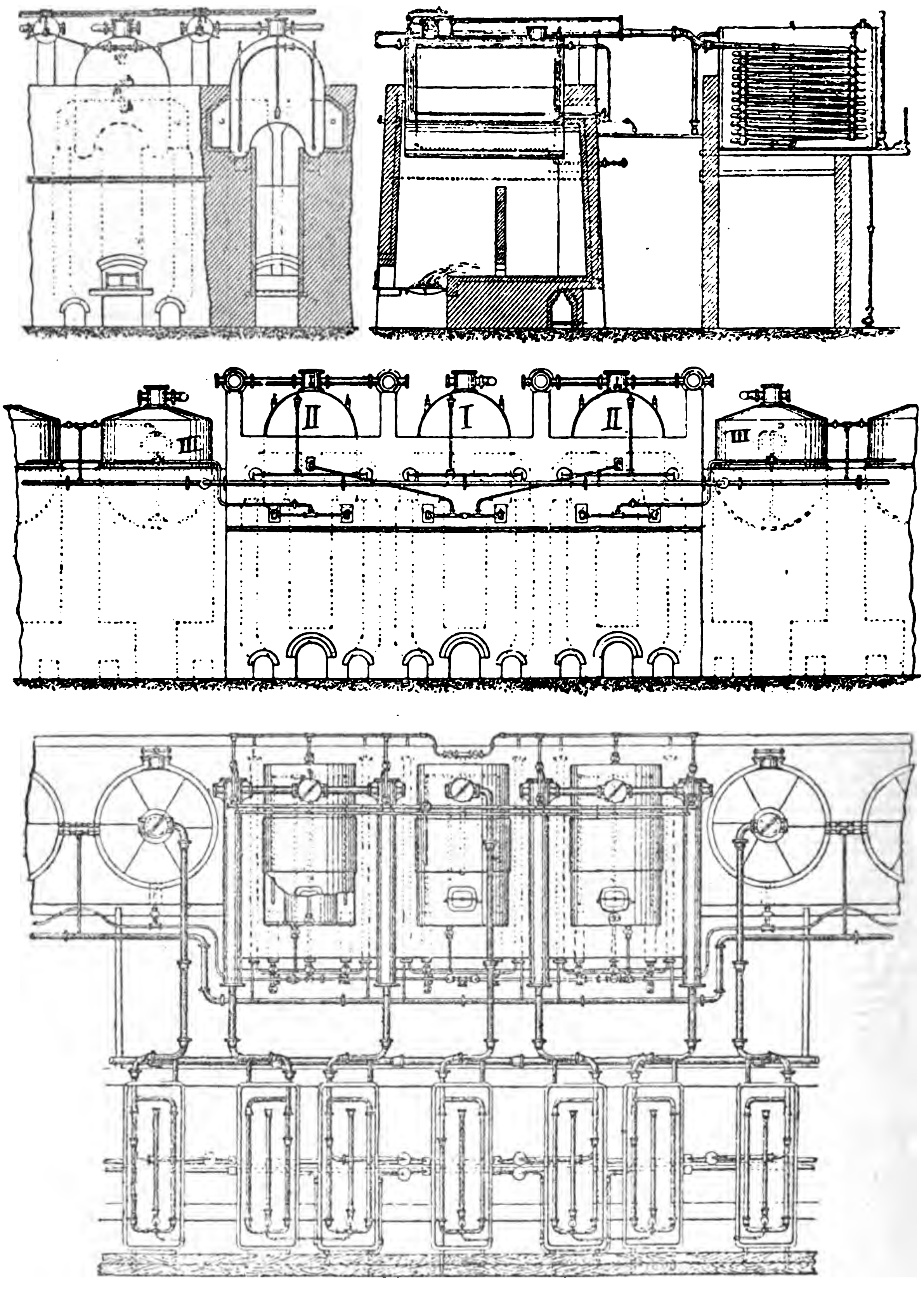
The process commonly used for the conversion of water into sulphate of ammonia is as follows:—The ammonia water is distilled in stills to obtain ammonia gas. The most suitable still is the Henderson patent column still. In this still the ammonia water is distilled by a continuous process. About 35,500gals. ammonia water are passed through each still daily. Fig. 2 is a drawing of this still. It consists of a large cylindrical iron tank 22ft. long and 5ft. in diameter, and contains fourteen trays. Each tray has a circular channel with risen up edges fitted with caps, which are so arranged that when the ammonia water passes in on the top of the first tray it has to travel right round it before it reaches the second tray, and goes on in this way until it reaches the bottom, and by this time the ammonia gas is thoroughly extracted out of it. The ammonia water coming into thorough contact with the steam gets heated up, which drives off the ammonia gas, which is carried by a lead pipe into wooden boxes commonly called "cracker boxes" containing sulphuric acid. These boxes have to be lined with lead to prevent the sulphuric acid from acting on the wood. The ammonia gas is passed into these cracker boxes until the acid smells strongly of it. The neutralised liquid is run off into evaporating dishes, and a fresh supply of sulphuric acid run into the cracker box. The eva-

Fig. 2



SECTIONAL PLAN.
VERTICAL SECTION
ELEVATION

Fig. 3.



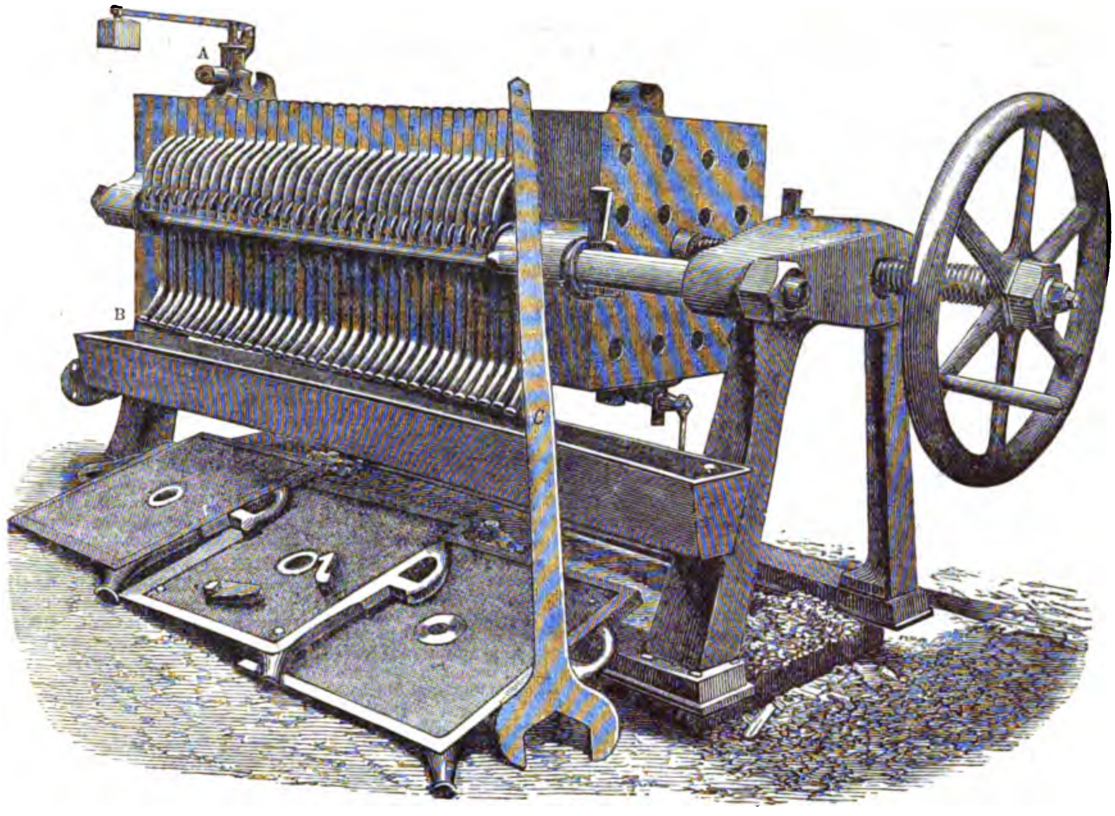
porating dishes are fitted with lead worms, through which steam is passed at a pressure of from 30lb. to 40lb. per square inch. The liquid is evaporated, and the salt falls out of solution, and is ladled out from the bottom of the liquid by perforated ladles, and placed in a heap to drain and dry, after which it is crushed by a mill, and filled into bags ready for the market. The sulphate of ammonia prepared in this way contains about 24 per cent. pure ammonia (NH_3) with a trace of iron and bases out of the acid.

We now fall back upon the crude oil, which is the most important product of shale, and from which all the other products are obtained. It has a black colour resembling petroleum, and is solid at ordinary temperatures, owing to it containing solid paraffin. The first step taken in the refining of it is the destructive distillation by which it is broken up into its different constituents. The most volatile portion of the crude oil is called naphtha; the next, burning oil or paraffin oil; and the next lubricating oil. The crude oil may be distilled by a continuous process by using the Henderson patent continuous distillation boilers. There is a great advantage in using these boilers, because, in the first place, there is a saving of fuel, in the second place, a saving of manual labour, and, in the third place a better quality of product, and less loss.

The old system of working was by coking stills. The oil was run into each one separately, and the fire kindled. When the oil was distilled to dryness, the fire was drawn, and the still allowed to cool down. After it was cold, the men had to go inside it, and pick out the hard coke, which was a very difficult job. In this way the loss of heat in heating up and cooling down of each still separately was waste of fuel and manual labour—something great. All this is done away with in the Henderson system of working. The crude oil is run into No. 1 boiler, Fig. 3, where it gets concentrated, giving off naphtha-gas, which is led into a worm-condenser, where it is condensed and run into a tank. The residue of No. 1 boiler is led by a T-tube into No. 2 boilers, where it is heated higher, and gives off a gas which is condensed into a liquid called green oil.

The residue of No. 2 boilers passes into coking stills, where it is distilled to dryness. The gas given off the residue stills is condensed into a liquid which is called green oil, and is mixed with the green oil given off No. 2 boilers. The naphtha given

Fig. 4.



off No. 1 boiler is impure, and has a yellow colour. To render it pure and free from colour, it has to be washed with oil of vitriol. This is done in large iron tanks lined with lead.

The oil of vitriol is run into the tank along with the naphtha and stirred for an hour or so, then allowed to settle until the naphtha is quite free from tar. The tar is run off the bottom of the tank, and a solution of washing soda or caustic soda is stirred up with the naphtha to neutralise the acid left in it. It is now allowed to settle until quite clear, and the solution run off the bottom of the tank. The naphtha treated in this way is quite colourless, with a slight smell, and is now ready for the market.

The green oil off No. 2 boilers and the residue stills is treated in a similar way as the naphtha with oil of vitriol, only it has to be kept warm to prevent it from turning solid. After it has been treated, the oil is distilled in a bench of boilers in the same way as the crude oil was distilled, No. 1 boiler giving off paraffin oil, No. 2 boilers giving off a heavy oil containing paraffin, and the residue stills giving off the same as No. 2 boilers. The paraffin oil is treated with oil of vitriol in the same way as the naphtha was treated, when it is now ready for the market. The heavy oil containing paraffin has to be cooled by freezing machines and filtered through cloths to separate the solid paraffin from the oil. There are machines fitted for this purpose so as to contain about sixty cloths at a time.

The oil, after it is cooled, is broken up with stirrers and pumped in through the pipe A, Fig. 4. The oil is expelled from B to C, leaving the solid paraffin behind. The oil is distilled in a residue still to dryness to obtain a lubricating oil, which is washed with oil of vitriol and caustic soda to extract impurities, and is now ready for the market. The solid paraffin is treated with naphtha, cooled and pressed by hydraulic presses to squeeze the naphtha, which contains all the colouring matter, out of the paraffin. The paraffin is steamed to extract all traces of naphtha, so as to make it safe when burning in lamps or as a candle.

Broxburn. **Thomas Clarkson.**

THE ORIGIN OF ROCK OIL.

[30235.]—In your interesting article, July 26th, the rival theories on this subject are described, including that which I long ago expounded, and reprinted in "Science in Short Chapters,"—viz., that it is simply due to the distillation of coal which has been converted from the bituminous form to that of anthracite by such distillation; a process and result corresponding to that carried out by myself and others in Flintshire a quarter of a century ago. We did it by putting the coal and shale into iron retorts and heating them, collecting the liquid and solid paraffin products in condensers, and allowing the gaseous hydrocarbons to escape.

My contention is that nature *must* have done the like wherever ordinary or cannel coal, or bituminous shale has been subjected to the action of the internal heat of the earth, an action which it cannot have escaped when buried to a sufficient depth by superimposed deposits. Our artificial liquid, solid, and gaseous hydrocarbons differed only from the natural oils and gases in the necessary consequences of more rapid distillation, and our coke only differed from natural anthracite in its porosity, due to the absence of pressure.

The objection stated in the article above named is the only one of any weight, and is easily answered. This objection is that the oil is found in older and lower strata than that in which the coal occurs. A little reflection will show that this is exactly what the theory I advocate imperatively demands—that it strongly supports, instead of at all refuting, the theory.

The coal measures are porous rocks, and the millstone grit which underlies them is also porous, and there is such a force as gravitation. Put these two facts together, and it must follow that the oil, when formed, must have percolated downwards through the pores of these rocks, until it reached a compact or non-porous rock. If this non-porous rock dipped—as rocks usually do—it must have followed the dip until it reached an impervious stratum dipping in the contrary direction, or a non-porous fault. There it would accumulate.

The history of a petroleum spring thus corresponds exactly to that of a common water spring. Holywell, in Flintshire, the greatest spring in Britain, is a case in point. There we find millions of gallons of water pouring hourly from the mountain limestone, forming at once a respectable ewer, and doing much useful work. It is therefore necessary to suppose that this water was generated by or in the mountain limestone, or that the water is of the same geological age as the mountain limestone.

We know that the water which we find to-day is the rain that recently fell upon the porous rocks of the coal measures of Flintshire, and the millstone grit of the Hope Mountain and the other hills in the immediate neighbourhood, or on the soil which holds the roots of the trees that Mr. Gladstone cuts down in Hawarden Park, and that of the surrounding ground above, and on the south, east, and west of Holywell.

This rain falling on these high grounds sinks into the soil and into the porous rocks until it reaches the underlying mountain limestone, which generally dips towards the Dee. At Holywell is a fault which throws up the mountain limestone as an impervious wall forming a dyke or barrier that bars the further flow of the subterranean stream, which is thus forced to the surface. Such is the history of tens of thousands of other great underground streams, and such *must* have been the history of underground streams of oil that must be formed wherever coal or bituminous shale has been subjected to the action of the heat of the earth reaching to 300° Fahr. and upwards.

The oil thus accumulated may either pour out of the surface of the earth, as at Baku, Trinidad, and other places, or may be in cavities, or in the pores of the lowest of the porous rocks through which it has flowed until reaching the impermeable barrier. The latter is, of course, more likely to occur in the case of the oil than in that of water, seeing that the oil is generated at great depths, while the water is originally a purely superficial deposit.

W. Mattieu Williams.

The Grange, Neasden, N.W., Aug. 2.

A GOOD RUN ON THE CALEDONIAN RAILWAY.

[30236.]—I send you an account of a good run I lately had upon the Caledonian between Carlisle and Edinburgh. Though it is not quite so good as some runs of last year's race, I think (and I hope that you may think so too) that it is worthy of record. It was the 10 a.m. express to Edinburgh. The running to Carlisle was not remarkable.

Mls.	Chs.	Stations.	Time.	Remarks.
—	—	Carlisle ....leave	4 40	10 minutes late
8	46	Gretna .... pass	4 50	
16	57	Kirtlebridge ,,	4 58	
25	63	Lockerbie .. ,,	5 7	
39	58	Beattock .. ,,	5 20½	10 miles incline
49	59	Summit .... ,,	5 35	[1 in 60
73	14	Strawfrank Junc.	5 58	Slow to 15 miles
90	32	Micalder	6 16½	[per hour
100	48	Edinburgh.. arr.	6 28	2m. before time

Engine No. 124 (new 1886). Train consisted of five coaches and luggage van. **J. W. S.**

COLOURED FIRES.

[30237.]—I notice in your valuable journal an article copied from *Suad Apothek Ztg.*, respecting coloured fires, and as these articles appear to crop up from over the water every year in a mysterious way with astonishing formulæ, may I be permitted to point out that these formulæ have not one single feature to commend them, unless it is excessive cost of production of worthless and dangerous compounds?

The formulæ in question are not coloured fires within the meaning of the term as understood by pyrotechnists; are, in fact, flash lights or chlorate explosive mixtures, and will not burn as a coloured fire.

Sulfonal is unsafe in a chlorate mixture, unstable even in the hands of an expert in explosives, and is in no way superior to shellac with or without a small percentage of pure sulphur. The same will also apply to the picrates.

I suppose that the writer of this article is aware of the violent action of sulfonal and potassium chlorate when fired by means of a detonator. This formulæ for the so-called white fire is really little better in active power than that of the old friend of our youth, Chertier's white fire. Even if you could obtain a steady flame from equal parts of sulfonal and potassium chlorate (which I deny), the cost of production and risk of storing the compounds is strongly against its use. For instance, take the lilac fire with lithium carbonate and sulfonal, the lithium salt is worth about 1s. per oz. retail, and is in no way superior to pure precipitated strontium carbonate, at nearly the same price per pound. The cost of the lithium, added to that of the sulfonal at 3s. per oz., makes this costly, and the latter can easily be replaced with shellac without destroying the brilliancy or colour of the flame. Again, the term "violet fire" is a misnomer, as it has been found impossible to produce a violet Bengal fire either open (as a pan fire) or in cases. It has been done with lances of small calibre; but the effect is very poor, and is never, or rarely, used by the professional pyrotechnist, so that I will leave our readers to judge what the effect would be in the wide bore of a Bengal case.

Again, the violet fire in question containing magnesium is wrong both in theory and practice, the composition in question only producing an explosive flash.

The great active power of the magnesium flame is against one being able to produce any striking or deep colour, and violet is about the last colour one would expect to succeed with. A violet flame is characterised by a very low illuminating power, and the action of the magnesium when in combination with a violet composition is simply to either destroy it, or so to neutralise the violet tinge as to be imperceptible at a short distance.

It is quite possible to tinge magnesium in combustion with a slight green tint by aid of barium chlorate, or pale red or rose by means of strontium carbonate, nitrate, or oxalate; but in both cases the colour effect is weak (decidedly sickly), and detracts rather than adds to the beauty of magnesium fire.

With respect to the low illuminating power of the violet light, let any of the readers of "Ours" kindly notice the effect of the violet lamp or tail light used on some of the engines on our lines to convince them that the term "violet fire" is a delusion, useless amidst the brilliant works of pyrotechny. **Wm. Henry Browne,**

Analytical and Consulting Chemist for Explosives.

Wentworth House, Aldbrough, Hull, July 30.

EIFFEL TOWER.

[30238.]—If "F.R.A.S." and others who persist in adhering to the theoretical measurements would have the candour to withhold their private opinions till they could furnish some demonstrable data for their statements, they would be doing themselves and their subject more justice than by yielding to prejudice, as they do. I am perfectly ready to reimburse them all reasonable expenses if they can succeed in demonstrating the fact that no object can be seen beyond the limits prescribed by the published tables. I shall, of course, expect them to submit to the same conditions if they fail. But the evidence against them is most overwhelming and conclusive. I have before me an extract from a passenger on board the *Iberia*, one of the Royal mail steamers, Orient line, in which he fully confirms what I said about the distances on the Mediterranean. I quote his words:—"Our rate of sailing was 324 miles in the 24 hours. At 12 midnight we were alongside the lighthouse at Port Said, it having become visible at 7.30, when we were about 90 miles distant. It is an ordinary tower, about 60ft. high, and lit by electricity." Another correspondent writes:—"I am able to affirm that fishermen in the North Sea, lying off Lowestoft and the Yarmouth Roads, can clearly see the Granville Hotel tower light at St. Lawrence-on-Sea, a distance of 80 miles. The light is, perhaps, about 200ft. or 300ft. above the sea level." These are the only two I will venture to quote. But they were from those who, I think, would be fully prepared to prove that they have rather understated instead of exaggerated their accounts. Of course, under unfavourable conditions, the objects would not be seen for a tenth part of the distances specified. It is folly and worse than folly for men to allow their prejudices to warp their candour, and to persist in a theory of measurements which no experiment would justify or confirm. The view of an horizon, from right to left, of 50 or 100 miles in extent, ought to convince any reasonable person that in every direction the shape of the surface must be the same. It is very strange that in a practical age like the present men can be found to persist in contradicting facts which are as easily provable as the width of a gravel walk. Do my opponents call it science to make statements they cannot venture to establish? We are making a great display of our navy. Is it not time that our nautical tables should be as accurate as possible?

John Hampden.

The Northern Lighthouse Board have adopted Priestman's oil engines for blowing fog signals in preference to steam or gas-engines.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[68648.]—**Setting up Watch and Clock Springs.**—Setting up spring depends upon what kind of a watch you are doing. If it is a verge, I generally set them up about three-quarter turns, if geneva quarter, and a lever watch half turn. As for clock, English timepeices according to spring on the barrel. If you put a new line to a clock, it wants more setting up than an old line.

Hednesford. W. Carrington.

[68683.]—**Enamel Paint.**—Some samples I had to examine lately consisted largely of resin dissolved in common petroleum spirit, with the addition of the colouring matter. Photus.

[68813.]—**Dog-Cart Brake.**—Any brake on a dog-cart does more harm than good; for if applied when going down hill it puts more pressure on the horse's back when less pressure is requisite.

Thornfield.

[68868.]—**Immersion Objective.**—The substitution of oil of cedar wood for water with a Seibert's $\frac{1}{18}$ water-immersion would be detrimental to the performance of the lens. A lens has to be specially constructed for oil-immersion. In America some lenses were made which were alleged to be suitable for either water, glycerine, or oil, the screw collar being placed at a certain point in each case. In practice, however, the lenses only performed really well with one immersion medium. The aperture of Seibert's water-immersion $\frac{1}{18}$ varies between 1·05 and 1·1 N.A. Unless the fronts of oil-immersion lenses are very carefully fixed in their settings the oil will creep in through to the back and spoil the performance of the lens. It is, moreover, a troublesome business to clean it out.

E. M. Nelson.

[68870.]—**Slide-Rest on Gap-bed Lathe.**—If F. Allen will send me sketch of section of his bed with lower slide of rest, giving thickness of top of bed and bottom of slide, and the width between the "shears," I will send full-sized or scale drawings of an arrangement which I think will suit. Please write me direct if possible, as I am shortly leaving this town. A. F. Shakespear.

Lüttichaustrasse 14, Dresden.

[68903.]—**Pigs in Clover.**—It is amusing to read the so-called "replies" to this query, especially one on p. 396. You are to "so manipulate the board" as to get all the marbles into the innermost pen. Just so; but the adviser does not say how that is done. Well, it is simply this. Just fix the box on a lapidary's table, and spin that round rapidly; the pigs will then find their way "into clover." It seems to me ridiculous for anyone to occupy space by merely telling us what is stated on the "box." I presume we can all read that.

S. T. G.

[68951.]—**Freezing Machines.**—The querist need not look any further than his back volumes to find all the freezing machines he will care to take on. As to ammonia, ether, and similar machines, the querist had better find out how to make machinery to keep the vapours in, for no one has yet succeeded, and, *pace* the article on p. 472, I do not believe anyone will succeed in keeping the vapours in altogether. The Fleuss freezing machine (see p. 453, No. 1,164) is about as simple and as efficient a machine as can be found, and it is not unlikely that it is the very machine mentioned.

Nun. Dor.

[68959.]—**Early Engines.**—Trevithick invented the blast-pipe and used it somewhere about 1804, so it is no use talking about 1825. In the early years of the century inventors did not think so much of being able to say, "I invented so-and-so"; but there cannot be much doubt that "Capt. Dick" was one of the first to use the blast-pipe, as it is now called. There is a good deal of information on the subject in back volumes. N. D.

[68964.]—**No Water.**—This query is a purely personal matter—of no interest to anyone but the querist and those in similar circumstances. He should, failing other advice, apply to the Local Government Board, who will quickly make his local board "sit up" if they have done anything wrong. It is a pity that more people do not write to headquarters, instead of sending effusions to the local papers. The Government officials are real live entities; but if they are never applied to, it is not their fault if things go wrong. Write, then, to headquarters, and write again if you get no satisfaction. Nun. Dor.

[68965.]—**Phonograph.**—The indenting needle is a simple piece of steel ribbon attached to a disc of mica or glass. If "J. C." wants more information than that, I would suggest that he procures the specification of the patent, or obtains a look at the instrument itself. I do not understand what he means by "the spring." There is not a spring, except he calls the mica or glass disc a spring.

S. R.

[68966.]—**Edinburgh University.**—Seeing that all particulars can be obtained by looking in the *Calendar* of the University, it seems a waste of space to ask questions about the rules in these columns. R. T.

[68969.]—**Westinghouse.**—The company will give all needful particulars as to the repairing of any part of the Westinghouse brake apparatus.

T.

[68973.]—**Indiarubber.**—The rubber must be masticated and mixed with bisulphide of carbon, then moulded into the form required. C.

[68980.]—**Speed of Bicycles.**—As the bicycles could not run without someone on them, obviously their relative speed will depend on the rider. The "friction on the centre of 58in. being greater because of its distance from the ground," is simple nonsense. The friction depends on the weight carried. Biker.

[68981.]—**Watering Bowling Greens.**—Decidedly, water them, and water thoroughly. When not in use, a fine pronged fork should be driven in here and there to loosen the soil and encourage the development of roots, so as to produce a springy piece of turf. C. K. L.

[68984.]—**Parallel Motion.**—I don't see how it is possible for the Editor to find room for a continual repetition of sketches every time some inquirer wants information. "Amateur" can find a diagram in almost any textbook on the steam-engine, and certainly also in several back volumes. Besides, for a model, what can it matter so long as the beam and motion are of such a size as not to offend the eye? A. H.

[69055.]—**Blue Salt.**—To "Young Analyst" and "Principia."—I do not know of any metal which will dissolve in these substances, excepting, of course, zinc (and perhaps one or two other readily oxidisable metals), which is soluble in potassium hydrate solution with evolution of hydrogen. Metallic copper will apparently dissolve in NH_4HO, owing to a trace of oxide on its surface. Perhaps you have mistaken a metallic acid (tungstic or titanic) for the metal? Principia.

[69056.]—**Black Needles.**—The metal is probably an oxide or other compound of platinum or gold. I do not know whether mercury reduces the other precious metals—i.e., palladium, rhodium, ruthenium, osmium, and iridium. Being nobler metals than mercury, I should think they would be reduced. Silver is reduced in the form of grey needles. Principia.

[69057.]—**Lavender Bead.**—To Col. Ross.—I am very glad you have noticed my query. I have lately purchased your book, "The Blowpipe," in the hope of proving the substance, which I cannot determine in the wet way. I do not find lavender beads mentioned in this work. You will see, by my answer to "Young Analyst," the bead is formed by the black needles mentioned (69056). These needles form a white opaline bead with boric acid. True Blue.

[69085.]—**Electric Alarm Clock.**—Thanks to Messrs. Mason and Bottone for assistance. Have forwarded address to column. I have made the simple contrivance described last week, but, of course, cannot shut the glass cover of face; apart from that, it works very well.

British Mechanic.

[69103.]—**Water-Gas.**—Water-gas is made by passing steam through a column of red-hot coke or anthracite. It consists of a mixture of hydrogen and carbonic oxide gases, and is produced by the new patent water-gas apparatus of the British Water-Gas Syndicate, Limited, Leeds. A small gas plant, consisting of generator, scrubber, and gas-holder, can be put up that is suitable for the requirements of one or more houses, the existing pipes and fittings being used. As the purified gas has no smell, a pungent odour is given to it, so that the least escape may be easily detected without using a light. A Fahnehjelm magnesia comb, mounted on an ordinary Bray burner, is all the special fitting needed for its use for lighting purposes.

Bocking, Braintree. F. H. Blomfield.

[69117.]—**Rats.**—Oil of rhodium is used to attract rats to traps. It can be obtained from most chemists, costing about 6s. to 8s. an ounce. Only a few drops will be required on the bait. The oil is the essential oil obtained from Convolvulus scoparia.

Bocking, Braintree. F. H. Blomfield.

[69117.]—**Rats.**—In answer to "Principia," oil of rhodium (oleum rhodii) is said to be derived from the wood of a species of rhodoriza. It is pale yellow when quite fresh, bitter, and aromatic, with a very agreeable odour of roses, and is often used as a substitute for otto of roses in cheap perfumery and to adulterate it. A bitter taste in the latter shows that it contains either oil of rhodium or a

of sandal-wood. I can obtain the oil of rhodium here in Liverpool at eighteen-pence the drachm. This is retail price: I never bought any wholesale.
A. E. B. M.

[69124.]—**Pendulum.**—The number of seconds in the sidereal year is 31,558,152, and in the ordinary year 31,557,929.

$$\therefore \text{sidereal second} = \frac{31{,}558{,}152}{31{,}557{,}929} \text{ seconds,}$$

hence sidereal second's pendulum

$$= \frac{31{,}558{,}182}{31{,}557{,}929} \times \frac{\sqrt{(32{\cdot}19)}}{3{\cdot}141}$$

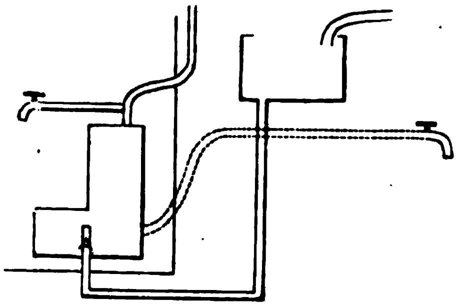
In Lee's "Acoustics: Light and Heat," the linear expansion of iron is given as ·0000118, of steel ·0000124, and zinc ·0000294.
C. H. R.

[69128.]—**Odour of Decomposition.**—Try valerianic acid.
Principia.

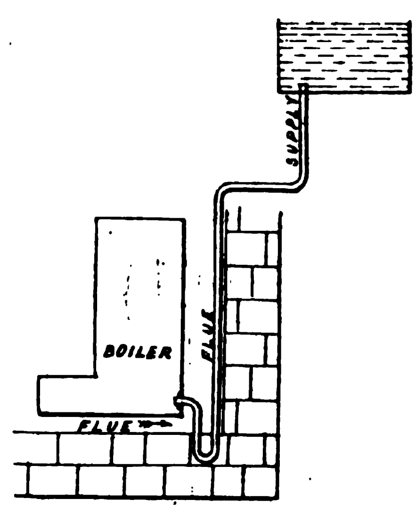
[69129.]—**Geneva Watch Repairs.**—"Young Watchmaker" wishes to know how to put new holes in plates. I should advise him to get Saunier's "Watchmaker's Handbook"; it is 12s., and may be obtained at A. Fisher, 11, St. Bride-street, London, E.C. It will give him hints how to put new teeth in wheel, and also how to do hard and soft soldering. The best material for cleaning watches is, I should say, burnt bone. As for clock, I should use rottenstone and oil, and polish with chalk and brush. Any further question he wishes to ask I will answer.
W. Carrington (Practical Watchmaker).
Hednesford, Staffs.

[69135.]—**Cold Tank.**—To prevent the water becoming heated you had better fit a small non-return valve in the lower part of boiler feed-pipe. Another way is to carry your supply-pipe down below bottom of boiler some 6ft. and up again to boiler in the form of a siphon.
F. W. Cannon.

[69135.]—**Cold Tank.**—Reverse the pipes as in the above drawing, taking away the short piece of pipe at A; the water then will be always cold in the tank.
Arthur Hart.



[69135.]—**Cold Tank.**—"Croft" can soon overcome his difficulty by altering his supply pipe (which is now, according to sketch, almost a flow, and converts his cold tank into an accumulator) by putting in a siphon (nearer the boiler the better) as per sketch.
British Mechanic.



[69137.]—**Zeiss's Apochromatic Quarter.**—There can only be two solutions to this question:—(1) the lens has been injured, or (2) it is not used properly. It is impossible for me to say which is at fault. Of course, a lens of ·95 N.A. must resolve more than one of ·86 N.A. unless it has been injured. I have seen a good number of apochromatic $\frac{1}{4}$'s and $\frac{1}{8}$'s, and must say that the worst apochromatic I have seen excels the best old dry achromatic I ever saw; and it must be remembered that, although Zeiss's D D were good lenses, they were by no means at the top of the list. With regard to the compensating eyepieces, in my opinion they greatly improve the definition with old achromatics, and with the apochromatics they are indispensable. In using the apochromatic $\frac{1}{4}$, great care should be exercised to have the tube of the microscope 9·8in. long.
Edward M. Nelson.

[69138.]—**Series v. Shunt.**—In a series dynamo any increase in the ext. R. will diminish the E.M.F. as the current flowing round F.M.'s is proportionately reduced. With a shunt machine an increase in the ext. R. shunts more current round F.M.'s, and therefore increases the E.M.F. Compound machines have both shunt and series coils. There are two varieties, the long-shunt and the short-shunt compound. In the former, the shunt F.M. coil forms a shunt to both armature and series F.M. coil, or, in other words, is connected to the terminals of the ext. circuit. In the latter, the shunt F.M. coil forms a shunt to armature alone—i.e., is connected to the armature terminals. With compound machines a constant P.D. (potential difference) is maintained at the terminals, even though the ext. R. vary considerably. Series machines, if short-circuited, burn up, unless provided with a safety fuse. They cannot be used for sec. batt. charging or for electrolysis on account of their liability to reverse under such conditions. For instance, in charging a sec. batt., if, from any cause, such as a momentary slackening of the engine, the battery E.M.F. overcomes the charging E.M.F., the polarity of the machine is immediately reversed, with clearly most disastrous consequences to both itself and battery. Of course, the use of an automatic cut-out would remedy matters, but not sufficiently to allow of any preference for the use of a series machine. If used for parallel lighting the E.M.F. would rise considerably if additional lamps were switched on. Clearly, therefore, a series machine can only be used in cases when the ext. R. is constant, or for arc lighting, in which slight changes in E.M.F. make no difference. A shunt machine may be short-circuited with impunity; does not reverse, and is therefore adapted for sec. batt. working and for electrolysis. For parallel lighting on a small scale, when the total number of lamps lighted does not vary considerably, a shunt machine may be used; but when the lighting is on a fairly large scale and the number of lamps in circuit constantly altering, a compound machine is a sine quâ non. Your supposition that a series machine is any cheaper or easier to work is obviously incorrect. The extra structural expense incurred in laminating F.M. would not be warranted by any great increase in efficiency. Certainly for a given output a laminated dynamo would be lighter, as one could use the best Swedish iron; but lightness is not one of the most important considerations involved. Ordinarily, dynamos are not carried about much. Just as we speak of an electric circuit, and of the resistance which that circuit offers to the flow of a current, so can we talk about the magnetic circuit of a magnet (i.e., the path through the substance of the magnet itself from the N. to the S. pole, and back again outside from the S. to the N. pole) and the magnetic resistance which that circuit offers to the flow of magnetic lines of force. In designing a dynamo, one of the primary considerations is the magnetising force in ampère turns. With a given number of turns of wire (w), and a given strength of current (c) we get a certain number of ampère turns ($w \times c$), giving rise to a definite number of lines of force. If the wire is wound on a long, thin core, many of these lines of force are, so to speak, "choked," and there are a lesser number available for the magnetisation of the armature than would have been the case if the cores had offered less magnetic resistance. Edison's first machines with long thin cores and absurdly thin yokes are good examples of bad designing. In the Edison-Hopkinson machine these defects are remedied. Edison's "steam" dynamo (*sic.*) *vide* Thompson's "Elec. and Mag.," p. 384, is another example, several long thin cores being used when one thick one would have been a great deal better. *Vide* also "E. M.," Aug. 2nd, query 69191, for yet another ludicrous example. Continuous current machines may be divided into two classes: single-magnet machines and double-magnet machines. In the former, salient magnetic poles are used. Examples: the Edison Castle, Excelsior, and most new types. In the latter class, consequent poles are used, as in the Siemens, Gramme, and Crompton machines. "J. T. F." is very much at sea when he asserts that "every dynamo that has been constructed invariably has more than two field-magnets."
W. Perren Maycock, A.I.E.E.

[69139.]—**Chromic-Acid Battery.**—If "F.G." will just draw a simple diagram and give a little thought to the matter, he will soon see how ludicrous his proposition is. The terminal plates or electrodes will combine to give him the effect of a single cell, while the intermediate pairs will fizz away on short circuit until either every scrap of zinc is dissolved or the solution neutralised.
W. Perren Maycock.

[69143.]—**Polishing in Lathe.**—Professional turners generally use olive oil for polishing, applied with a rag.
F. W. Cannon.

[69151.]—**Incandescent Lamp (Edison's).**—I would advise "F.R.Met.Soc.," in measuring the R. of a glow-lamp on the Wheatstone bridge, not to use a battery of more than, say two cells at most. In testing 50v. lamps with a six-cell Leclanché, I have found it impossible to obtain a balance, the resistance of the lamp gradually falling as the filament heated.
W. Perren Maycock.

[69152.]—**Electric Light.**—With 30lb. boiler pressure, and running your engine at 350 revolutions per minute, you would get nearly $\frac{1}{4}$H.P. This is amply sufficient to light five or six 16c.p. lamps. Boiler should be about 14in. diameter, of the vertical tubular type, about 3ft. 3in. high. Approximate cost of a new boiler, best make, complete with all mountings, £14. A good dynamo for the work would cost, say, £6, and the lamps about 25s.
J. Ball.

[69154.]—**Photographic.**—You had better distil some of the water and try again. If you find the paper still bad to wash, try some other brand. The permanence of photos depends upon their being well and thoroughly washed. You can take instantaneous photos with a single combination, but the results will be rather indifferent.
F. W. Cannon.

[69159.]—**Model Engine.**—Flywheel is about right, but boiler too small. Engine would give the power you name. I have seen such an engine driving a dynamo, lighting a 5c.p. lamp, but of course only as a hobby.
Bristol. T. C.

[69160.]—**Jewelry.** — What a cruel thing for "Three Legs" to solder a 9-carat catch on a fine (?) gold brooch with silver solder! As to restore the colour, he can now only gild it, and it will then look about as well as a brass one. Does he not know that neither silver solder nor 9-carat gold will colour in the sense of colouring as known in the trade? Gold solder may be made by taking seven parts of the gold you are making up and one part of a mixture of silver and copper, melted together, so that 18-carat gold is soldered with 15-carat, and 15-carat with 12-carat, &c.
E. Parr.

[69162.]—**Engine Query.**—A single cylinder, 2in. by 4in., will do what you want. Boiler, 24in. high by 15in. diam., and firebox 12in. by 12in. Copper $\frac{1}{16}$in. thick, and get the rivets where you get the copper.
Bristol. T. C.

[69164.]—**Damp Cellar.**—You must ventilate it well both under and over the floor-boards; you can also assist the drying by placing some dry lime in pans about the place and under the floor, changing it at intervals when the lime has absorbed all the moisture it will take up.
F. W. Cannon.

[69167.] — **Insulation Resistance.** — This is indeed a very low insulation resistance, and as it seems possible that there are damp contacts around the circuit, electrolysis would most certainly occur at these points if a continuous-current machine were used.
W. Perren Maycock.

[69174.]—**Cocaine.**—You had better go to a chemist and ask him to make you a solution of cocaine for "mal de mer." You might easily make a mistake in doing it yourself, and it is dangerous in large doses. I suppose you know that either the alkaloid or hydrochlorate is very expensive. I have found Burroughs & Welcome's tabloids of antipyrin (5 grains) more efficacious, but persons with weak hearts must take small doses of either.
Vooght.

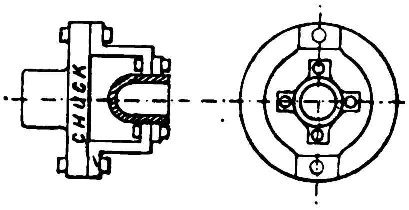
[69176.]—**δ Cygni.**—Mr. Tarrant, F.R.A.S., in No. 2,866 of the *Astronomische Nachrichten* gives the following measures of δ Cygni:—

Epoch.	Position Angle.	Distance.
1885.. 498	318·27	1·58″
1885.. 544	317·32	1·74
1885.. 521	317·99	1·66 Mean.
Englemann's Measures are :—		
1885.. 90	319·0	1·84″

Probably the distance is slowly increasing.
W. R. Waugh.

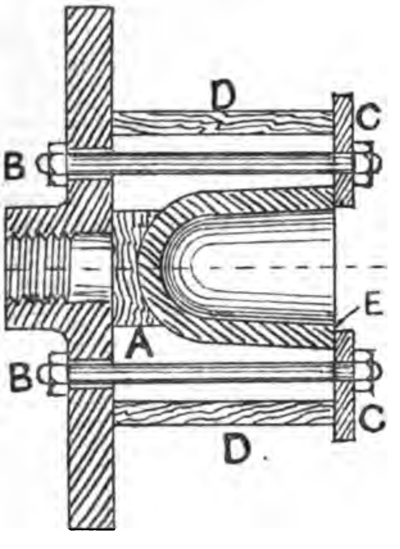
[69177.]—**Turning.**—You can bore the cast-iron pieces by driving them into a wood chuck, and turn the outside by driving them on to a peg mandrel fixed in your dog or bell chuck, and keep them steady by entering your back centre into the outside end of cone.
F. W. Cannon.

[69177.]—**Turning.**—In objects such as "La France" describes, it is as well to consider before they are cast how they are to be bored out, because provision can often be made in the shape of lugs,



&c., which are of great use in that operation. I should make provision for the articles he describes in the manner shown by the sketch herewith. The lugs can easily be dressed off after the article is removed from the chuck. Langdon.

[69177.]—**Turning.**—The figure shows how you may bore your castings. A is a block of wood laid against the chuck, and hollowed to take the round end of the casting. B B are bolts, three or four in number, passing through the face-plate, and clamping the casting fast against the block of wood. C C are washer-plates of iron, which take the pull of the bolts, and D D are blocks of wood that keep the washers level, and form a fulcrum for the pressure of the bolts. If the bearing surfaces are sufficiently broad and numerous, and the bolts stiff enough, the casting so held cannot be moved by the stress of turning. By method of trial and error, it is easy to adjust and centre the casting until it runs perfectly true. The faces E of the casting cannot be turned while the pieces C C block the way. To turn these faces the pieces C must be removed, after boring the interior, and the mouth be then bridged with a bar of iron, a centre made in it, and the casting run between the bearing afforded by the block A and the poppet-centre. If the outside has to be turned, that can be chucked easily by bringing the dogs of a jaw chuck to bear either against the outside or the inside of the end E, and centring the round end on the poppet. It would be better to turn the outside in the first place, because that would then afford a correct guide for the setting shown in the figure for boring the interior. If the interior were bored first, and the attempt made to chuck for turning the outside afterwards, the interior would have to be centred truly by fitting it over a block of wood turned to suit, because it would not be possible to see and adjust the running of the inside. This casting might also be chucked for boring by bolting an angle-plate on the face-plate and fastening the casting with bolts to the angle-plate, and adjusting its correct position with wood blocking. But this is not so efficient a method, nor so simple as that illustrated.—J. H.



[69178.]—**Compo.**—A mixture of pitch, shellac, and sulphur will fulfil the requirements. S. Bottone.

[69180.]—**Blowpipe Lamp.**—You will find a good spirit lamp fed with methylated spirits will give excellent results. S. Bottone.

[69180.]—**Blowpipe Lamp.**—The best substitute for a Bunsen burner where gas is not available is the so-called spirit blowpipe lamp. This lamp is constructed of japanned tin or brass, and consists of a reservoir for the methylated spirit, and a tube terminating in a funnel, which when filled with loose cotton wick constitutes the burner. These lamps are much used by dentists, watchmakers, and others who require a hot, steady, and smokeless flame for soldering purposes. They are, furthermore, easily obtained, and are fairly inexpensive. J. West.

[69182.] — **Flute.**—Your correspondent, Mr. Rowley, evidently plays a flute with unpadded foot-keys, and as such keys are seldom airtight, the lower C and C sharp are very difficult of production. The holes on the old cone-bore 8-keyed flute have to be placed where they can be stopped by the fingers, and the E and A holes are too high up to enable them to be of the correct diameter; if in tune, to keep the tuning nearly (not quite) correct, these holes are very small, and consequently the E and A are the weakest and feeblest notes on the instrument. The most improved form of flute is undoubtedly the cylinder bore with parabola head, with covered holes—i.e., every hole covered by means of a padded key. In flutes of this construction, and fingered in the modern style, every hole is in its absolutely correct position, and the instrument is perfect in tone, tune, and intonation. The Boehm fingering is the most commonly used, but is very difficult to learn after the old fingering, owing to the fact that to produce a higher note a hole below it has to be stopped—e.g., in playing F followed by F sharp to produce the F sharp instead of simply raising the next finger above that used to make F, the next finger has to be raised, and the E hole below it stopped, and so in other notes. The easiest flute to learn is undoubtedly the Carte '67 system: I learnt it in one month, and now, after six months' practice only, I can play better, faster, and more easily on it than I could on my old 8-keyed flute, which I had used for over 14 years. The special advantages of this model are—Extra D with all fingers off in two octaves; 3 fingerings for B flat, all perfectly in tune; 2 fingerings for F sharp and F natural, one of the F sharp fingerings being the veiled "Boehm" F sharp, and the other perfect by means of the F sharp key. When playing in sharp keys, the fingering of the two lower octaves is identical with that of the 8-keyed flute, so that there is little to learn besides flat keys. The action of the fingers is the same, no matter what key the music is in, whereas it is very difficult to play in certain keys on the "Boehm" flute, as the action of the fingers changes with the key. I should advise Mr. Rowley to go to A. Collard and Co., of 14, Old Bond-street, and get one of their ebonite '67 model cylinder flutes, and I am sure he will be fully satisfied as to quality and price, Mr. Collard being a well-known performer. The chief difficulties are the open G sharp key, which, now I am used to it, I would not be without, as it facilitates execution in the keys of A and E; and the open C key closed by the left thumb, instead of the closed C opened by the first finger of the right hand. In fact, on the '67 flute the key of E four sharps is the easiest key to play in, as the D sharp and G sharp keys look after themselves; and on the old 8-keyed flute the interval from G sharp to F sharp or E was always faulty, owing to the G sharp key closing before the fingers stopped the holes below it. If you will give Mr. Rowley my address, I shall be glad to give him any further information. I don't know a good book on flute construction. Carte and Rockstro have published works, I believe; but I have not seen them. T. E. Halford.

[69183.]—**Pearson's Orrery.**—"Orrery" will find a very complete description of Pearson's orrery in Rees' "Cyclopædia," under the article "Planetarium." Several most elaborate drawings are given in Vol. IV. plates. F. M. Chase.

[69185.]—**Repairing Incandescent Lamp.**—This is a very delicate job; but refer to pages 374 and 395, Vol. XLIV. for replies to a similar query. I think the Globe Co., in their catalogue, mention a holder something on the principle of a small vice, that meets this difficulty. M.M.I.Sc.S.

[69185.]—**Incandescent Lamp.**—With careful manipulation a fresh piece of wire may be silver-soldered on before the blowpipe.

W. Perren Maycock.

[69185.]—**Incandescent Lamp.**—It is just possible, with great care, to make a little loop of copper wire, shaped like a letter Q, adhere to the platinum wire ends which are broken flush with the glass. The way to do this is to get a friend to hold in readiness a freshly-tinned and hot soldering iron, with a drop of solder on it, while you gently heat the broken portion of the lamp over a spirit-lamp flame. As soon as you judge the glass is warm enough not to split on the application of the iron, let a bead of solder touch the broken ends of the platinum wire. Then, holding the tinned Q with a pair of wooden forceps, bring it into contact with the bead of solder, and remove the whole from the flame. S. Bottone.

[69185.]—**Incandescent Lamp.**—You will not be able to mend the terminal, as the heat generated by the strength of current required to light the lamp would be sufficient to soften the solder employed, and thus the joint would fail. A plan recommended by a skilled electrician, whose name I am not at liberty to mention, has, however, met with marked success. I detail it as he himself described the method to me. Take a file and carefully chip away a little of the glass round the broken end of wire. The lamp at its apex is tolerably thick, so that with a due amount of caution this operation may be successfully performed. Now screw a short piece of watch-spring on to the ebony lamp-holder, having the screwed end in connection with the terminal on the holder, and bending the free end so that it presses lightly yet steadily on the projecting end of wire. Thus you will find your lamp, to all intents and purposes, restored, in a simple yet thorough manner, to its former state of perfection and utility. J. West.

[69186.] — **Engine.** — If your engine is non-condensing, and not working expansively, it will give about 5½H.P. at 200 revolutions per minute. J. Ball.

[69186.]—**Engine.**—As usual, the most essential particulars are left out—viz., cut-off and speed. We are given, however, the useless particular of the flywheel, as if that helped. Suppose we guess at 4H.P.

Bristol. T. C.

[69188.] — **Condensing Exhaust Steam.** — You can use Holman's exhaust steam condenser. Write to Tangyes, or other makers, for particulars.

Bristol. T. C.

[69188.] — **Condensing Exhaust Steam.** — Perhaps the best aud cheapest way to dispose of the exhaust steam from pumping-engine is to connect exhaust steam pipe with pump tail pipe.

Methley. John Ripley.

[69189.]—**Mean Stroke.**—This is half the sum of the travel of top and bottom, or $\frac{12 + 1\frac{1}{4}}{2} = 6\frac{5}{8}$in. Yes, it would be correct to take area × above travel × 20, &c., as usual for power.

Bristol. T. C.

[69189.]—**Mean Stroke and Pressure.**—Since the stroke at any point varies with the distance of that point from centre of motion, the mean stroke must be that measured midway between boss and periphery. That will be at a distance from the centre $= \frac{20\cdot5}{2} + 3\frac{1}{2} = 13\cdot75$in. Since the length of working arc in your engine is exactly half the radius, mean stroke $= \frac{13\cdot75}{2} = 6\cdot875$in. Foot-pounds of work done in each stroke = piston area × steam pressure × mean stroke (in feet) $= 246 \times 20 \times \frac{6\cdot875}{12} = 2818\cdot75$. J. Ball.

[69190.]—**Lap and Lead.**—You do not require width of ports for this, because the valve must move the lap + lead (according to question), and if there were no lap on exhaust, that would be amount of opening of exhaust. The answer is $1\frac{1}{4} + \frac{1}{8} - \frac{1}{4} = 1\frac{1}{8}$in.

Bristol. T. C.

[69191.]—**Electric Motors.**—Wind the armature with 5oz. No. 20; put 4lb. No. 16 on the field magnets; couple up as a series machine. It will run very well with six or eight quart bichromate cells, coupled in series, when it will generate somewhat less than 1 man power, say ½ man power. If driven as a dynamo, the contrary way to which it runs as a motor, it will generate sufficient current to light 4 lamps of 6 to 8 volts each; but they must be coupled in parallel. The speed must not be less than 3,000 revs. per minute. S. Bottone.

[69192.] — **Deodorising Carbon.** — Pure naphthalene has a very decided smell. Albo-carbon is crude naphthaline. I don't think you will succeed in deodorising it any more than you could H_2S—that is, without destroying it. Principia.

[69192.]—**Deodorising Albo-Carbon.**—Albo-carbon is a definite chemical body, known to chemists as naphthaline. The smell is part and parcel of its nature, and cannot be removed without its ceasing to be naphthaline. A cheap, inodorous substance, which might suit your purpose, you would find, I think, in the common paraffin wax, which can be got wholesale at about 4d. a pound. S. Bottone.

[69193.] — **Chromic-Acid Cells.**—Killed spirit should never be used for connections, on account of its corrosive action; rosin is the best flux to use. The total E.M.F. of any battery is the sum of the E.M.F.'s of its constituent cells; but the available potential difference (P.D.) at the terminals is less than this; *vide* my reply 69053, p. 462. The difference between quart and pint cells is not so much in the "working power" as in the length of time the cells will run. W. Perren Maycock.

[69193.]—**Chromic-Acid Cells.**—In soldering, use killed spirits where the parts can afterwards be washed with water to prevent corrosion; where otherwise, rosin. The total E.M.F. of a battery is the sum of the electromotive forces due to each separate cell, whether they are of the same voltage or not. The amount of zinc consumed in each cell of any battery is the same when cells are connected in series. You may test the candle-power of your lamp by sticking some object, such as a walking-stick, vertically upwards a foot or so in front of a screen, and then adjusting your lamp and candle behind the stick till both of them cast equally dark shadows of the stick on the screen. Then measure the distance of the lamp and candle respectively from the screen. The intensities of the lamp and candle-light respectively are in direct proportion to the squares of their distances from the screen. Thus, suppose lamp to be 5ft. from screen, while candle is 2ft., then the relative intensities will be as 4 to 25; that is, the lamp is giving out 6¼ times as much light as the candle. With regard to the power your batteries will yield with a suitable motor, if you know the current your cells give, and their E.M.F., you can find the power by means of the rule—

$$\frac{\text{volts} \times \text{ampères}}{746} = \text{horse-power}.$$

You had better at once diminish your result by 50 per cent., to allow for inefficiency of motor. I presume your "self-acting switch" would require to lift the plates from the spent solution, and lower them or others into the reserve cells. To do this electrically would need a rather complicated arrangement; but I should think you might devise some clockwork to shift the plates after so many hours' work. J. Ball.

[69193.]—**Chromic-Acid Cells, &c.**—My articles on "Electro-Motors" will be found in Nos. 1236, 1238, 1242, 1246, 1251, 1257, 1262, 1269, and are still continuing. Unless the places joined can be washed in plenty of water, the use of killed spirits is to be avoided, since, being deliquescent, it absorbs moisture from the air, and soon corrodes the joined wire, &c. Rosin—or, better still, a sperm candle—will make a nice clean joint. If a number of cells of different voltages be joined together in series, then the voltage of the combination will be the sum of the voltages of the component cells; so that if you had six cells giving each two volts, and six cells giving each 1·5 volt, coupled in series, the total voltage would be 21 volts; but the total current would be limited by the conductivity of the cell of highest resistance, and as it is really current that one works with, and not voltage, it is absurd to couple up a cell of low resistance like the chromic-acid cell along with a cell of high resistance like the Leclanché. The best way to test the power of an incandescent lamp has yet to be found. A rough-and-ready way is to set up a stick a foot or so in front of a white screen, and place the lamp to be tried and a standard candle in front of the stick—one a little to the right, and the other a little to the left. Each light casts a shadow of the stick, and by moving the candle nearer or further from the stick till the intensity of shadows is equal, a fairly accurate approximation of the power of the lamp can be obtained. It must be borne in mind that the power of the light is as the square of the distance which either light has to be moved to produce equality of shadow. With a very perfect motor, three pint chromic-acid cells might give a maximum of ¼ man-power. Three quart cells might give ⅓ man-power under the same conditions. It would be possible to make an arrangement by means of which one set of cells could be raised from, and another set depressed into, their respective cells by balancing the two sets of cells on opposite extremities of a poised rod. The "reserve" set should be made somewhat heavier than the "starting set." The current should be made to pass round an electro-magnet, with an armature so regulated by a spring as to keep up the poised rod so long as sufficient current were flowing; but that it should allow the armature to fall off, and consequently let the "reserve" set fall into their cells as soon as the current fell short of a given amount.

S. Bottone.

[69194.]—**Electro-Motors.**—If you have wound the F.M. in the same manner as electric bell magnets are wound, and have coupled up so as to get a N. and a S. pole, you have got the magnets right. But the cause of failure may be—(1) leakage, through defective insulation; (2) commutator slit in wrong position as regards brushes. When the iron cheeks of the armature are facing the cheeks of the electro-magnets, the brushes should be resting on the slits of the commutators.

S. Bottone.

[69197.]—**Magnet.**—No. 16 B.W.G. nearly corresponds to No. 14 A.W.G. No. 14 A.W.G. = ·0641in. diameter; No. 16 B.W.G. = ·065in. diameter. Phos.

[69197.]—**Magnet: American Wire Gauge.**—I gave a full table of wire gauges on p. 377, No. 1,266, of the "E. M.," in which you will see that No. 14 A.W.G. corresponds as nearly as possible to No. 16 B.W.G. S. Bottone.

[69198.]—**Dry Battery.**—Principally plaster of Paris, along with a little oxide of zinc and chloride of zinc. The chemical formulæ of these bodies are:—$CaSO_4$ plaster of Paris, ZnO zinc oxide, $ZnCl_2$ zinc chloride. S. Bottone.

[69199.]—**Engine.**—Ports should be ¼in. area, or, say, 2in. by ⅛in. barely, and put full 3/16in. lap on the valve. Tubes of boiler are bad; put in straight tubes, and merely a thin tube, with a funnel-shaped top inside—the funnel being an inch above top of tubes, it merely acts as a guide for the descending water. The 4½in. pipe is intended to prevent burning the flue, and need only go halfway down from top of boiler to crown of furnace.

Bristol. T. C.

[69200.]—**Observatory.**—The plan adopted by the late Edward Troughton may possibly meet the requirements of "G. G. B." A description of this is given in Simms's work on the "Astronomical Telescope," p. 64. E. D.

[69202.]—**Ozonised Water for Mouth Wash.**—This is probably a solution of hydrogen peroxide or di-hydroxyl (H_2O_2). Principia.

[69202.]—**Ozonised Water for Mouth Wash.**—Generally a dilute solution of potassium permanganate, sometimes dilute solution of hydrogen peroxide. Before "Pills" goes into public life, I should strongly advise him to read "Beasley's Formulary." S. Bottone.

[69203.]—**Secondary Battery.**—The surface, and not the weight of the lead, decides the output. Every foot of positive surface is equal to six ampère hours. The reason why thick leads are used in commercial batteries, is because they are honeycombed to retain plenty of lead oxide paste.

S. Bottone.

[69204.]—**Vulcanite Polishing.**—Use a buff covered with buff leather, and apply rottenstone with free use of the biceps.

Edinburgh. Fabricant d'Armes.

[69205.]—**Electric-Light Battery.**—Provided the porous cells are really fairly porous, so as not to present an extraordinary resistance, you will find four cells ample. It will be well to use double the number of cells, and connect the lamps in series, if two lamps are used. S. Bottone.

[69207.]—**Balance.**—Procure Thornton's "First Lessons in Bookkeeping," Macmillan and Co.; also "Every Man his own Accountant," Simpkin and Marshall. With these all difficulties will disappear.

S. Bottone.

[69208.]—**Stained Glass.**—I have not seen the windows to which you refer, but I don't believe the statement. If white light passes through the glass unaltered, how is it that it produces in the eye a *coloured impression?* J. Ball.

[69209.]—**Barometer.**—In all probability air has entered the tube either from some sudden blow or similar cause. The only method is to empty the tube and refill, taking care not to lose any of the mercury, and replacing it drop by drop, shaking down to the bottom so as to expel the air. It is quite possible to put it right without applying to an optician. C. H. B.

[69213.]—**Ginger-Beer.**—The percentage of alcohol depends entirely on the amount of sugar used—that is, if the liquor is fermented at all. It may vary from 1 to 7 per cent.; the first is most usual. The unfermented kinds (the aërated) contain no alcohol. The ginger-beer plant is a true fungus of the yeast family, known to botanists as Mycoderma saccharomyces. The resulting ginger-beer is perfectly wholesome. Its flavour is somewhat like koumiss or sour milk, and it does not appear to contain much alcohol. S. Bottone.

[69213.]—**Ginger-Beer.**—The amount of alcohol in ginger-beer will depend upon the amount of sugar which has undergone fermentation. The simplest way to ascertain its quantity would be by means of a small hydrometer, such as is sold in a cheap form for taking the specific gravity of milk. Cane sugar, when fermented, yields a little over half its weight of alcohol; 1 per cent. of alcohol in dilute solutions lowers the specific gravity about 1·8°; 1 per cent. of cane sugar raises the specific gravity about 4° (taking water at 1,000). Thus, to form 1 per cent. of alcohol 2 per cent. of sugar will disappear—or, in other words, 8° of gravity will be lost; add to this the loss of gravity by the alcohol formed, and the whole will amount to 9·8°. If the specific gravity of the beer be taken at 60° Fahr. before and after fermentation, each 9·8° of gravity lost will approximately represent each per cent. by weight of alcohol formed. If it be remembered that fairly good strong whisky contains about 40 per cent. by weight of alcohol, some tangible idea may be formed of what percentage of alcohol means. Several low forms of fungi, which usually grow on the surface of a liquid or moist body, when plunged beneath the surface of a saccharine liquid, are capable of inducing alcoholic fermentation, and one or several of these constitute the ginger-beer plant. I have no reason to doubt that the beverage produced in this way is perfectly wholesome.

W. J. Sykes, M.D., F.C.S.

[69214.]—**Bell Indication.**—You could have nothing better than an ordinary electric "contact," with a bell or indicator.

W. Perren Maycock.

[69214.]—**Bell Indication.**—This can best be done by employing an electric bell. The mat at the shopdoor should be so constructed and hinged as to move down about 1½in. when anyone treads upon it. Under the mat should be placed a contact so as to close the circuit when the mat has been depressed. This contact should be connected by wires to the bell and battery, which should be placed in the room behind. The method of constructing and connecting up the mat has been described and illustrated many times in back numbers.

F. C. Allsop.

165, Queen Victoria-street, E.C.

[69216.]—**Model Loco.**—Quite a waste of labour; but ¾in. by 1¼in. cylinders quite large enough.

Bristol. T. C.

[69216.]—**Model Locomotive.**—The boiler is approximately to a scale of 1in. to the foot. Cylinders, therefore, should be from 1¼in. to 1⅜in. bore, and 1⅝in. to 2in. length of piston stroke.

J. H.

[69220.]—**Silent Alarum.**—An ordinary clock can be fitted so as to complete the circuit of a "shocking coil" at any desired time, the electrodes or terminals of the coil being connected through twin flexible wire to plates of metal foil on the inside of a wristband, &c.

W. Perren Maycock.

[69221.]—**Lathe Matters.**—Leave the tops of teeth alone if they are chilled, unless you have an emery wheel. A cutter with teeth something like a saw for taps; but on a single cutter driven sharp (a fly-cutter) for gun-metal. Plenty of cutter frames illustrated in back numbers. You do not require gear wheels for fly-cutters.

Bristol. T. C.

[69222.]—**Discharge from the Ear.**—From the description given, and the fact that your doctor says you have a perforation in your ear, I have formed the following opinion of your case, and I give the best advice with regard to treatment that circumstances permit. You are suffering from a perforated tympanum and chronic otorrhœa—that is to say, the drum of your ear is broken, and you have chronic catarrh of the middle ear (chronic inflammation of the ear beyond the broken drum). Through this broken drum the discharge trickles, and you can easily understand that the treatment should run as follows:—1. Cure the inflammation, and so arrest the discharge. 2. Endeavour to induce the drum to heal and the perforation to close. If you close the drum before you effectually cure the catarrh the effect will, in all probability, be most disastrous, as you will seal up the pus in the interior of the ear. You now understand your position, as far as I can explain it to you without actually seeing the ear. I should advise the following course of action:—Place your case in the hands of your medical man, and adopt his treatment. Keep your ear scrupulously clean; syringe night and morning with warm water and whatever lotions he gives you, and remember your case is one that calls for great skill and judgment on the part of your doctor (value him accordingly), and great care and cleanliness on your own part. It is a very difficult thing to permanently cure otorrhœa: so do not be impatient. Improve your general health as much as possible, and your trouble will, in all probability, slowly take its departure. You had better wear a small piece of cotton-wool in the ear at all times; change this frequently. Avoid all draughts, as you are very liable to catch cold in the affected ear—this might prove a source of great inconvenience and possible danger. Don't get sea-water or any foreign substance in the ear at any time. Should matters get worse instead of better, you should see an aural surgeon at once. Do this through your own medical man, and not on your own responsibility. Your teeth, if efficiently stopped, are not likely to affect your ear trouble. Local disorder will account for all your difficulties. J. West.

[69224.]—**Medical Coil.**—If you wind it with two layers No. 20 as primary, and 14 or 15 layers of No. 36, you will get a very powerful coil, provided you insulate the layers carefully.

S. Bottone.

[69224.]—**Medical Coil.**—You would certainly, as you suggest, get a much stronger shock by rewinding your coil with three or four layers of No. 18 for primary, and using, say, 6oz. or ¼lb. of No. 36 silk-covered wire for secondary. Put paraffined paper between each layer. Of course you will want a regulator—a brass tube sliding over core is best. Don't increase present diameter of coil. Thickness of core is somewhat excessive.

J. Ball.

[69225.]—**Electric Lamps.**—You could not do this economically with primary batteries, and secondary batteries you are probably debarred from using, as one must have access to a dynamo for recharging them. W. Perren Maycock.

[69225.]—**Electric Lamps.**—Do not attempt it. Nothing is so expensive and so unsatisfactory, in the way of lighting, as lighting by batteries. The lamps themselves will last 1,000 hours; but the batteries will take a large space, requiring recharging every night, will weigh very much, and cost a great deal in maintenance. A skilled man to recharge, wash zincs, &c., will cost you £1 a week. The cost of charging will be about 3s. per night. You can see such batteries almost anywhere. Try Judson's, Southwark Bridge-road, and mention my name. S. Bottone.

[69226.] — **Electro-Plating.** — The larger the carbons the less the internal resistance, and therefore the larger the current, provided the outer resistance does not exceed greatly that of the battery itself. The use of coupling up many cells in series is to enable the operator to overcome a large outer resistance—a thing impossible with a single cell. To nickel-plate, an E.M.F. of about 10 volts is required, and this means at least 5 bichromate cells. S. Bottone.

[69226.]—**Electro-Plating.**—The power of the battery depends on the amount of outside surface of the carbon, not upon its volume or weight, except as far as these affect the surface. The power depends on the size of the zinc as well as carbon. The querist will probably find it best to buy a proper carbon-plate for his cell, as the rough pieces from the gas retorts are generally of awkward shape, difficult to cut, and cause a lot of bother in making good connections, while a good plate with lead top and screw may be purchased for a few pence. The line "it is well known," &c., is utter nonsense. "W. M." would do well to study a text-book—try S. P. Thompson's "Elementary Lessons in Electricity and Magnetism," published by Macmillan at 4s. 6d. J. Ball.

[69229.]—**Air Gun.**—You do not state what kind of air gun, if it is a "Gem" or a Quackenbush; either the spring has lost some coils, or the washer has fallen out. If an old-fashioned cane with separate pump, the fault is in the valve, which either has too much play or requires a new horn washer. To repair either of the latter requires experience.

Edinburgh. Fabricant d'Armes.

[69231.]—**Pyrotechny.**—To Dr. W. H. Browne.—With respect to the query addressed to me by T. Pearce on pyrotechnic matters, I beg to say that I cannot advise the use of boiler tubes for shell mortars for several reasons. If your correspondent can really afford a first-class article, I would strongly advise him to have a steel one, built on the heavy type by all means; they are the cheapest in the end, will last a lifetime, and are safe in the hands of a qualified pyrotechnist. However, if T. Pearce must have something cheap, the best thing he can do is to have a light one made on my principle, for light mortars, with best charcoal plate No. 16 iron wire gauge. For a 5½in. mortar the length of the tube should be 20in., and the inside diameter as above—viz., 5½in. The tube should be overlapped at the seam, and brazed inside and out, and the brazing kept as smooth as possible inside, so as not to cut or damage the shell-case or fuse. The tube can be attached by means of screws to a wood foot, with its concavity; the outside of the mortar should be wrapped with stout cord or copper wire. These light mortars answer admirably, and will last a number of years with care. One caution I would give respecting shell-firing—in all cases pit your mortars; accidents will happen "in our best families" (as Mrs. P. would say, when reading the latest scandal in high life), for unless a mortar is of high-class make and material, it is quite possible that it may give way if a shell detonates, and the pitting of the tube reduces the danger to a minimum. With a perfect mortar, and properly constructed shell stars, the accident of detonation should be harmless—simply shock; but even then I say pit all your mortars, be they good, bad, or indifferent. My object in giving the size of the mortar as 5½in. is simply this: shells of a smaller calibre are not so easy to manufacture; the cost is little more than a smaller size, and, lastly, the size of shell given above is the smallest that can be used with any degree of satisfaction or spectacular effect. W. H. Browne.

Wentworth House, Aldbrough, Hull.

[69233.]—**To Mr. Bottone or Others.**—There is nothing extraordinary in this. As the coils are single, and the armature well ventilated, No. 15 will carry 20 ampères easily. Each half of the armature coils carries 20 ampères, the total being 40. The only secret is the well-ventilated armature. S. Bottone.

[69235.]—**Melting Brass.**—You cannot melt brass with spirit. Make a furnace of sheet iron, cased with bricks, and use coke. You can get small furnaces, at reasonable prices, of the Morgan Crucible Co., Battersea, S.W., that would suit your purpose admirably. J. H.

In China the inhabitants are counted every year in a curious manner. The oldest master of every ten houses has to count the families, and has to make a list, which is sent to the imperial tax-house. Last year the whole number amounted to 879,383,500 inhabitants.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

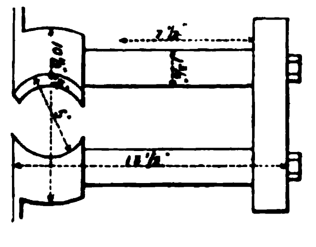
68748. Anemometers, p. 290.
68749. Underground Surveying, 290.
68753. Silicic Acid and Alumina, 290.
68758. Prime Cost, 290.
68761. Camping Out, 290.
68765. Spectacles, 290.
68772. Ventilation, 290.
68777. Frigoline or Frigiline, 290.
68781. Cupola, 290.
68784. Spirit Compasses, 290.
68789. Raising Water, 290.
68790. Cycling, 290.

68948. Gaiffe's Chloride of Silver Cell, p. 378.

QUERIES.

[69237.]—**Fretwork Machine.**—Will some one kindly inform me how to construct an efficient fretwork machine out of a Wheeler and Wilson treadle sewing machine? Can any of the top part of machine be used in the construction of the same?—H. R. H.

[69238.]—**Dynamo.**—To Mr. Bottone.—I have carcase of dynamo, as per sketch, pole-pieces of cast iron, magnet cores of wrought iron; also about 14lb. of 16 d.c.c. copper wire, which I should like to use for winding field-magnets, and 3lb. of No. 20 d.c.c. How many lamps would it light, and what power would it take to drive it?—Vincent.



[69239.]—**Emptying Tank.**—I have a very large tank to empty often. Would it be emptied quickest with one twelve-inch pipe, or two six-inch?—W. T. K.

[69240.]—**Pump.**—Can any reader give me sketch or description of direct-acting pump to work with cylinder ½in. bore, ¾ stroke, similar in appearance to Westinghouse air pump, or dimensions, &c., of smallest size injector it is possible to make work? Boiler to be supplied is 13in. long, 4in. diameter, locomotive type; can get plenty of steam.—O.

[69241.]—**Organ Blowing.**—Will any one who has had experience with gas-engines kindly tell me what engine is best adapted for the above purpose?—the organ being a large "three decker"? As the bellows are situated some distance below the organ, I am told that they will require a ½H.P. engine to drive them; two men at the present time being insufficient. The Bischopp and the Otto have both of them been suggested as suitable, each of them with their peculiar merits and advantages over the other. The Otto is generally recommended for economy of gas, good workmanship, and consequently lasting properties. The Bischopp, on the other hand, does away with the water jacket, valves, &c., is easily started, and needs less attention; yet, in spite of Bischopp's many advantages over the Otto, the latter seems to be almost universally adopted for blowing organs.—Raets Sahc.

[69242.]—**Pigments.**—Will a brother colour-maker or chemist kindly help me by answering the following questions? If so, I'm sure his service and advice will be esteemed by several readers of this most enlightening publication, for several makers of pigment colours must have read the papers on the analysis of pigments with much satisfaction. In the manufacture of carmine, I believe that the French excel the whole world, that is, in price, for as regards brightness of colour, I can myself make a carmine from cochineals that will excel the Frenchman's in brightness; but I own that his is sold for about as much as half of what it costs to make mine. What I want to know is of an adulterant that will not turn carmine dark, nor make it hard and brittle to be soluble in ammonium fortissim ·880? I have tried starch; but when dissolved in hot water it goes to a jelly; also the base or alumina from alum, and soda carb.; also from ammonia carb., and soda carb.; but these, when mixed with carmine in the paste, produce a kind of crimson lake colour, and are hard and brittle, and not soluble in ammonium fortissum. Also will a chemist or maker kindly let me know if there are any books published on the analysis and manufacture of vegetable and mineral colours?—Persian Carmine.

[69243.]—**Dynamo.**—Would some of your correspondents kindly answer me the following? I have got a Gramme dynamo, with five pounds of No. 20 wire on each limb of field magnets, twenty pounds in all, coupled up as a shunt machine. The armature is made of laminated punchings, and on the cog principle, with twelve spaces for wire. It is 5in. in diameter, and 3in. broad. What amount of wire should I put on the armature, and what gauge?—R. Shaw.

[69244.]—**Electric Lighting.**—I want to light my shop with two 16-candle lamps. Shall I be able to do it with a dynamo by hand power in conjunction with an accumulator? How can I make the accumulator?—G. W.

[69245.]—**Marking Ink.**—Can you inform me what chemical to mix with nitrate of silver to prevent it rotting the fabric, and is there any other way of making marking ink without using nitrate of silver?—S. W.

[69246.]—**Logarithms.**—Having shortly to make a number of calculations, and being desirous of curtailing the time, I have endeavoured to use a table of logarithms. The correct characteristic I can put, positive and negative, and get the mantiss, but when I begin to add or subtract the logarithms, I am at fault.

94·785 + 6·8798

Log. of 94·785 = 97672 + 2 = 1·97674
Log. of 6·8798 = 83746 + 6 = 0·83752

1426

Nine and nine are eighteen. What is done with the 1? Again—

0·02132 ÷ 0·098764

Log. of 0·02132 = 33021 + 4 = $\bar{2}$·33025
Log. of 0·098764 = 99458 + 2 = $\bar{2}$·99460

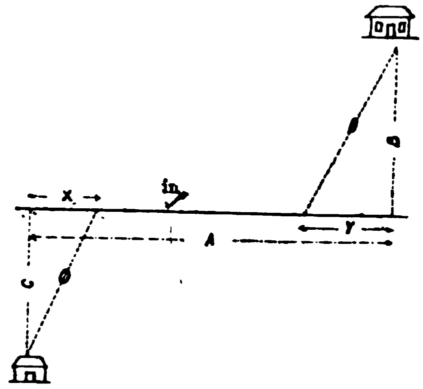
3565

Here is 10 to be taken from 3. What is the rule? Would some reader refer me to a book that gives the necessary information, or tell me how to proceed from this point?—Logarithms.

[69247.]—"**Richter's Dream**"—Where can I find "Richter's Dream"? Sir Robert Ball recited it when bringing a lecture on astronomy to a close.—A. Griffiths.

[69248.]—**Cutting Boiler.**—What is the best way to cut bottom off a boiler, 20in. diam., 5-16 plate (vertical)? I wish to cut about a foot off firebox and shell.—Engineer.

[69249.] — **Indian Railway Problem** — The following original problem in maxima and minima, with two independent variables, has a short solution, and is very neat, if I am correct. It also gives a good example of partial diff. coefficients, usually written with brackets thus, $\left(\frac{du}{dx}\right)$. I would like to see how our mathematical friends will deal with the question, if room can be given in these columns. In the days of my youth, I was employed as assistant engineer on the East Indian railway near Patna. My length of railway was quite straight for ten or twelve miles, and at certain seasons passed through a vast sheet of water, the overflow of the Ganges. Our bungalows were, therefore, built on high ground, some distance from the railway. We engineers, when we visited each other, had to go partly in boats, and partly in trollies on the railway, the trolly being pushed behind by two natives, who ran on the rails and kept up a speed of about six miles an hour. The horizontal line in the diagram represents a length of railway = *a* (miles) between the feet of the perpendiculars *c* and *b* drawn from the two bungalows represented. I live in the bungalow to the left, and wish to visit my friend in the other. I set off in a boat along a diagonal line, my boat going at the rate of two miles an hour. When I reach the railway I get on to a trolly, and am pushed along at six miles an hour, until I meet my friend's boat waiting for me, which I enter, and proceed along the diagonal line to the right. My friend's boat goes three miles an hour. I require to know at what points the changes from boat to rail, and vice versâ, must be made in order that the journey may occupy the least time, or (see diagram) what will be the values of *x* and *y* when the time is a minimum. The lengths of *c* and *b* in miles are known.—M.I.C.E., Bath.



[69250.]—**Striking Gear for Clock.**—I have made and fitted up my house with several electric bells. From the kitchen clock I have arranged two to ring as alarms in separate bedrooms, one and a half minutes each time, at five and seven o'clock respectively; besides which, I have attached a wire from the bell and hammer of same clock, which strikes the hour on a single-stroke gong in my bedroom without my hearing the clock ticking. I have just finished making a 24-hour clock, going part only, and I want to make it strike the hours electrically. Can any reader suggest an arrangement by which single-stroke bells could be made to strike the hours, say, one up to twelve, on a 2in. bell, and one up to twelve (12 up to 24) on a 3in. bell, without adding striking gear to the clock?—H. G.

[69251.]—**Proving Pump.**—Would some of our readers kindly inform me the principles of the best proving pump for boiler tubes with hydraulic pressure. Also the cheapest and best accumulator I could make, and how to make it.—Tubes.

[69252.]—**Hard Water.**—Can any of "ours" inform me what to do to soften some spring water? I have a well about 12ft. deep, and there is always plenty of water, but so hard, that when used for washing clothes, it causes a thick skin of dirt on the copper and tubs.

Would it be any better if I sank a tube another 12ft.?—Mechanic.

[69253.]—**Shop Front.**—Can any of "ours" inform me if I could alter my window, that is now level with the wall, into a large bow front for a shop, without troubling with any surveyor? I should not alter the brickwork, but make a large glass front, and fix it over the other. There is plenty of room, as there is 10ft. of garden, and the front would be out about 3ft.—Mechanic.

[69254.]—**Meridian Instrument.**—I found recently amongst a lot of rubbish an instrument called Dent's Patent Meridian Instrument, and made by the eminent firm of Dent, in the Strand. I wrote to Dent for information how to use it, but was told in reply that the instrument was out of date. Perhaps some of your scientific readers could give me the necessary instructions for its use.—Meridian.

[69255.]—**Ventilation of Mines.**—When a furnace is producing an air current of 15,000c.ft. per minute, with pressure of 5·2lb. per square foot, the temperature of downcast 40°, depth of shaft 400ft., barometer 30in., what will be the temperature required in the upcast?—Perplexed.

[69256.]—**Great Western Narrow Gauge.**—Will some correspondent kindly state how far west the G.W. narrow gauge extends, whether as far as Newton Abbott or Exeter?—X.

[69257.]—**Developer.**—To "Sm." or Mr. Bottone.—I have been trying hydrokinone as a developer in place of the oxalate, which I have been using for some years past. The resulting negatives are splendid and print well, but all are covered with a slight grey deposit, even on the edges which should be clear glass. Please tell me how I can obviate this, as I wish to use this developer for bromide paper, which is, of course, completely spoiled by above-mentioned deposit.—Excerpta.

[69258.]—**Great Western Engines.**—Will some one have the kindness to give a sketch of the G.W. broad-gauge engine Prometheus, stating if this is a new engine or one rebuilt, and, if the former, whether it is convertible to the narrow-gauge as all the other recently constructed B.G. engines are? A sketch and a few dimensions of the latest type of narrow gauge four-coupled express engines would also oblige.—W. G. T.

[69259.]—**Electric Lamp.**—To Mr. Bottone.—I have had an electric lamp and battery given to me, and I found that the solutions had dried up and crystallised in dark red crystals on the zincs. Was the solution chromic-acid? Also can you please tell me what c.p. lamp I could light from the battery. There are six cells. The zincs and carbons are 3½in. by ⅝in. Any hints will oblige.—J. S.

[69260.]—**Telephones.**—I have made a pair of telephones, with magnets 4½in. by ⅝in., and ¼oz. of s.s.c. wire on each bobbin. I have only tried them on about 6 yards of No. 22 wire (from one room to another), and they act very well for a few words: but after that nothing but a rumbling sound can be heard until they have been at rest for some time. Can any of our experienced readers suggest any cause of failure?—H. T.

[69261.]—**Collodion Positives—Limelight.**—I have undertaken to take portraits by limelight at a bazaar to be held some months hence at a school. I have the limelight apparatus already there in connection with magic lantern; and, if at all possible, want to use it in preference to magnesium. I think collodion positives would, perhaps, be most in demand, and shall be glad if any of "ours" can give me any information as to arranging limelight, &c. Mine is a "blow through" jet, which gives good results with 12ft. disc using the lantern. Would it be necessary to use the condenser, or should the limelight be open, using white paper reflectors? It will be all evening work, and studio will be a large classroom. Also will someone advise a good method of taking positives, or refer me to some book for information, as I have not tried any but gelatine plates hitherto? Any hint from others who may have had similar work will be thankfully appreciated.—Photus.

[69262.]—**Humidity.**—Would some correspondent inform me how the humidity of the atmosphere is estimated, and what is meant by 80° of humidity, and describe the instrument for the purpose?—Jacob George, Alexandria, Egypt.

[69263.]—**Gauges.**—I have a standard gauge for wood-screws, and a Birmingham wire gauge. The screw gauge runs from double zero to No. 32, and the B.W.G. from No. 1 to 26. Can any reader tell me the gradations of each gauge separately?—Jacob George, Alexandria, Egypt.

[69264.]—**Midland Single Locomotives.**—To Mr. Stretton.—I would be much obliged if you could spare the time to send a side and end elevation and particulars of one of the new single express engines for the Midland, which you mentioned in your answer to 69094 last issue?—Meteor.

[69265.]—**Decomposing Water.**—What amount of work is required in foot-pounds to decompose 1lb. of water by means of the electric current?—Wemyss Bay.

[69266.]—**Pilsener Lager Beer.**—Will Dr. Sykes or some other gentleman kindly describe the manufacture of the Pilsener lager beer?—C. S.

[69267.]—**Launch Boiler.**—I intend to have a multitubular marine boiler with one furnace, made for a single-cylinder launch engine, 1½in. bore and 1¾in. stroke, 500 revolutions per minute, and 60lb. pressure. Would some one kindly tell me the proper diameter and length of shell, diameter of furnace, and dimensions of dome (if required)?—M. M.

[69268.]—**Arc Lamp.**—Would Mr. Bottone kindly say if an arc light could be run with a current of about 12 volts, as supplied from six cells of the pint chromic-acid type? If 12 volts would not be enough E.M.F., how much would be required? Also kindly say how a simple mechanism could be made for lamp with this current? What thickness should the carbon rods be?—No Sig.

[69269.]—**Heating Apparatus.**—Being about to erect a tomato house (30yd. long), I should be thankful if some practical reader would give advice respecting the proper arrangement of heating apparatus. What are the necessary conditions to be observed in the arrangement and relative positions of boiler and pipes, and the theoretical principles which determine this arrangement in order to insure an efficient flow of hot water? As this question of heating seems to be very litte understood by gardeners, I am sure a reliable reply to this query would be greatly appreciated by many.—L. Bentley.

[69270.]—**Waterproof Roof.**—Could any fellow reader inform me of a good, durable, waterproof covering for a small roof? It is covered with zinc at present; but it has become so worn that the rain easily comes through. Would it be advisable to re-zinc it; and if so, how should I do it? I want something reasonable and good.—Roofer.

[69271.]—**Sulfonal.**—Can any of "ours" say what this compound is? It is mentioned on p. 464 "E.M." July 26.—Principia.

[69272.]—**Dynamo for Arc and Incandescent Lamps.**—Will some one briefly state the difference in the construction of a dynamo for arc lighting to one for incandescent lamps? Is the armature for arc lights wound with a larger diameter wire? If so, why is this? Would an ordinary dynamo do for both systems?—M.M.I.Sc.S.

[69273.]—**Breaking up Old Castings.**—I have a large quantity of heavy castings, parts of hydraulic presses and such like, to break up, pieces to weigh about 1cwt. I could do it foundry fashion; but with coolies that would be slow work. I would like to do the job by explosives, say dynamite; but am ignorant of the method of procedure. Can any kind reader give me a workable plan? Explosives to be fired by battery preferred; but any other method will be readily acted on.—McJute, Calcutta.

[69274.]—**Friction.**—Will any reader enlighten me on the following? I have a steel cylinder 4in. in length, and 3in. in diameter, with ¾in. of each end fitted into brass bearings, which can be well lubricated. Between these bearings, and on the top sides of the cylinder is a constant hydraulic pressure of 30lb. to the square inch: the cylinder is fitted horizontally, and has to revolve. I want to know what resistance the pressure offers to the tube revolving? And what would be the difference in resistance if the bearings were reduced to ¼ of an inch diameter?—J. W. H.

[69275.]—**Harvest Spider.**—Will some reader kindly give me definite information as to the history, nature, and protection from, or cure for, the bite of the harvest spider, commonly called the harvest bug (Acarus autumnalis) which infests certain localities and some of our watering places during July and August? It is amusing to hear the people allude to the effect on the skin produced by these insects "as the change of air doing them a world of good," and I have heard some doctors who ought to know better ascribe other causes for these eruptions on the skin than by this insect. After asking advice of many friends I resolved on a careful microscopic examination of the spots on my own skin, and found small specimens, scarcely visible to the naked eye, which I extracted with a needle. The animal is so small that I could only see it as a bright red speck running briskly across a white paper, upon which I placed it with the needle point, and even this required a close observation. When the animal has inserted itself beneath the skin you feel a slight irritation, which causes you instinctively to scratch the spot, and by so doing you kill the spider, then the formic acid, I suppose, mixes with the blood, and produces for at least three days a most painful irritation, which none of the supposed remedies which I have used seem to soothe. Lately I have been trying cajeput oil, and find a little relief.—William.

[69276.]—**Cement for Bicycle.**—I want to make a good cement for fixing the rubber tires of a bicycle into the steel felloe. Can anyone oblige me with the ingredients and quantities required to make a good cement? I believe old rubber or guttapercha, shellac, pitch, &c., are used. Will the same cement do for cuts in rubber tires?—P. E. D.

[69277.]—**Pattern Required.**—Can any reader oblige with instructions for cutting out pattern of oval tin baking dish, sides to slope at an angle of 45°, major diameter, 12in.; minor diameter, 8in. Any hints will greatly oblige.—Blacksmith.

[69278.]—**Observatory.**—For a 3in. telescope, what ought to be the dimensions of an observatory? What would be the best and cheapest material? And chiefly how could the roof be worked so that it could be easily manipulated? And what would be the cost? I am anxious particularly to obtain some few hints as to the roof.—Meddyg.

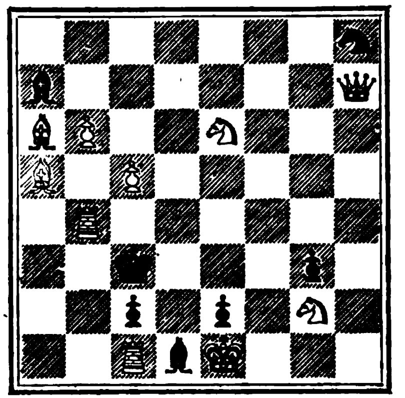
Railway Mileage in Different Countries.—Belgium has the largest railway mileage in proportion to area, having fully twenty-five miles of railway to every 100 square miles. Some parts of Germany, such as Saxony, show a ratio scarcely less than this; but Germany as a whole has only twelve miles of railway to every 100 square miles of territory, while Great Britain has sixteen miles and Holland thirteen. Switzerland has not quite twelve miles to 100 miles of area, and France only a little over ten miles. Of course, thinly settled countries cannot make a good showing in this respect as compared with densely populated States; yet the United States has 4¼ miles of of railroad for every 100 square miles of territory, which is a better average than that of Europe as a whole. If we compare mileage with population the results are reversed. Here we find the highest ratio in Australia, with an average of twenty-seven miles of railroad to every 10,000 inhabitants. In British America the ratio is almost the same. In the United states it is computed at 25¼ miles of railroad to every 10,000 inhabitants. In the Argentine Republic the ratio is fully half that in the United States. In no part of Europe is it much over one-third, and in Europe as a whole only about one-seventh, or less than four miles for every 10,000 inhabitants. Of the more thickly settled European countries, Switzerland has, on the whole, the best ratio, with six miles for every 10,000 of population. France has about 5¼ miles, Great Britain, Germany, and Belgium, each a little over five miles.

CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLXI.—By W. Gleave.

Black.



White. [10 + 7

White compels Black to mate in three moves.

Solution to 1,159.

White.	*Black.*
1. Q-R 8.	1. Kt takes Q (a).
2. R-Q 6 (ch).	2. R takes R.
3. Kt takes Kt mates.	
2. Q-R 8 (ch), &c.	(a) 1. Kt takes Kt (b).
2. Q takes Kt, &c.	(b) 1. Kt-K sq (c).
2. P takes P, &c.	(c) 1. P-B 5 (d).
2. Q-R sq (ch), &c.	(d) 1. P takes Kt (e).
2. Q-R 5 (ch), &c.	(e) 1. P takes P (f).
2. Kt-Kt 4 (ch), &c.	(f) 1. B takes B P (g).
2. Q-Q 8 (ch), &c.	(g) 1. R-K 2 (h).
2. Q-B 6, &c.	(h) 1. Any other.

NOTICES TO CORRESPONDENTS.

Correct Solutions to 1,159 by T. A. Pringle (very good problem), W. L. Martin (triple if 1. R-K 2, and dual if 1. P-B 5), Fr. Fernando, W. Gleave (two duals; 1. P-B 5, and 1. B-B 7, or Kt 8), F. C. Cook (triple, but variation 1. P-B 5 omitted: duals only reckon after Black's first move), Muzio (dual); to 1,156 by Retchford, H. G. Walsh, Muzio, F. C. Cook (very good), Othello, H. Warren, J. E. J. Smith.

F. C. Cook.—As you did not give the triple and duals in 1,157, we cannot, of course, allow you for them.

B. Green.—In your attempt at 1,158 you have overlooked that if 1. Kt-B 7, 2. R-B 5 (ch), K can move to B 5.

Cost of the Production of Tea in Ceylon.—A Ceylon journal has published a tabular statement of the cost of the production of tea on an estate of 250 acres in full bearing, with a good factory, adequate machinery, and fuel on the estate, at various rates of yield per acre. The prices are expressed in hundredth parts of the rupee, or "rupee cents.," and include carriage to Colombo and shipment there, in mercantile phrase "f.o.b. Colombo." At a yield of 150lb. to the acre the price would be 50 cents. per pound; 200lb. to the acre, 46 cents.; 250lb., 40 cents.; 300lb., 37 cents.; 350lb., 35 cents.; 400lb., 32½ cents.; 450lb., 31¼ cents.; 500lb., 29½ cents. On a larger estate of, say, 400 acres the prices might be reduced by one or two cents. per lb., the average yield in Ceylon being taken at 300 to 350lb. an acre, and the price of Ceylon tea put on board in Colombo at 35 to 37 cents., or 6d. per lb. This apparently does not include the planter's profits and interest on capital. Another estimate, however, gives 6½d. per lb., with a yield of 500lb. per acre as the actual expenditure in production; and a price of 8d. per lb. with 500lb. to the acre will be required to give a profit of 50 rupees per acre to the planter. A yield of 400lb. per acre will give the same profit if the average price, as at present, be not below 9d.

How many words can be written on a postcard? There has just been a competition amongst the stenographers to decide this question, and Sylvanus Jones, of Richmond, Va., has taken the prize by writing upon a card 36,764 words.—*American Paper.*

The South Australian Railway Commissioners have, Colonial papers say, decided to adopt the Westinghouse automatic brake on the broad gauge, and the automatic vacuum brake on the narrow gauge, lines in the Colony.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, August 7, and unacknowledged elsewhere:—

Herbert Wilkins.—F. Campin.—T. P. W.—Denton.—R. G.—Author of the "Philosophy of Sight."—Chasseur.—Thalia.—Cycle.—E. P.—W. G. Clifford.—New Subscriber.—C. E. Gittins.—Ixion.—The Lydney Dispenser.—Old Hand.—E. Ward Bussell.—J. H.

C. White. (Many thanks for your attention; but the award of the John Scott Medal of the Franklin Institute does not imply that the invention has been recently made: it may be many years old. The Trypograph to which you refer we described in No. 753, August 29, 1879, just about ten years ago. We should not be surprised to find the same idea in the *Mechanics' Magazine* of about 50 years ago; but that would not alter the fact of the award of the John Scott Medal.)—Waldo. (We do not undertake analyses, and cannot forward your sample to a chemist who does work of the kind gratis. If you are "very anxious to know," no doubt a chemist will be able to tell you, and we presume there is an official analyst for your county. Of course, you do not say whence you obtained the powder; but it looks like some preparation of chromic acid—probably evaporated battery solution.)—C. M. (Nothing of the kind; aquafortis, or strong water, is nitric acid, which is especially useful for etching metallic surfaces.)—Spark Grinder. (In the phonograph the battery is used to work the motor which rotates the cylinder: it has nothing to do with the phonograph effects. The phonograph has been fully described in back volumes, and recently in back numbers: see No. 688, if you can (it is out of print); but if you want to make one, it would be better to see the instrument itself. The diaphragm is vibrated by the sound-waves set in motion by the voice, as the name implies. The phonograph has nothing to do with electricity.)—Enquirer. (You can procure hydrometers of any dealer in philosophical or chemical instruments.)—R. B. (You will find all the information needed, even in recent back numbers—in fact, we have had a surfeit of dynamos.)—W. R. Bird. (The English Mechanic Telephone is not protected by patent: in fact, it has been expressly disclaimed, because it was described in our No. for Aug. 11, 1876, whereas the patent was not applied for until after that date. Consequently there was prior publication, and the instrument so described could not be patented.)—W. B. Tydemann. (For electric scarf-pins, see the back volumes and p. 244 of this volume.)—Country Clock Dresser. (We do not give addresses, as you will see by Hints No. 4; but as you have Britten's book, you can easily find out the addresses in Clerkenwell. See indices for full details about the chiming clock.)—Young Watchmaker. (Perhaps it is an error in the book. Write and ask the author. If it is an error, he will thank you for your trouble, as his object is to have the work as perfect as possible.)

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USEFUL AND SCIENTIFIC NOTES.

Compressed Air on French Tramways.—The use of compressed air as a motive power for tramways in France is extending. The system adopted is that invented by M. Mekarski, director of the Nantes tramways, which have been open since 1879. Two years ago the system was successfully applied on the tramways at N[illegible], in the neighbourhood of Paris, and more recently [illegible] those of Berne and Limoges. This year it will [illegible] substituted for horse-power on the tramways of Lyons. The inventor asserts that his system is far more economical than horse traction—the cost of coal per day of a machine equal to [illegible] horse-power being only 4s.—much cheaper [illegible] electricity or steam power, and that the machinery is simple and does not require a skilled mechanic to control it. The British Consul at Nantes in a recent report states "that the tramways of that town, which are worked by the system of M. Mekarski alluded to above, continue to give satisfaction. The cars are comfortable, and run smoothly, with little noise. They do not interfere with the general traffic in the streets, and their immunity from accidents is remarkable. The average speed is about eight miles per hour, but it can easily be increased or moderated, and in case of need an almost instantaneous stoppage effected."

"Antiquities."—In the new number of *Harvard College Bulletin* Mr. W. H. Tillinghurst has the following note:—"It is believed that M. Chevreul reached a greater age than any other person who had received a degree from Harvard College, outliving by a year Judge Timothy Farrar (1767), born July 11, 1747, died February 21, 1849, at the age of 101 years, 7 months, 10 days, who received the degree of LL.D in 1847 on the completion of his one hundredth year. Two graduates of American Colleges have outlived M. Chevreul. Rev. John Sawyer (Dartmouth, 1785), was born October 9, 1755, and died October 14, 1858, aged 103 years, 5 days. He received the degree of D.D. from Dartmouth in 1857, when 102 years of age. But the oldest College graduate in this country known to the writer was Nathan Birdseye (Yale, 1736), who was born August 19, 1714, and died January 28, 1818, aged 103 years, 5 months, 9 days."

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, AUGUST 16, 1889.

'HE CHEMICAL NATURE AND MANUFACTURE OF WATER-GAS.

THE possibility of manufacturing gas from water is no new idea. It has been matter of common knowledge for a coniderable time that when steam is passed ver red-hot carbonaceous matter its deomposition is effected, and a chemical comination takes place between its oxygen and he carbon of the burning fuel.

The cheapness of the raw material, the eneral facility of obtaining it, and the high mperature at which the mixed gases resultg from this decomposition burn, have inuced many scientists, as well as manucturers, to devote much attention to it, in he hope that the products might be found apable of convenient storage, and of being sed with advantage for lighting purposes, as ell as for the varieties of furnace-work hich are involved in so many industries.

Although the subject appears at first sight be a very simple one, its investigation and roper treatment have presented a vast umber of difficulties, which have been inurmountable to many who gave their minds o it; hence, for a long while, the fact that as can be produced by the contact of waterapour with incandescent matter has been egarded more as an interesting laboratory xperiment — nothing more. Nevertheless, everal went so far as to patent their ideas, elieving they had approached the solution f the problem of its economic application.

The first patent was taken out as long ago s 1824 by one Ibbetson. Within the last ear or two a great many have been applied or and granted. Amongst the applications n 1888 there was one by Mr. B. A. Thwaite, f Liverpool, and this was accepted on ay 1st, 1888. Improvements in the manucture of illuminating gas from water have een recently patented by two Americans— r. S. H. Linn, of Rochester, New York ealed June 25, 1889), and Mr. Moreland ork, of Baltimore (May 15, 1889). These re amongst the most recent.

It is, perhaps, scarcely possible to assert at there exists anywhere a method of anufacturing water-gas which is the xclusive property of the inventor. The eneral idea is common property, and those hose names are much before the public in onnection with it have chiefly concerned hemselves with devising modifications in he plant and machinery.

The manufacture of water-gas, so long he inventor's dream, has now been removed rom the domain of theory into that of ractice, and in the United States, in Germany, and Austria, as well as in England, ts commercial success has been realised.

The theory of the manufacturers of this ew lighting and heating agent can be asily understood by those who possess nerely an elementary knowledge of the priniples of chemistry.

Steam consists of oxygen and hydrogen ases in a state of combination represented y the formula H_2O; the only part of the uel which need be taken into consideration s the carbon. When steam is led over very ot fuel—such as coke—it is decomposed nto its elements, Hydrogen (H) and oxygen O); the oxygen combines with the carbon of he burning fuel, forming carbonic-acid gas CO_2). The carbonic-acid gas, or carbonic nhydride, as it is variously called, coming contact with more incandescent matter at higher temperature, takes up more carbon, rming carbonic oxide, thus—

$$CO_2 + C = 2CO.$$

Hence the results of the interaction of the steam and heated coke is a mechanical mixture of carbonic oxide and hydrogen, and the proportion of the former constituent varies with the temperature.

If the temperature be sufficiently elevated no carbonic acid is formed, but only carbonic oxide and hydrogen. The theoretical composition of the water-gas is then—

Carbonic oxide (CO)	50	per cent. by volume.
Hydrogen (H)	50	,, ,, ,,
	100	
or—		
Carbonic oxide (CO)......	94	per cent. by weight.
Hydrogen (H)	6	,, ,, ,,
	100	

If the temperature be lowered, the proportion of carbonic oxide becomes proportionately decreased, and its place taken by carbonic - acid gas, until finally, if the temperature be sufficiently depressed, the water-gas produced may have the composition—

Carbonic acid gas (CO_2) ..	33	per cent. by volume.
Hydrogen	66	,, ,, ,,
	99	
or—		
Carbonic-acid gas	92	per cent. by weight.
Hydrogen................	8	,, ,,
	100	

Hence it is obviously of great importance to keep the temperature high.

The chemical reactions which take place at the moderately high temperatures used in the ordinary manufacture of water-gas may be represented by the following equations:—

$C + 2H_2O = CO_2 + 4H$ (decomposition complete about 500°).
$CO_2 + C = 2CO$ (decomposition between 1,000° and 1,200°).
$C + H_2O = CO + 2H$ (reaction complete at highest temperatures)

Since the combustible employed is never pure carbon, it is necessary to take account of the action of the super-heated steam and the carbonic-acid gas on the hydrocarbons, which, originally in the coal, may yet partially remain in the coke, and the most important of these is, according to Prof. Lang, marsh-gas (CH_4).

These reactions may be represented by the following equations:—

$CH_4 + H_2O = CO + 3H_2$
$3CO_2 + CH_4 = 4CO + 2H_2O$ (between 700° and 800°).

It is also necessary to consider the very important action of the carbonic oxide upon the steam.

According to Messrs. Maumann and Pictor (*vide* Report of the Germany Chemical Society, 18th par. No. 14), this reaction commences at about 600°, and can be represented thus:—

$$CO + H_2O = CO_2 + 2H_2.$$

At a temperature of 900°, 10 per cent. of carbonic-acid gas is produced, and this, again, if it come in contact with the hotter coke is, as before, converted into carbonic oxide. Water-gas, then, is simply a mixture of hydrogen and carbonic oxide gases, according to theory containing variable proportions of marsh-gas, carbonic-acid gas, nitrogen, &c., which depend partly on the presence of impurities in the raw material, and partly on the inefficiency of the method of manufacture.

There is very much that is common in the various plant and apparatus employed. Whatever may be the name of the process, there is always a "generator," which is usually cylindrical and composed of boilerplate lined with some fire-resisting material. At the base of the generator is a furnace, and the generator itself is stuffed with coke fed from above.

When the generator is to be started, the operation of "blowing up" is first resorted to; by means of a steam jet exhaust, the mass of burning coke is soon raised to a condition of brilliant incandescence. This operation forms what is variously called "Siemens gas," "generator gas" or "producer gas."

After this has been going on for a certain time the valves are reversed, the steam is shut off from the exhauster, and directed into the top of the generator, and during this second operation water-gas properly so called is formed. The water-gas is conducted away into "scrubbers" of the usual type, towers filled with coke provided with running water; it then passes into gas-holders wherein some of the heavier impurities are deposited, then into purifiers containing oxide of iron, which fix any carbonic-acid gas that may have been present; it is finally stored in gasometers.

Amongst the many systems which have been devised and put to a practical test, those of Strong, Lowe, Darling, Tessié du Motay, and Dwight are chiefly known. The system in vogue in America is that of Lowe; while in Europe Strong's method is in most general use. Lowe's system has been modified by Granger, of Philadelphia, and this method is especially concerned with the manufacture of water-gas for lighting purposes. The gas, consisting of the usual mixture of carbonic oxide and hydrogen, is produced by passing steam over incandescent anthracite, and then it is treated, while still warm, with gaseous hydrocarbons derived from petroleum residues. The increase of illuminating power thus conferred upon the crude water-gas renders it a very efficient medium for lighting purposes. Water-gas prepared by Granger's improved method requires very little purification. It is passed into a scrubber, and then treated with warm water, then into a condenser which retains various solid and liquid impurities, and finally stored in a gasometer. Mr. G. Moore, whose report on this gas is very complete, gives the following analysis:—

WATER-GAS BEFORE BEING TREATED WITH HYDROCARBONS.

Hydrogen	52·88
Carbonic oxide (CO)	36·80
Carbonic acid gas (CO_2).....................	3·47
Nitrogen	4·69
Marsh gas	2·16
	100·00

WATER-GAS AFTER BEING TREATED WITH HYDROCARBON (TWO SAMPLES).

	(A)		(B)
Hydrogen	37·20	......	35·88
Carbonic oxide (CO)............	28·26	......	23·58
Carbonic acid gas (CO_2)	0·14	......	0·30
Nitrogen	2·64	......	3·85
Marsh gas	18·88	......	20·95
Ethylene........................	11·29	......	12·80
Propylene	0·00	......	0·00
Benzol vapour	1·53	......	2·63
Oxygen	0·06	......	0·01
	100·00		100·00
Density { Theoretical	0·5825	......	0·6057
Density { Practical	0·5915	......	0·6018
Temperature of the flame	2903°	......	2886°
Heating power	5380	......	5630
Lighting power	22·06	......	26·31

A cubic mètre of this gas was produced by using 0·58 kilogrammes of anthracite and about 18 litres of petroleum residue.

Strong's method briefly consists in forcing the first products of combustion (producer gas) into one or more recuperators lined with fire-brick, and containing burning coke at a very high temperature; then steam is introduced in an opposite direction, and the whole forced back into the generator. When illuminating gas is required by this method, it is sufficient to mix hydrocarbons with the steam.

Strong's system is at work at Essen, Hoerde (Westphalia), Witkowitz (Moravia), Leeds, &c.

The flame of oxide water-gas that has not been treated with any hydrocarbon is not of itself luminous—it is of a pale blue colour; but the temperature of combustion is tremendously high, being, it is said, often 2,772° Fahr. hotter than the flame of coal-gas.

The value of such a source of high temperature for many kinds of forge and furnace work cannot be over-estimated, and installations of plant are being set up for the most varied purposes.

It is said that, by some methods, no less

Fig. 84.

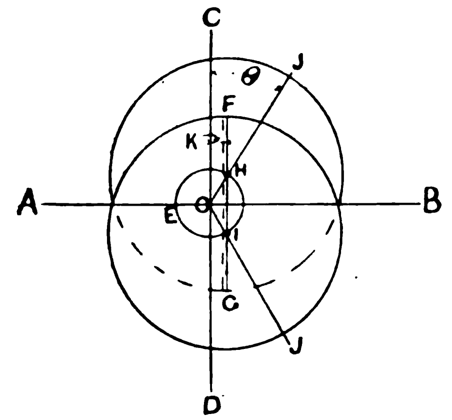
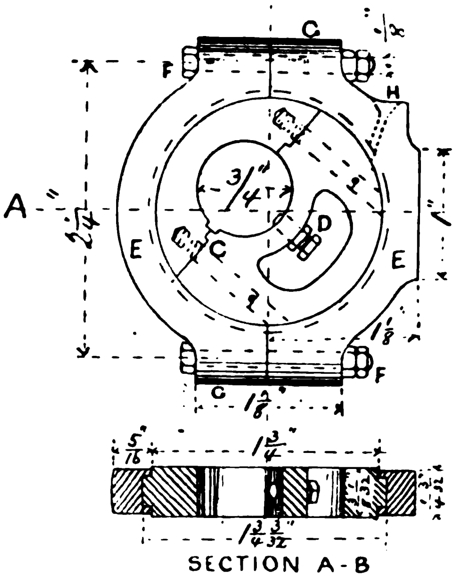
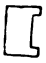


Fig. 86.





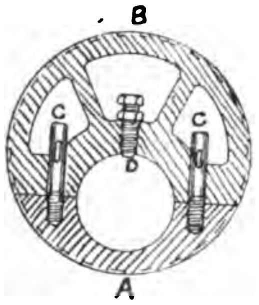


Fig. 85.

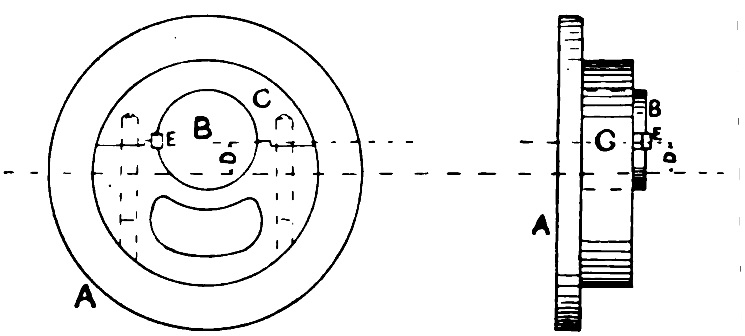


Fig. 87.

than 150,000c.ft. of water-gas for heating purposes may be obtained from one ton of coal, at the rate of 20,000c.ft. per hour, whereas, according to Ure ("Dictionary of Arts and Manufactures"), one ton of good average coal only produces 10,000c.ft. of coal-gas, and one retort generally takes twenty-four hours to do it.

The intense heat of the water-gas flame suggested the employment of some refractory material which should be capable of becoming brilliantly incandescent. As is well known, cylinders of lime have long been employed in connection with the oxy-hydrogen lime-light. Lime was also tried with water-gas; but the best results were obtained by the use of calcined magnesia in the form of small "combs." These are found to be fairly durable, and cost only 1½ each.

In some methods the "producer" gas is wasted, but others store it in a special gasometer, for it is too useful to be lost. When both water-gas and producer-gas are stored the cost is ridiculously small, being less than ½d. per thousand cubic feet.

The economical aspect of the employment of water-gas is obvious from what has already been said. It also has another and no less important aspect. The impurities of coal-gas, in spite of all precautions, are notorious. To breathe an atmosphere continually in rooms imperfectly ventilated, as most rooms are, and lighted by coal-gas, is positively dangerous to health. Now, the products of combustion of purified water-gas, when used for illuminating purposes with the magnesia combs, are simply carbonic-acid gas and water. There is no sulphur to form sulphuric acid, nor any other dangerous component. Moreover, a reference to the amount of air consumed shows at once the sanitary superiority of water-gas over coal-gas. Thus—

1c.ft. coal-gas	requires 5·2c.ft.	of air
1c.ft. water-gas	,, 2·2	,,

that is, 3c.ft. more air available for breathing purposes. Doubtless this innovation is destined to produce something akin to a revolution in heating and lighting operations, for the great point in its favour is its *cheapness*, and that of itself is sufficient to commend it in these 19th-century days.

It remains to be added that in America already there is a publication devoted to its interests—namely, the *Water-Gas Journal*, which appears every month at Philadelphia.

A MODEL LOCOMOTIVE.—XVI.

Eccentrics.

We will now take the sections of the valve-gear in detail, and describe their construction and methods of fitting up. We shall properly regard the eccentrics as meriting our first notice, because they are the prime factors in the gear.

The diagram, Fig. 84, gives us the elements of the eccentric design. Mark a horizontal line, A B, and a second line, C D, perpendicular to it. From the intersection of these strike a circle, E, equal in diameter to the intended travel of the valve—in this case ½in. This will equal twice the throw of the eccentric. Parallel with C D, and at a distance from it equal to the intended lap of the valve = $\frac{3}{32}$in. + its lead = $\frac{1}{32}$in., lay down line F G. Diagonals, J, drawn from the centre O to the points of intersection H I, will represent the angle θ of advance of the eccentrics, and the centres H I will be the centres of the sheaves. The distance K will equal the maximum distance open to steam with the valve in full travel. The diagram shows the precise relationship between each sheave in a pair, and we want two such pairs, which will be keyed on the axle so that the line A B in one pair shall stand at right angles with the line A B of the other pair. H is the centre of the sheave for forward gear, and I that for backward gear.

Eccentric sheaves are necessarily cast in halves to get them over their axles. But they are either made singly or in pairs. The single eccentrics are divided through the centre of the bore, and at right angles with the axis of greatest eccentricity, Fig. 85. The smaller portion, A, is made of wrought iron, the larger, B, of cast iron of "cylinder metal" quality; studs C are tapped into the wrought iron, and cottars are driven through those ends of the studs which pass into the cast-iron portion. The eccentric sheaves being set in their correct positions on the axle, keyways are cut to correspond, and the sheaves are still further secured by means of set-screws D.

In another method the sheaves are divided through the bore; but the two halves which form the pair for back and fore gear are cast together, so saving the trouble of adjusting each single sheave separately from its fellow. The two castings are then screwed together, the heads of the screws being countersunk. The joint of the castings is then made along the line A B in Fig. 84.

Keys are somewhat objectionable in eccentric sheaves, because of the weakening of the axle due to the cutting out of the key-beds. Some locomotive engineers, therefore, dispense with these; then the sheaves are made as just named, but lips or claws are cast upon the sides of the sheaves to lay against the edges of the crank webs by which they are driven. Both Mr. Worsdell and Mr. Stroudley adopt this method.

Fig. 86 shows the eccentrics for the model. For the large part of the sheave we make a pattern with a print for coring the lightening hole, and cut out a hole for the axle to ⅝in. diameter. Prepare a bit of wrought iron for the small part, and rough it to outline. Fit and bolt this to the cast iron before reducing the faces to finished thickness. It is well to file a check, as shown, C, partly to take a portion of stress off the bolts, and to afford a trifle more of hold to the screw-threads. We tap into the wrought iron in preference to tapping into the cast iron, because a cleaner thread can be cut in the first-named material. This means the drilling of deep holes through the cast-iron portion of the sheave. But the screws are turned parallel, and slotted across the top, to be driven in with a screw-driver which will be circular in section and of suitable diameter to pass deeply into the drilled holes. The holes had better be drilled first through the cast iron, and then those in the wrought iron marked therefrom, and drilled small enough for tapping. When this is done and the halves united securely with their screws the eccentric sheaves will be turned. In the first place, turn the two faces, making the sheave $\frac{3}{4}$-$\frac{1}{32}$in. thick, clipping the periphery of the sheave in the jaws of the dog chuck, or even driving it into a chuck of hard wood. Set the eccentric sheave next so that the joint coincides with the centre of the lathe, and bore the hole, using, not a drill, but a small side roughing tool for the purpose. The sheave must next be set out of centre very exactly to turn the outside. It cannot, therefore, be pinched on the outside, but must be held in such a manner that the outside will be left clear for turning. There are more ways than one of doing this, but the best and simplest is to make a chucking plate specially for the purpose. This, Fig. 87, is a plain-turned disc, A, having a stud, B, turned in one with it to the diameter of the hole bored in the sheave C, and with the amount of eccentricity, D, required; and there is the further advantage that any number of eccentrics which are turned upon the plate will have precisely the same quantity of throw. As the figure is drawn, the outside of the disc is clipped concentrically in the dog chuck, and then the eccentric sheave is in the proper position for turning. But the chucking plate need not be circular. It may be rectangular; but then it will be necessary to line out the sheave and adjust its outside diameter in the lathe by the scribed and centre-popped circle. The circular chucking plate saves this trouble. When the sheaves are turned, the holes over the screw-heads may be filled in with white metal.

To hold the eccentric on the stud, a key E is used. We suppose we shall key the eccentrics on the axle, and the keyways which will be required in the sheaves can be cut at once. Having a corresponding keyway cut in the stud of the chucking plate, we can key the sheave to the stud, and so secure it during turning, and there will be the advantage that all the keyways in the sheaves will occupy the same position in relation to the full of the sheave.

A templet will be used when turning the outside. It will be of the shape in Fig. 88, and in the turning of the sheave and the boring of the straps some care will be necessary in order to insure that correspondence without which their mutual fitting will be either too slack or too tight. A common nut-headed stud with a lock nut is fitted at I to tighten the sheave in position, Fig. 86, D.

The making and fitting of the straps E, Fig. 86, is as follows:—Two half-patterns are cut from solid wood, being like their castings, with allowances of $\frac{1}{16}$in. in the bore, and on the faces for machining. The joint faces are fitted, bolt-holes drilled, bolts F inserted, the strap pinched in a dog chuck, and one face turned, and the shoulder next that face bored. The strap is then rechucked, the opposite face turned to $\frac{1}{4}$-$\frac{3}{32}$in., and the bore finished. A templet, the reverse of that employed for turning the sheave, is used. Observe that the straps are turned a trifle thinner than the sheave, so that they shall not rub against each other in working. On removing from the lathe the outsides of the lugs G are filed true and smooth, and the oil-hole H drilled and countersunk. A siphon arrangement, and a cover to the oil receptacle would be used in practice.

J. H.

REFLECTORS FOR GAS AND OTHER LIGHTS.

Fig. 1.

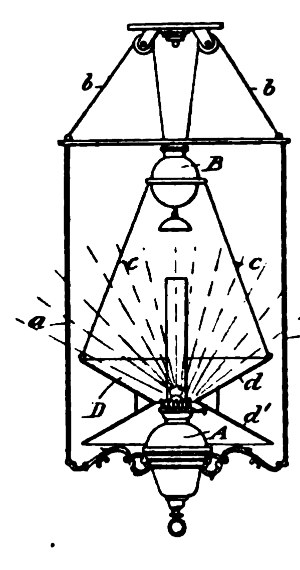
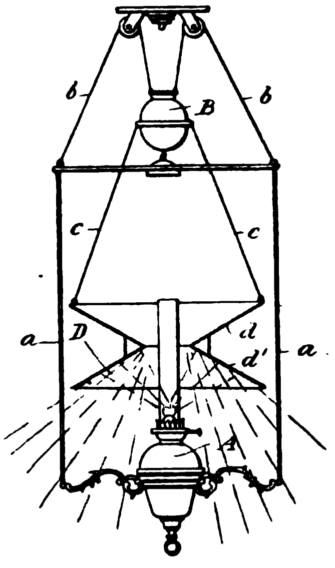
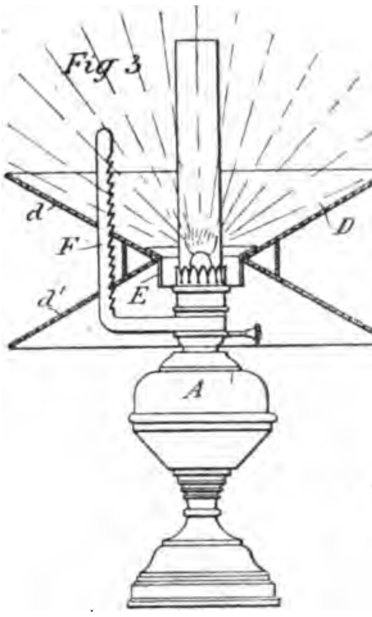


Fig 2.





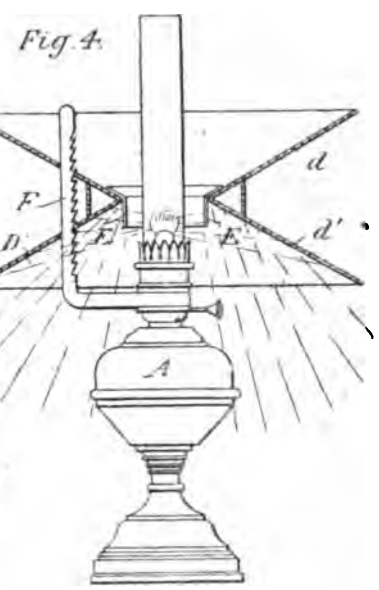
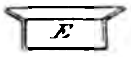


Fig. 5.



It is well known to those who use their eyes that a great deal of the light from our street lamps and others is wasted, simply because it is directed where it is not wanted; but although several attempts have been made to utilise the wasted light no successful invention has been introduced as yet. Mr. Cobbe, a theatrical manager, of Berners-street, London, has taken out patents in 1887 and last year, for devices which enable the light to be either thrown directly down, as with ordinary lamps provided with a shade, or diffused throughout the room or apartment without the direct rays coming in contact with the eye. Fig. 1 represents a hanging oil-lamp with the reflector in section and in position to throw the light upwards. Fig. 2 is a like view when the reflector is in position to throw the light downwards, and exposing the naked light free from the shade. Fig. 3 represents an ordinary standing or table-lamp, the reflector being shown in section and in position to throw the light upwards. Fig. 4 is a like view with the reflector in position to throw the light downwards, and Fig. 5 is a detached sectional elevation of the flame-shielding ring shown in Figs. 3 and 4. In Figs. 1 and 2 the lamp A is shown as being supported by a suitable frame carried by rods, *a a*, which are connected by cords, *b b*, with the weight B, from which cords or rods, *c c*, descend to the shade or reflector D. The shade D is formed of practically two truncated cones, *d d*¹, attached at their smaller ends as shown. With this construction, if the lamp-frame be lowered, the shade will be correspondingly raised. If the shade or reflector be made of opaque or non-light-conducting material, such as metal or cardboard, when it is in the position shown in Fig. 1, the light and the greater part of the heat will be reflected upward to the ceiling and higher part of the walls of the room, whence it is evenly diffused throughout the apartment without practically casting shadows and without bringing direct rays upon the line of sight. If it be desired to have the light cast downwards, as with the ordinary lamp, the reflector is so separated from the flame-level as to secure this end, as shown in Fig. 2: but in this case the reflected light has all the disadvantages common to the ordinary lamp, although the objectionable feature of having the light practically exposed on the line of sight may, to a certain extent, be overcome by the use of a ring or sleeve E, of opaque or semi-opaque material, such as opal glass, oiled paper, or similar material (as shown in Figs. 3, 4, and 5), adapted to be carried by the shade, and of a length sufficient to practically surround the flame when the reflector is raised, as shown in Fig. 4, in which, as in Fig. 3, the entire shade is shown as being carried by a toothed rack F which passes through both reflectors. Although in the drawings the invention is illustrated as being applied to an ordinary oil-lamp, it is evident that it may be also used with gas, electric, or other artificial light.

HEAT-ENGINES OTHER THAN STEAM.—IV.*

I HAVE for a long time been considering whether it was not possible to divide the various sorts of "heat-engines other than steam" into some two or more great classes, having distinct and well-defined characteristics, but I have found it impossible; and although it is not scientifically correct to speak of hot-air engines, of gas-engines, and of petroleum-engines, as is popularly done—because, as a fact, these are all hot-air engines, yet, on the whole, I think it is better in our case to follow the popular division, even though it is scientifically incorrect. I propose, therefore, first to consider "Hot-Air Engines," then "Gas-Engines," and then "Petroleum and other forms of Heat Engine," always using these titles in their popular sense.

One of the earliest successful hot-air engines was that invented and patented by the Rev. J. R. Stirling and his brother, in the year 1827.

We have already considered what is the effect produced by increasing the temperature of an inclosed volume of a gas such as air, the volume remaining constant; and I have also shown you the effect of increase of temperature on a volume of air—the pressure remaining constant, but the air expanding as heat was applied; and you will have realised that an ideal heat engine for power purposes would give the greatest efficiency if (among other advantages of which we shall have hereafter to speak) all increases of temperature in the working agent were made with its volume remaining constant (or even, it may be, being lessened), and all decreases of temperature were due to the transformation of heat into work during expansion.

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* Extracted from the Cantor Lectures delivered by Mr. H. Graham Harris, M.Inst.C.E., before the Society of Arts.

But to construct a hot-air engine such as this, in which a reasonable power might be developed, would require, among other things, enormous cylinders; for the pressure at which the engine would work would practically be extremely low, and the element of time would become of great importance, i.e., the time necessary to impart the large quantity of heat to the air, and to cool it, at each stroke would be considerable, with the result that the speed of the engine would be low. There is a device called a "regenerator," included in the first patent of Stirling, which to some extent meets this difficulty, and which, in other forms, is one of the most important devices in the arts and manufactures.

Let me try to illustrate to you what the principle of the regenerator is, and let me try first to define, pithily, the sense in which the word is here used. A regenerator is really a heat "filter," that is to say, the heat is filtered out of the hot air or of any hot gas passing through it. The apparatus consists of a series of absorbing surfaces—usually in hot-air engines there is a metal box filled with numerous thin plates, in contact with which the hot air or hot gases are caused to pass, and in doing so they give up the heat they contain to these plates or surfaces, and the hot air or hot gas leaves the further side of the regenerator at a temperature much lower than that which it had on entering it, because it has given up to the surfaces presented to it a portion of the heat which it contains.

Now, if the current of air or of gas be reversed (or if the cool air or gas be allowed to pass in the opposite direction, back through the regenerator), it will re-pick up the heat which had been left behind on the first journey, and will leave the regenerator at almost as high a temperature as that which the hot gas had on first entering it.

In Stirling's device air was supplied to a cylinder or air vessel at a pressure of about 150lb. on the square inch by means of a small pump attached to the engine, which was worked from the cylinder, the pump serving also to make up any loss of air by leakage, or otherwise. There were two of these cylinders, each with its own piston or displacer, and with its own regenerator. One was attached to one end of the working cylinder of the engine, and the other to the other end of this cylinder.

Let me point out to you what are the peculiarities of Stirling's engine. First, the air, by the alternate heating and cooling of which it is worked, has an initial pressure imparted to it of 150lb. on the square inch, and at this pressure it is maintained, as against loss by leakage or otherwise, by means of a small air-pump.

Let us now examine another hot-air engine, one of even earlier date than that of Stirling's first patent of 1827. It is certain that no record of the history of hot-air engines would be complete without mention of the name of John Ericsson, who died in America (the country of his adoption) as recently as March the 8th last. He was an engineering genius. To him the invention of the screw propeller is sometimes attributed; he is credited with designing and building the first real ironclad, completing it in 100 days from the laying of the keel-plate. A steamer fitted with a "caloric" engine, as he called it—a hot-air engine really—on his principle, was built and successfully tried. This engine was designed to develop as much as 600H.P. His patent is dated 1826. You will see that the engine shown here is a mixed air and steam engine. The atmospheric air, or a portion of it, having first been used for the combustion of solid fuel under a steam boiler, was thereby heated and was afterwards used, together with the hot gases produced by combustion, to act in an ordinary working cylinder, and thus assist the steam engine. In an alternative engine described in this patent, the hot products of combustion could be mixed with the steam from the boiler, and the two together could be used in the same cylinder of the engine. You will realise that the essence of this invention of Ericsson's, as compared with that of Stirling's, is that in Ericsson's engine a portion of the air was passed directly through the fire, and the gases of the products of combustion themselves were used directly in the power cylinder, and were exhausted after completing their work, while in Stirling's engine the air was heated, first by the regenerator and then by being brought into contact with a hot diaphragm or plate of metal, the fire being on one side of this and the air upon the other, the two not coming directly into contact with each other; further, the air was not exhausted at the completion of each stroke, but was used over and over again. Broadly speaking, these two engines represent the two great classes of hot-air engines:

In the one, the air to be used in the power cylinder, is passed directly through the fire, and goes, with the gases produced by combustion, into the power cylinder. In the other class, the air does not come into direct contact with the fuel, but is heated through an intervening plate of metal.

In an engine of either class, a fresh charge of air may be drawn in for every stroke, the air may be used under an initial pressure, or at atmospheric pressure, and may be exhausted from the engine when it has done its work, or the same air may be used continually, the power then being obtained by heating and cooling it for each stroke.

These hot-air engines of Stirling's and of Ericsson's—the earliest as they were—contained all the elements of practical success which, so far as we now know, are capable of being usefully employed in similar engines.

If this is so, you may ask me—Why did they fail to become more popular? Well, they failed from practical reasons—practical difficulties arising from working and manufacture; and as these practical difficulties and practical reasons are those which limit the useful effect to be obtained from any hot-air engines—popularly so-called—it may be as well to briefly consider them at this stage.

As I have said, Stirling's engines had the heat transmitted to the working agent—the air—through the thickness of the cast-iron air vessel shown on the diagram.

Now air is practically very difficult indeed to heat; it is one of the worst conductors of heat we know, and it is impossible in such an engine to transit the necessary quantity of heat to the air sufficiently rapidly, unless the surface exposed is very large.

Very low maximum temperatures, as a fact, are obtained with engines such as the "Stirling," where the heat is transmitted through the thickness of a metal plate. In a Stirling engine indicating as much as 37H.P., the maximum initial temperature was only about 650° Fahr., and the final temperature only about 160°, and to obtain this difference of temperature a machine, or engine, was required so bulky as to weigh a little more than one ton for each indicated horse-power that was obtained. In the steam-engine of a torpedo boat the indicated horse-power is obtained from as small a weight as 45lb., including in this the proportion of weight of the boiler and of its water.

Further, the high temperatures to which the heating vessels of such hot-air engines must be subjected in order that the temperature of the air shall be raised as high as possible, cause these vessels to be rapidly burnt out and destroyed.

You may say that, if this plan of working of Stirling's, where the heat was transmitted through a metal plate, was a failure, why not let the fire burn directly in the air which has to be heated, still using this air under an initial pressure as Stirling did? This plan has been tried in the Wenham engine—one of the most successful of the more recent hot-air engines—and in other similar engines; but, on consideration, you will see that this plan has also its disadvantages. You will see that the air, after it has passed through the fire, and has done its work, must be exhausted from the engine, for fresh air is required to support combustion, thus losing that portion of the heat taken away in the air when it is exhausted. You will also see that as the fire must be stoked, or, in other words, as fresh fuel must be supplied to it, this must be done without permitting the air which is under pressure to escape. Further, it is found, in practice, that where the fire is directly in contact with the air used for a working agent, this air takes up, in its passage through or over the fire, grit and ashes, which cause friction and rapid wear in the metal surfaces in moving contact.

This brings me to the question of lubrication, which has been a source of great difficulty. With the high temperatures, which can alone be economical, either lubrication is insufficient, with the result that the friction is great, or if lubrication is at all satisfactory, then it can only be carried out at great cost, and with some such material as plumbago.

One further and almost insuperable practical difficulty connected with this class of hot-air engines has been found, and that is the difficulty of keeping the various joints tight, and avoiding leakage. The high and constantly varying temperatures cause unequal expansion of the metals of which the heating vessels and working cylinders are composed, with the result that these are warped and twisted. Further, it does not at all follow that a joint which is satisfactory when the metals in contact are cold, and is then capable of standing sufficiently high air pressures, will be equally satisfactory when the metals are hot, or when they are subjected to numerous and rapid variations of temperature. In addition to this, a leakage of air, which is (unlike a leakage of steam) invisible, is not so simple a matter to detect; and thus the leak may only make its presence known by the lessening of the pressure and of the speed of the engine, or by its stoppage altogether. Again, in this class of hot-air engines, where the air is used under initial pressure, valves of some kind are absolutely necessary, and these are great sources of trouble, the difficulty being to keep them tight. The high temperatures cause warping, and the ashes and grit cause scoring, of the surfaces in contact.

Professor Rankine, in his work on the steam-engine, discussed very fully the various advantages and disadvantages to be obtained from the use of hot air in motive-power engines. The theoretical conclusions at which he arrived were strongly in favour of such engines, but the practical difficulties I have enumerated, and other minor practical difficulties which exist, have up to the present prevented an extended use of hot-air engines except for small powers.

In the two forms of hot-air engines which are most generally in use nowadays in England, the design is such as to eliminate most of these practical difficulties, but even in these the power obtained is small in comparison with the weight of the engine.

The "Rider" engine is one which is at present largely used for small powers. It illustrates very satisfactorily the various advantages obtained in those engines where the air is used over and over again, and is never exhausted from the engine, being heated by the external application of heat to a vessel or cylinder in which the air is contained.

I have here a working cardboard model of the engine. You will see from this that there are two vertical cylinders, each of which has in it a piston, or plunger, their strokes and diameters, however, not being equal; that in the power cylinder, in which the air is heated, being the larger. One of these may be called the compression plunger or displacer, and the other may be called the power plunger. You will see that from each of these a connecting-rod is taken, these rods being coupled to two cranks, one on each end of the crank-shaft, this shaft carrying the flywheel in the middle of its length. The cranks are placed at such an angle with regard to each other, that when one is at the bottom of its stroke, the crank of the power plunger is slightly above the middle of its stroke. You will see that under the power cylinder there is the fire, and surrounding the cylinder in which the displacer works, there is a water jacket for cooling.

Let us now move this working model, and let us place the plunger power at the bottom of its stroke. You will see that the other plunger is now slightly below the half-stroke upwards. You will also see that between the two cylinders there is a passage open at all times to both the cylinders, and having in it a series of thin wrought-iron plates placed very close to each other, so as to form the "regenerator" —the air in passing backwards and forwards from one cylinder to the other having always to pass through this regenerator. We have here, therefore, two vessels, one kept hot the other kept cold, the capacity of these vessels capable of regular variation (not only as regards each vessel, but, in some parts of the stroke, as regards each other) by the movements of the plungers, and in the passage between the two vessels there is the regenerator for storing up and giving out the heat from the air passing to and fro.

Now, the power plunger, being at the bottom of its stroke, and the fire being lit, and this portion of the apparatus being made completely hot, the air below it is heated, expands, lifts the plunger; further air is driven in from the other cylinder by the descent of the displacer through the regenerator, and around the pendent liner in the cylinder is also heated until the power plunger is driven to the top of its stroke. At this time the compression plunger or displacer, is at the half-stroke upwards, and as the engine moves on, the power plunger comes down, and hot air from the power cylinder is driven through the regenerator, where, until it has come to cool in the compression cylinder, it acts to force the displacer upwards, assisting therefore the momentum of the flywheel to bring the power plunger downwards. By the time the power plunger is at the bottom of its stroke all the air has passed into the compression cylinder; has been cooled; and has thereby had its volume reduced; then the momentum of the flywheel carries the crank shaft on; the displacer is brought downwards; the air—passing from the compression cylinder back to the power cylinder through the regenerator—picks up the heat which had been left behind in this; has fresh heat added to it from the hot sides of the power cylinder (against which it is forced by the pendant cylindrical liner in the cylinder) is by this heat again increased in pressure under the power plunger; forces this plunger upwards. This "cycle" of operations is continuously repeated as the engine works.

I have here also a working cardboard model of the "Bailey" hot-air engine. In this case we have only one vessel or cylinder, having within it the working piston and another longer piston called the displacer. At one end of this vessel the fire is placed, and at the other end there is a water jacket through which a continuous current of cold water is kept circulating. The action, as you will see, is somewhat similar to that of the Rider engine, the two pistons, however, working in the one cylinder.

You will note that in neither of these engines which are, as I have said, among the most successful and most largely used in England at the present day, is there any valve through which the air has to pass in order to go from that part of the apparatus where it is heated to that part of the apparatus where it [illegible] -1, further, the only moving parts [illegible] are those in the there [illegible] between surfaces. These engines, therefore, both of them, are free from the difficulties arising from valves subjected to the necessary high temperatures, and are also, to a very large extent, free from the difficulties of lubrication of surfaces subjected to such high temperature.

An engine has recently been devised—and I believe experimental runs are now being conducted with it—differing from both of these, for in it the air is used under an initial pressure; a portion of it is passed directly through the fire, the remainder passes into the engine with this, and mixing with the first air and with the products of combustion from the fire, together go to work the power plunger directly, being then exhausted from the engine, and a fresh charge of air drawn in at each stroke. A portion of this fresh charge of air is, as I have said, passed through the fire, but the remainder is delivered round the upper part of the power cylinder above the fire, and spreading itself round the power piston, which has—as the Rider engine has—a long pendent part below that which is in frictional contact with the side of the cylinder, sweeps downwards in the narrow space between the two, thereby (it is said) sweeping away the grit and ashes, thus preventing the excessive wear usually found to arise from these, and allowing of ample and efficient lubrication of the surfaces in contact. In this engine it is necessary (as the fire is burning in the air under pressure) that the fresh fuel shall be added without allowing escape of air. This is accomplished in an extremely ingenious manner by the engine itself, automatically, and at intervals (the fire having been once started), through what is technically known as an "air lock."

We will conclude this portion of our subject and our lecture for to-night by investigating, for some few minutes, the efficiency which has, up to the present, been obtained with hot-air engines, comparing this efficiency with that of the steam-engine. We must do this by taking as the basis for our comparison, the 11 per cent. of efficiency of the steam-engine, because that represents the percentage of effect obtained from the solid fuel which is put into the furnace of the steam boiler; that is to say, we must as far as the steam-engine is concerned, include and not exclude the boiler, and we must do this because in hot-air engines solid and not gaseous fuel is the fuel which is generally used; because it is burnt in a furnace similar to that of the steam-boiler furnace, similar in its losses and its advantages.

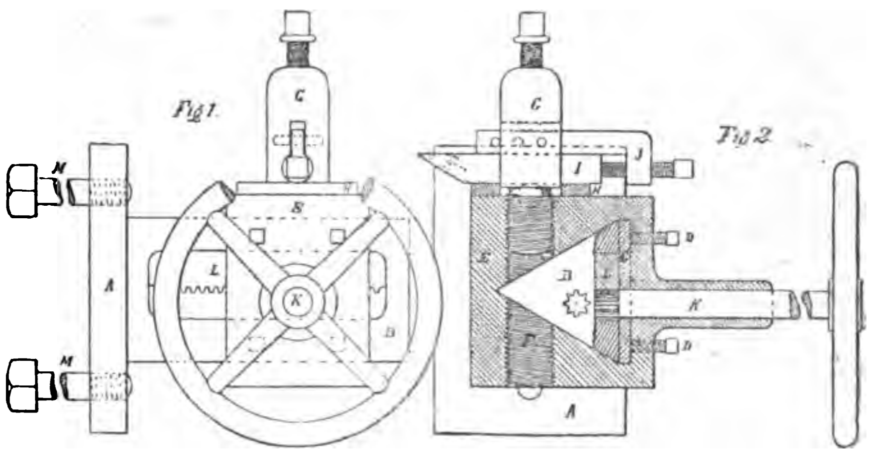
So far as I can gather, the large engine of Ericsson consumed as much as 6¼lb of coal per indicated H.P. per hour. The lowest record that I find of consumption in a hot-air engine is that in connection with the celebrated engine of Stirling, which drove the machinery at the Dundee Foundry for upwards of three years. This had a working cylinder 16in. diameter and about 4ft. stroke, made about 25 to 29 revolutions per minute, and indicated some 40 H.P. Fairly careful trials were made with this engine, with the result that it was found to consume some 2½lb. of coal per indicated H.P. per hour. This engine worked at the Dundee Foundry, doing the whole work of driving the factory for some three years; but it was then laid aside, because the heating vessels had by that time been entirely destroyed, owing to the high heat to which it was necessary to subject them in order to obtain the above power.

I think the hot-air engine—always using that term in its popular sense, and not in its truly scientific sense—is a striking example of how theory and practice are, at times, at variance. Theoretically, the mechanical efficiency of these engines should be very much higher than that of the steam-engine, but owing to the many practical difficulties of which I have told you, their mechanical efficiency is, as we have seen, very much lower.

I think, as the result of what we have learnt this evening, you will agree with me that, although there may be special cases and special circumstances which will justify—in fact, compel, if I may so put it—the use of a hot-air engine, yet it is not at all probable that such engines will supersede the steam-engine for large powers; that it is only for small powers these engines will be at all largely used; and that for large powers they are practically, from an economical point of view, unusable. It is not, in my opinion, therefore the hot-air engine which is, in the near future, to supersede the steam-engine.

SLIDE-REST FOR COMMUTATORS.

ONE of the most difficult operations to be performed in connection with an electric light station is the turning up of commutators on the dynamo machines. They are sometimes put between the centre of a lathe and turned up in the ordinary manner, but this procedure, although successful so far as the turning process is concerned, has its particular objections. In the first place, the shaft is probably sprung somewhat in securing the armature, so that it will not run true. Frequently in boring the hole through the hub, hard spots will be encountered, and when the set screws are tightened to secure the armature, the shaft has to accommodate itself in a measure to the shape of the hole. Again, the wear upon the journals has a tendency to throw the shaft out, as the metal may be closer grained upon one side of the journal than upon the other, or it may have hard spots in it. The shaft may also have been turned in a lathe where the live centre did not run true; so you see there are many little things that are likely to occur in every day practice which would prevent us from truing up commutators on lathe centres in the manner just described, and make a good job. In fact, I have seen these commutators trued up in this way run out a good thirty-second of an inch. Such a commutator when put to work, running 1,200 to 1,400 revolutions per minute, will spark at the brushes terribly, for the reason that the brushes cannot be kept in good contact with the surface of the commutator. The dynamo man will generally screw down upon the brushes, so as to get a better contact, and as a natural result tears the surface of the commutator all to pieces by abrasion of the parts in contact. I would much rather, without removing the shaft and armature from the machine, hold a piece of chalk close to the surface of the commutator and rotate it so that the chalk will touch the high spots and leave its mark. Then with a file remove the protuberances, and gradually by numerous trials work the surface down to its original condition.



This and other similar experiences led me to design and make the slide-rest shown in the accompanying engraving. The dynamo I had in charge were of the Fuller-Wood and Ball types, where to turn the commutator one has about 7in. in length, and has to work in between the end of the dynamo frame and the end of the armature. Therefore I could not use a screw to feed the tool on my slide-rest, so I adopted the design here shown in Figs. 1 and 2. I had a triangular-shaped slide made with a flange A at one end, 3in. wide, 6in. long, and ¾in. thick, for the purpose of bolting or clamping this slide-rest to the end piece of the dynamos. The slide B is 6in. long and 3in. across the sides of the triangle.

This peculiar form makes a very stiff slide, and the lost motion is readily taken up by one gib C, adjusted by four set screws D. The rest E is made of brass for convenience in working, as well as economy. A hole, F, was drilled and tapped with the 1in., eight threads to the inch, straight through, so that by changing the tool-post G from one side to the other, the slide-rest may be in a few seconds converted either into a right or left-hand, as desired. By placing the washer H under the tool I, it may set in any desired position. A gib J, provided with holes and a pin as shown, placed on top of the tool, furnishes a ready means of adjusting and feeding the tool endwise by simply turning the set screw which presses against the butt end of the tool. The rest E is fed longitudinally by means of a small pinion cut in the end of the shaft K, gearing into the rack L. For clearness a portion of the slide B is shown, broken away to exhibit the rack, and an end view of the pinion is represented to show the eight teeth. The rack is held by two screws in a recess cut for its reception, and the shaft K is loose so that it may readily be withdrawn for convenience when putting the rest away after use. By turning the 6in. wheel the tool may be firmly and easily fed as desired. The two ⅝in. bolts M M, with iron clamps and suitable blocking, will enable the workman to attach this slide-rest to almost any style of dynamo. I use bolts of different lengths, so that we can readily attach it to any one of the fifteen dynamos placed in my charge. I never use power from a belt to drive the dynamo while I am turning off the commutator, but use instead a lathe dog with a long tail which forms a crank. This dog slips over the end of the shaft and a labourer furnishes the power to rotate the armature at the speed desired. For machines where this dog cannot be used, I have a crank that can readily be clamped to the rim of any pulley, and so accomplish the desired end. In reference to the rapid operation of this tool, I may say that I have often turned up commutators that were badly worn, in from ten to twelve minutes.—Lewis F. Lyne in *Power-Steam*.

HINTS ON MOUNTING OBJECTS IN FARRANT'S MEDIUM.*

ATTENTION is being turned again to this old but too much neglected medium, the preparation of which on all the published formulæ is attended with much trouble and vexation. The chief difficulty is in filtering the viscous mass, for, notwithstanding the caution always given against stirring the mass to mix it thoroughly, in my own experience the bubbles formed in stirring have uniformly disappeared on long standing in a warm room. Air-bubbles in the completed mount, however, exhibit all the obstinacy with which they have been credited when the mass is prepared on the formula commonly given—viz., two parts each by weight of gum acacia and distilled water, and one part of glycerine. The gum is dissolved in the water, the glycerine added, the mass filtered, and a little camphor added to prevent mould. This makes a quite viscous mass which quickly dries around the edge of the cover, but from which air bubbles cannot be driven out nor poked out if once imprisoned under the cover.

For such objects as are usually mounted in pure glycerine a much thinner preparation of Farrant's medium is very convenient, and is made by simply increasing the proportion of glycerine to gum. Another useful medium, which dries readily but shrinks more than the others, is made by taking by weight 6 parts gum, 4 parts white sugar, 16 parts water, and 6 parts glycerine, prepared as described. A still further modification is made by taking 8 parts gum, 4 parts white sugar, 2 parts gelatine, 20 parts water, and 12 parts glycerine. Dissolve the gelatine first, then add the gum and sugar, and lastly, the glycerine. This mass never dries completely hard, but only to a tough, leathery consistence. In all cases a little gum camphor, phenol, clove oil, or thymol should be added to the completed mass to prevent fungoid growth.

In the preparation of Farrant's medium on any formula, much time and annoyance may be saved by making the watery solution of gum, &c., much thinner than it is required to be, and *after filtration* evaporating it to the consistence desired, and then adding the glycerine. I always add to the water in the beginning an ounce or so of a weak solution of chloral hydrate, and add gum thymol to the finished mass; a piece the size of a large pin-head will do for an ounce of medium.

In mounting in any of these gum media, much trouble is saved by first macerating the object in some of the thin medium for a longer or shorter time according to its nature—longer for dense objects than for thin ones—and then arranging the object on the slip in some of the thin medium, allowing most of the water to evaporate (protected from dust), and then adding the thick medium and applying the cover, using a light spring clip to retain it in place. Air bubbles will not be included by this method.

If a surplus of the medium was used so that much has escaped around the cover, this excess should be cleaned away within twenty-four hours after the cover was placed, while it is still soft and *tough*. If the cleaning is delayed until the mass outside the cover is *hard*, the cover will often be moved or pulled out of position by the removal of the outer mass. As soon as the partially-cleaned slide has become quite dry, the slip should be placed on a turntable, and the slide cleaned *close up to the cover*, using a knife-blade or chisel-point to cut away the gum, and a moist rag or folded blotter to finish. Then add successive finishing rings of some resinous cement. Objects thus mounted will prove as durable as balsam mounts; there will be no shrinking or distortion of soft parts, as often occurs with objects in glycerine; the most delicate and colourless of structural details are well shown, and the objects photograph extremely well.

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* By C. M. Vorce, Cleveland, Ohio, in *American Monthly Microscopical Journal*.

Air-bubbles need not be included in the mounts; but if unfortunately present, they may be removed by placing the slide in a beaker or glass vessel in which it can lie flat, putting in distilled water to cover the slide, and, after standing a few minutes, place the vessel on a sand-bath, when the bubbles will soon emerge from under the cover and rise to the surface of the water; the slide is then to be carefully removed, wiped, and some of the thick medium spun round outside the edge of the cover, which will, in drying, fill the space under the cover without admitting any air. This is much better than to remove the cover or to try to poke out the bubble, as the removal or displacement of the cover is very likely to tangle up and destroy the object.

SOME DETAILS OF LOCOMOTIVES SHOWN AT THE PARIS EXHIBITION.

IN one of his interesting letters to the *Scientific American*, Mr. Joshua Rose says:—

There are more locomotives exhibited at this exhibition than there have been at any previous one, and I believe that the same may be said as to the diversity of designs. The English seem to have settled down to a fairly settled practice in the design of many details of locomotive construction, which the French, Belgians, and Italians seem to be all at sea upon. The Stephenson link is almost universal in English and American practice, while in the exhibits here the Crampton and Walschaert valve-motions hold the field, the valve-gear sometimes sticking out nearly 2ft. from the wheels, the crank-pin receiving the piston thrust and driving the coupling-rods and valve-gear. Again, the box form of Stephenson is rarely seen in American or English practice, as it is an expensive form to work, while the amount of wearing surface on the dies is limited. It is certainly an expensive form to repair, but it displaces the solid link in French and Belgian practice.

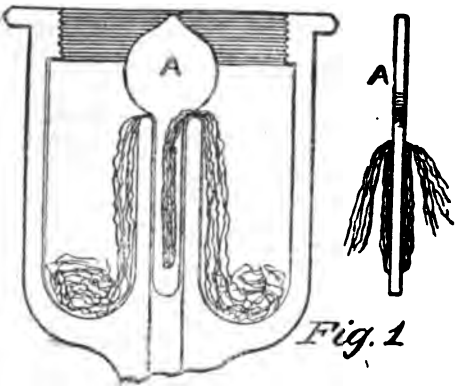


Fig. 1

Neglecting for the present the compound engines and referring to the ordinary engines, we may begin with the "Yapeyu," an engine evidently designed for the colonial trade and to meet a competition in prices, since the more costly forms of design are avoided. She is an outside-cylinder four-wheel coupled engine having a cow-catcher and buffers, the latter evidencing that she is not intended to go around such sharp curves as are often found on railroads in countries where cow-catchers are necessary. She has a single-guide bar, the connecting-rod being solid both ends, with no means of taking up the wear of the crosshead end of the rod. She has the old style of English coupling-rods, the keys of both rods being recessed for the points of the set screws (a practice that might be more honoured in the United States than it is at present). The boiler feed is supplied by a single plunger pump driven by an eccentric, and is supplied with pop-valves. There are two gauge glasses, one on each side of the fire, but no gauge cocks.

The best exhibit is one of the Midland R. Co. of England. It has an American truck, or bogie, as it is called here, and a pair of 7ft. 6in. driving-wheels, the cylinder being 18in. diameter, and the stroke 26in. The details of this engine are of the usual English type, but attention may be called to one or two points that differ from American practice. The English still cling to the old siphon-feed oil-cups, and in the case of connecting and coupling-rods (and, if I am not mistaken, sometimes in the case of guide-bars also) forge them solid on the straps. An example of one of the oil-cups on this engine is given in Fig. 1 herewith, A being a piece of brass with holes in it, through which six strands of worsted are threaded.

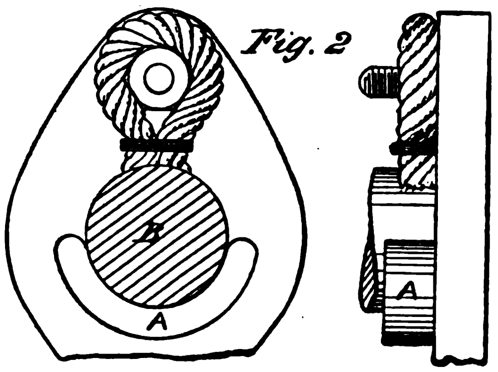


Fig. 2

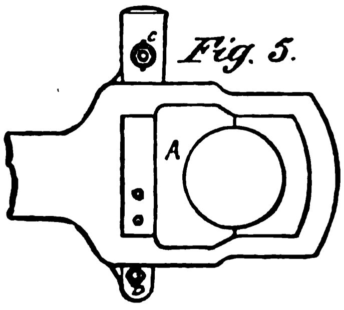


Fig. 5.

Fig. 3.

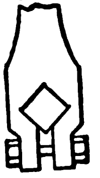
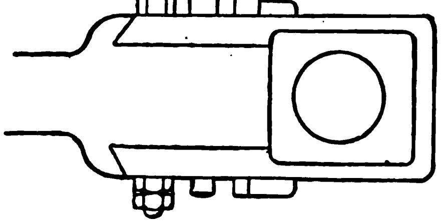


Fig. 4.



Of course such siphons feed the oil continuously whether the engine is running or not, but this has no importance in English practice. Another example of the oiling details is shown in Fig. 2, the gland having a recess, A (beneath the slide spindle B), which is stuffed with worsted saturated with oil. At C is a loop of worsted tied around the nut, and receiving oil which feeds down to the spindle.

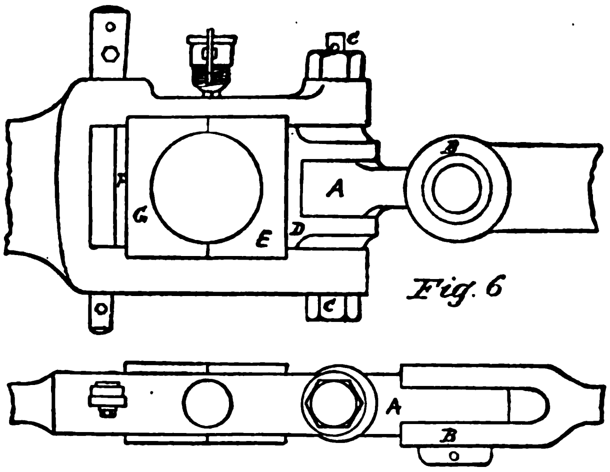


Fig. 6

The cylinders are oiled by a feeder outside the smoke box, which takes steam from the steam pipe and feeds oil into it, the feed occurring from the condensation of the steam, the accumulating water causing the oil to overflow through a pipe. The reversing gear is operated by a hand screw.

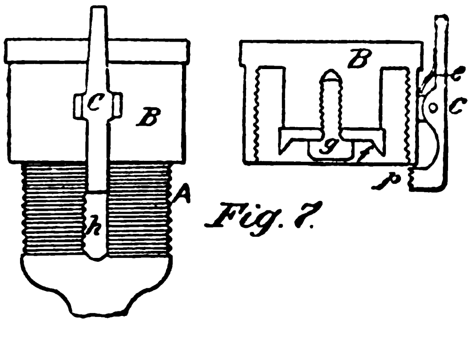


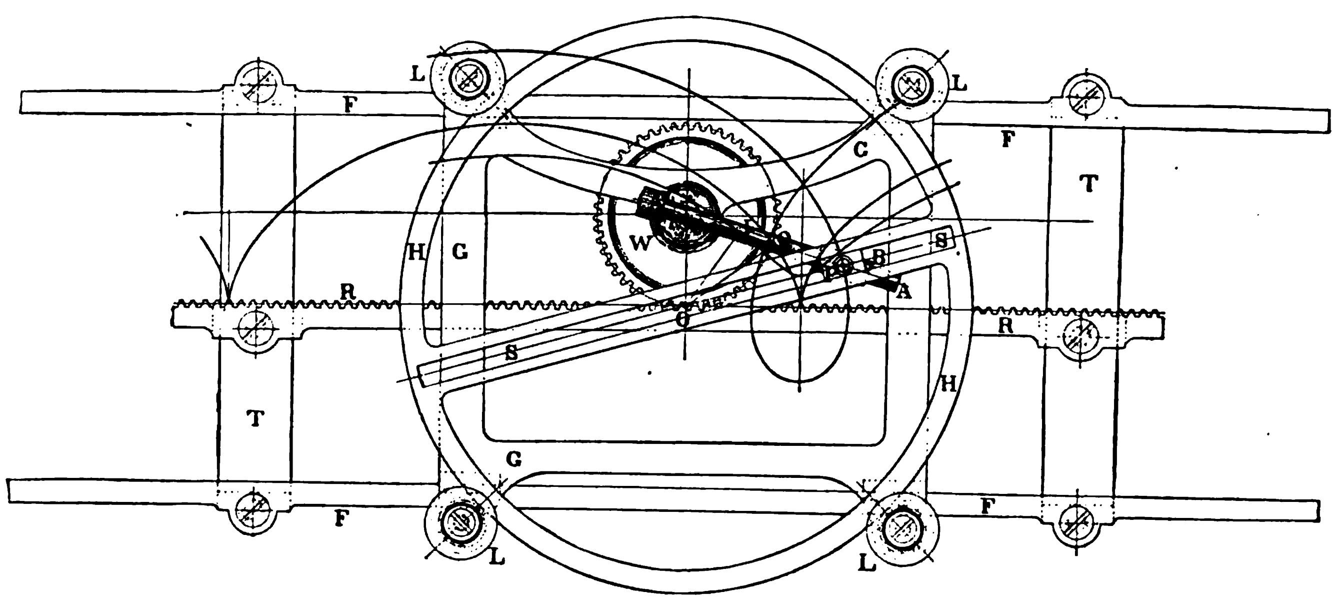
Fig. 7.

The air brakes are used in three ways, that is to say, three handles; one puts the brake full on the engine, tender, and carriages, another does the same, but more moderately, as it acts slower (its air pipe being of smaller diameter), the third puts the brake on the engine and tender only. The boiler feed is two vertical injectors in the cab.

The starting handle has a clip grip on the square of the rod, as shown in Fig. 3.

The connecting-rod of this engine is not of the ordinary English type, but of a class that is very old, and if I remember rightly was designed by Crampton, the bolt (see Fig. 4) being an addition. It is an expensive piece to make, and not so good in my judgment as the ordinary English form.

The South-Eastern Railway Co. exhibit engine No. 240, which is a good example of English practice, simple, mechanical-looking, and well built. It is a four-wheeled coupled engine with truck (bogie)



The principal dimensions are as follows:

Diameter of cylinder	19 inches
Stroke of piston	26 ,,
Pressure of steam	150lb. per sq. in.
Grate area	1,678sq.ft.
Heating surface of boiler......	1,035 ,,
202 tubes, outside diameter....	1⅝in.
Driving wheels	7ft. diameter
Weight on truck	13 tons
,, ,, driving wheels	15 tons 8cwt.
,, ,, trailing wheels	12 tons 17cwt.
Weight of tender when loaded.	30 tons
Coal capacity of tender	3½ tons
Water ,, ,, ...	2,650 gallons
Diameter of boiler............	4ft. 4in.

The transverse seams of the boiler (which has no dome) are single riveted, and the longitudinal ones double riveted with lap joints. The cylinder parts are 16in. long and 1¼in. wide. The valve lap is 1in., and the valve travel $4\frac{5}{16}$, the cylinder exhaust port being 3½in.

The reversing gear is worked by a steam and an cylinder, standing vertically on the foot-plate directly over the reversing shaft. The slide-valves are oiled intermittently from a steam oiling device n the cab. There are two injectors for the boiler feed, and a steam feed to the sand pipe, the steam et coming into the pipe close to the wheel (a plan now being generally followed in Europe). Among he many interesting details pointed out to me by he assiduous attendant of this engine is one that might more often be copied than it is—viz., there are three washers on the bolts at the foot of the ccentric-rods, which gives good facility (by reducing he washers) for lining the rods to length. The workmanship of this engine is very good, and the proportions mechanical-looking and substantial.

We may next take a Belgian engine, and the Belgians have a large and fine exhibit here. The ngine claiming first notice is labelled Grand Central Belge Atéliers de Louvain. It has outside ylinders, 24in. by 26in., eight wheels coupled, and Walschaert valve-gear. The workmanship of this ngine is very fine, and the proportions substantial nd good; but driving the valve-gear as well as the wheels from the crank-pin would be considered ecidedly objectionable either in American or English practice, especially as parts of the gear stand at least 18in. out from the wheel-hub. The oupling-rods have some details not usually found. hus, Fig. 5 shows one end of the coupling-rod, he brass A being wider than its mate to let the rank-pin flange pass through when taking the rod f or putting it on. The bolts C and D pass hrough the key and into a lug solid on the rod, and aving a slot in to let the bolts pass down with the ey. Fig. 6 shows the connection between the two oupling-rods, the piece A forming a joint for horiontal motion, and joint B one for vertical motion. his allows the rods to swivel when the engine is oing round a curve. The bolt C passes through A nd D, the latter forming an abutting piece for the rass E. At F is a plate or block, preventing the y from imbedding in the brass G.

The oil-cup of this engine is of a peculiar construction, which is being brought into use here for easing rather than oiling bearings. The cup is lled with a soft grease, which is forced on the aring by screwing down the cap of the cup. Fig. hows the construction. The outside, A, of the p is threaded to receive the cap, which has on it lever, C, threaded at *p*; *f* is a leather held to B screw *g*. The cup being filled with grease, the p is screwed on till it forces the grease down to rnal; to feed the grease, the cap is turned to screw down. At *h* is a groove with a straight side on the right hand, and running gradually out on the left hand, so that the end, *p*, of C will slide over the groove to let the cap screw down, but will abut against the straight side of the groove *h*, and not let the cap unscrew. At *e* is a spring to keep *p* on the thread on the outside of the cup. Other details of this engine are that it has a steam sand feed; the smoke-box door folds in two like a French window. There are two spring balances on the dome (not pop valves). The stuffing-box bolts on to the cylinder cover. The steam-pipes pass outside the boiler to the cylinders. The boiler, the steam-pipes, and the cylinders are lagged with polished sheet brass.

INSTRUMENT FOR DRAWING CYCLOIDS, &c.

By Prof. C. W. MacCord, Sc.D.

THIS apparatus consists of a rigid frame composed of two bars F F, and a rack, R, parallel to each other and secured to two transverse pieces T T. The outer bars F F serve also as guides, upon which the carriage G G slides freely. In this carriage is formed the bearing for the wheel W, which engages with the rack R, and rolls along it as the carriage moves. To the shaft of W is secured the crank A A, formed of a rigid steel rod, upon which the socket B may be clamped at any distance from the centre C, by means of a binding-screw, not shown. This socket B is pivoted to a block which is formed in one piece with the penholder P; and this block slides freely in the long slot S S. This slot is formed in a bar which runs diametrically across the light ring H H, whose centre is O, the point of contact of the pitch circle of the wheel W and the pitch line of the rack R. The ring H H runs freely in grooves cut in the circumferences of four rollers L L L L, which turn upon pivots fixed vertically in standards borne by the carriage G G, and symmetrically arranged about the centre O.

Thus by varying the effective length of the crank A A, the instrument can be adjusted to draw the prolate trochoid with its loop, as when the pen is at P, the cycloid with its cusp, if the pen be placed at Q, the prolate trochoid with its wave, if the pen be fixed within the pitch circle of the wheel as at I, or the right line if the pen be made to coincide with the centre C.

And the pen being fixed in the holder with its edges at right angles to the slot S S, will always run in the true direction of the curve; for the point of contact being the instantaneous axis, the central line of the slot is always normal to whatever curve the pen may be tracing; thus O P, O Q, O I, are normal to the curves above named at the points P, Q, I, respectively, and O C is perpendicular to the path of the centre at C.

It may be of interest to note that when the crank arm is either greater or less than the radius of the wheel, the ring H H moves with a variable angular velocity, except when the crank is reduced to zero by fixing the pencil at C, in which case the ring will not turn at all. But when the pencil is fixed at Q, as in tracing the cycloid, the angular velocity of the ring is constant, and equal to half that of the wheel W. So that were a machine for shaping cycloidal cams to be constructed upon this basis, the action could be improved by the addition of suitable gearing to drive the ring at the required rate.

It may also be observed that the penholder need not be formed in one piece with the sliding block, as above described. Instead of this, the sliding block, pivoted as before to the socket on the crank-arm below, may be provided on the upper side with suitable means for clamping a supplementary block or arm capable of sliding in the line of the slot S; thus the penholder, carried by this supplementary arm, may be set at any desired distance in the line of the slot, on either side of the crank pin.

If made in this way, the instrument will be capable of drawing not only the cycloid and trochoids, but curves at a constant normal distance from them, on either the concave or the convex side. Such parallel curves, when they lie on the concave side of the original or fundamental curve, sometimes present very curious and unlooked-for features. Upon the whole, then, this apparatus, when thus modified, although capable of tracing the cycloid on only one scale, may be admitted to have a tolerably comprehensive range, in respect to the variety of forms which it can be made to delineate.

THE RAILROAD TIME SYSTEM.

THE success of the railroad time system, which is now in general use in the United States, has naturally attracted some attention abroad, and its manifest excellence and convenience has been appreciated by railroad managers and others, who have had some opportunity of seeing its working. In England there has been some discussion upon the question, but the differences of time in that country are comparatively so small that it is not a question of moment. On the continent of Europe, however, and especially in France and Germany, it has been taken up, and the adoption of something similar to the American system finds many advocates.

The latest of these is Dr. Plechawski, of Vienna, who has been studying the question, and has written an elaborate article upon it. He is not satisfied with a limited application, but, with German thoroughness, he proposes to extend it to the whole world, and to establish an international time system, by which the entire circuit of the globe shall be divided by time-meridians, at intervals of 15°, or one hour apart, so that uniform time will be kept in all places within a given time-zone. He has worked out the details of the proposed system as far as to suggest names for the 24 hours, or time-zones, into which the earth will be divided under his plan.

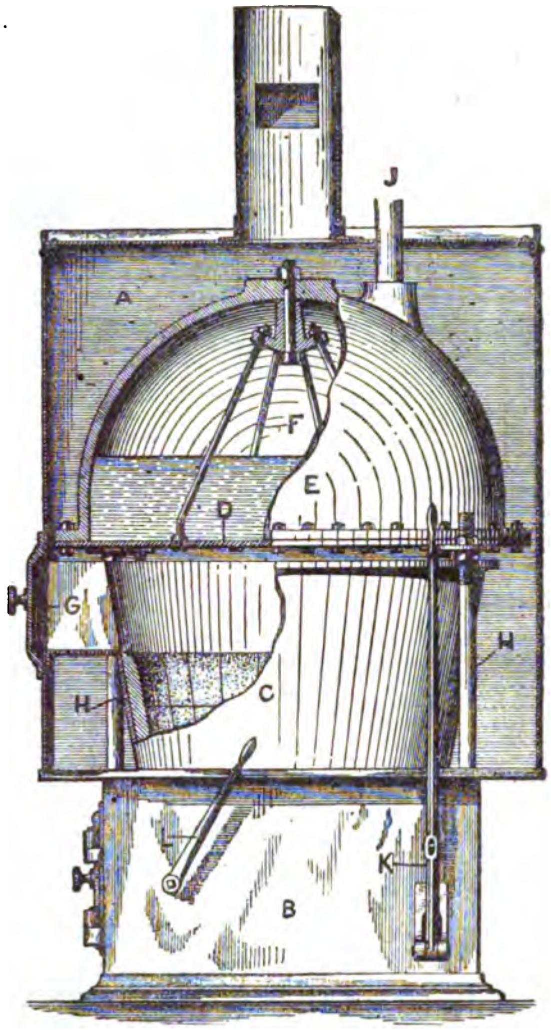
The advantages of our present arrangement over the confusion which formerly existed have been made so apparent by a few years of use that opposition to it has practically ceased in this country, and it is not unlikely that before long its general adoption will be secured, at least in all civilised countries. German opinion seems to be strongly in favour of it, and German influence in Europe will be of great assistance to the movement, although English opposition may for some time, by its obstinate conservatism, delay the completion of any general international agreement on the subject.—*Railroad and Engineering Journal* (N.Y.)

EDIBLE MUSHROOMS.

THE Department of Agriculture at Washington has recently published a pamphlet on mushrooms in consequence of numerous communications constantly received, from which it appears that in all parts of the country large quantities of edible fungi are never used owing to the inability of the people to distinguish them from the poisonous ones. In France mushrooms form a very large article of consumption and are widely cultivated. Mushroom beds are cultivated in caves frequently miles in extent. A cave at Mery is mentioned as containing, in 1867, 21 miles of beds, and producing not less than 3,000lb. daily. Another at Frepillon contains 16 miles of beds. The catacombs and quarries of Paris and the vicinity, and the caves of Moulin de la Roche, Sous Bicêtre and Bagneuse, produce immense quantities of mushrooms. They are all under Government supervision, and are regularly inspected like mines. The Chinese, who are noted for the care bestowed on their esculent vegetation, consume large quantities of edible fungi, imported mainly from Japan and Tahiti. For some years past New Zealand has exported large quantities of an edible fungus to San Francisco and Hong Kong for the consumption of the Chinese, who use it as they do the edible swallow's nest, as a chief ingredient in a favourite soup. They also employ it as a medicine, and, stranger still, for making a valuable dye for silk. Another remarkable edible fungus of New Zealand is the *Sphæria Robertsii*, which grows out of the body of a large caterpillar, practically converting the latter into a vegetable substance. The caterpillar lives underground, and the fungus springs upwards through the soil till it reaches a height of eight or ten inches. It is eaten by the Maoris, who employ it also, when burned, as a colouring matter. The Japanese grow several species of edible fungi in logs of decaying wood in a manner peculiar to themselves. Among the north-eastern tribes of Asia fungi are largely used as food. One species when pounded forms their snuff, while another, the *Fly Agaric*, which is utilised in Europe as a fly-killer, and is regarded as one of the most poisonous forms, is used by them as a substitute for ardent spirits, one large specimen being sufficient to produce a pleasant intoxication for a whole day. In Italy the value of the mushroom as an article of diet has long been understood and appreciated. At Rome it has been the custom of the Government to appoint inspectors to examine all the mushrooms brought in to market, and to reject such as are poisonous or worthless, which are thrown into the Tiber. Nearly every farm and nursery affords the conditions necessary to cultivate the ordinary field mushrooms, such as sheltered sheds, stables, and small hot-beds for winter cultivation, and melon patches, cucumber pots, &c., for summer culture. Mushroom spawn in bricks can easily be obtained from the seedsmen. Natural or virgin spawn, which is considered by many experienced growers as preferable to the artificial, can be obtained in most places where horses are kept. It is found in half-decomposed manure heaps, and is readily distinguished by its white filamentous character and by its mushroom odour. When dried it can be kept for years. Mushroom beds are easily formed on the floor of sheds by carrying in the fresh stable dung, adding to it about one-fourth of good loam, mixing both together, pressing firmly down, and letting the mass remain about two weeks untouched. By this time the temperature will be on the decline; and when it falls anywhere between 50deg. and 60deg. F. the spawn bricks should be broken into pieces two inches square and planted 12 inches apart, three inches below the surface. The mass should be beaten down firmly three inches of good soil added, and again beaten. For culinary purposes mushrooms should be generally allowed a growth of about six weeks, and when gathered should be carefully cut off with a knife, not broken. The temperature of the beds at spawning time should not exceed 80deg. F., and 70deg. F. is considered the most suitable regular temperature. It is advisable not to put the spawn at any uniform depth, but so that while one piece of it may be at a depth of six inches, or nearly so, others may touch the surface. This allows the spawn to vegetate at a depth and temperature most congenial to it. Mushrooms may be cultivated in warm cellars, in boxes about four feet square by 18 inches in depth, for family use.

FISH'S STEAM OR HOT-WATER HEATER.

THERE are numerous styles of heaters now on the market, many of which lay claim to superiority. The illustrations herewith represent one of the latest styles, the result of years of study and experience. It is called the Worcester improved automatic steam or hot-water heater, and is made by Henry C. Fish, of Worcester, Mass. By reference to the cuts herewith, it will be seen that the crown sheet, which is the heating surface, is placed as near the fire as is possible. The water is so situated with reference to the fire as to secure the most rapid conversion into steam, the immediate contact with the fire and between it, and the deflected current of heated and burning gases as shown by the cut. Special excellence is claimed for the steel crown sheet, upon which rests a shallow body of water, with a large surface for evaporation. This crown sheet, if the firing be properly managed, is very near the glowing coal, and this shallow body of water is, with wonderful rapidity, converted into steam, as any housewife will understand who has observed how much more quickly she can boil a quart of water if put on a hot stove in a broad and shallow, than in a deep and narrow dish. The steam generated directly in contact with the steel crown sheet is not cooled off by rising through a deep column of supernatant water; but issues into the steam dome as live steam ready for its work. The waste is so small that the boiler once properly filled needs replenishing only at long intervals, for the water circulates round and round in the apparatus. The need of replenishing the water is readily discovered by keeping proper watch of the indicator. The automatic draught and check is similar to that used in most steam heaters; but, unlike many, the motion of the rubber diaphragm which operates the lever is controlled by water rather than steam, which gives it a much steadier and quieter motion, while it is less likely to injure the diaphragm. By the use of more or less weight on the lever, the draught can be regulated according to the weather. A further device for controlling the draught is provided in the check draught, also operated automatically. If the closure of the draught does not sufficiently control the formation of steam, the check draught opens, and still further subdues the fire. The grate has been constructed with special reference to ease of removal of ashes, slate, etc., so that the fire may be kept bright and active. The shaking lever is long and powerful, and conveniently situated. The grate is so placed that a poker can readily be put in above it, so that ashes, clinkers, etc., can be very readily removed without dumping the grate. Dumping when needed is easily effected, and is not liable to occur accidentally. The fire is so easily kept clean without dumping that it may be kept continuously for a long period. The ash-pit is large. It will hold the ashes of several days, but should not be allowed to get too full, as it interferes with the draught, and is likely to overheat and injure the grate. The steam gauge shows at all times the condition of the steam, when there is pressure enough to move the index.



A, superheating space; B, base or ash-pit; C, fire-pot; D, crown sheet; E, dome; F, stay bolts and rods; G, feed door; H, boiler rests on; J, steam-pipe; K, grate shake; L, dump-lever.

PREVENTION OF TUBERCULOSIS.

THE conception of tuberculosis gained by the memorable discovery of the bacillus by Koch in 1881 is being rapidly pushed to its extreme logical conclusion. For it is remarkable how widespread is the acceptance of the belief, based on that discovery, that this morbid state, which manifests itself in so varied a manner, according to the tissue or organ that is primarily attacked, depends upon the introduction of this parasite into the body. The disease thereby takes a definite position amongst the infective class, since, so far as present knowledge goes, all diseases owning an ultimate cause in an organised virus are communicable. It does not matter for the argument whether—as undoubtedly would appear to be the case with regard to tuberculous affections, and as is probably true of the whole group of specific infective disorders—the victims selected have been already predisposed by heredity, environment, or otherwise to become a favourable soil for the growth of the parasite. This is a question which ought not to enter into the consideration of the preventive measures to be adopted, except in so far as it is necessary to secure that individuals so predisposed are placed under conditions the most favourable for the maintenance of general health. For it is conceivable that under certain transitory conditions an individual not predisposed may yield to the attack of this ubiquitous parasite. No better illustration could be given of the manner in which the bacillary doctrine of tuberculosis now dominates the scientific world than the fact that in Berlin, Paris, New York, and Glasgow there have been recently published declarations, police regulations, reports and judicial decisions, all of which turn upon the acceptance of this doctrine as an assured fact, with the corollary affirmation of the transmissibility of the disease from man to man, and from animals to man. The result is, and can only be, on the admission of this teaching as a proved scientific truth, the enforcement of prophylactic measures of the most stringent kind, such for example as have been widely promulgated recently by the Committee of the Paris Congress on Tuberculosis, constituted by many eminent men. The policy adopted is "thorough" enough to satisfy the most ardent hygienist; but he indeed would be sanguine who could hope to see even a tithe of these recommendations carried out in practice. For, owing to the complex conditions of civilisation, to the sentiment of humanity, as well as to the affections of the family circle, it is obviously impossible to obey these harsh, if wholesome, dictates of science. In the abstract, doubtless, such recommendations are logical and reasonable; in their application to the prevalent conditions of human existence they will fail by their own impracticability.

We talk of the segregation of lepers as the one efficient method for restricting the spread of that scourge of sub-tropical lands, and perhaps we could realise what that implies if we applied the same measure to subdue the ravages of a disease which in its extent and its fatality ranks far above leprosy. Yet, to be logical, to the one disease should be meted out the same measure as to the other, or the millennium of hygiene will never arrive.

We have stated the matter thus broadly, not because we either mistrust the evidence upon which the conclusions of the Paris Congress were based, or question the validity of these conclusions, but merely in order to point out the practical impossibility of acting upon them. Nevertheless there are directions in which it may be possible to carry out with fair prospect of success the most rigid requirements of the Congress, provided, of course, that there is good ground for the execution of such measures. It may, indeed, be impossible to protect mankind from tuberculous infection through individuals in the same way as is done in the case of contagious disease generally; but if it be true that much of human tuberculosis is derived from the lower animals it is at least comparatively easy to close this avenue of contamination. Not long ago it was maintained that bovine and avian tuberculosis were diseases of a nature distinct from human tuberculosis. Even since Koch's discovery this contention has been upheld, based now not merely upon gross anatomical differences, but on the infinitely more minute differences in the morphology of the bacilli that are met with in various kinds of animals. However, this view has now been practically abandoned, and, in his recent report to the Agricultural Department, Professor Crookshank dealt it the *coup de grâce*. It appears incontestable that the morbid condition known as tuberculosis is of the same kind in man as in those animals which are specially prone to it, some of which, such as cattle and poultry, form in many ways staple articles of human food. It has been abundantly proved that any portion of tubercular products administered to animals (prone to tubercle) in food or by inoculation will reproduce the disease in the latter; so that it would, with our present knowledge, be an act amounting to a crime to give an infant milk from a cow suffering from tubercular mammitis. Yet who knows how often this has been done in the past, or how much of infantile mortality from tabes mesenterica may be attributable to the direct introduction into the alimentary canal of the parasite—a result which would have its analogy in the induction of an attack of typhoid fever from the ingestion of water contaminated with the typhoid virus of trichinosis from the ingestion of a piece of raw, measly pork.

The Paris Congress of 1888, of which the transactions have just appeared, advanced this question a stage further, supporting it by many and forcible arguments, as may be judged by the following resolutions passed at the meeting:—"It is imperative that every possible means should be adopted, comprising compensation to parties interested, for the general application of the principle of seizure and general destruction in totality of all flesh belonging to tuberculous animals, no matter how slight the specific lesions found in such animals." And again: "The Congress expresses the wish that tuberculosis be included in the sanitary laws of all countries in the world amongst contagious diseases requiring special prophylactic measures;" whilst the French Government, at the very time of the session of the Congress, promulgated a decree enjoining the destruction of carcases in which the tubercular lesions were limited to parts of the body. This is the question which recently excited so much interest in Glasgow, where a judicial inquiry, lasting over many days, was made for the purpose of enforcing the order of the local authority for the destruction of two animals condemned as unfit for human food on account of the presence in them of such limited evidence of tubercular disease. The questions of scientific investigation were submitted to the close analysis of legal advocates, and expert witnesses were called to give evidence on both sides. The views of the Paris Congress prevailed, and Koch's bacillary theory, with all its consequences, has received judicial sanction at the hands of Sheriff Berry, who upheld the local authority, and declared that the flesh (in itself having the appearance of health) of a tuberculous animal is unfit for human consumption.—Extracted from *The Lancet*.

A NEW artificial leather is described in an English patent of 1888 by N. F. E. Rapeand, as follows:—"Leather refuse or cuttings are ground and made into a fibrous paste, with which is mixed a glue or gelatinous compound containing fatty matter and glycerine. The paste may be spread and formed into plates by machinery, to be afterwards rolled and calendered. As exemplifying the composition, the following proportions may be taken:—Leather refuse 78—90 parts; gelatine, 4—8 parts; tallow, 1—2 parts; glycerine, 5—12 parts."

SCIENTIFIC NEWS.

FROM Dun Echt Circular, No. 175, we learn that a telegram has been received announcing that Comet Brooks (*d*, 1889), discovered by Mr. Brooks, of the Smith Observatory, Geneva, N.Y., on July 6, was found by the Lick instruments on August 1 to be divided into three parts. The ephemeris of Dr. K. Zelbr gives the following position for Berlin midnight on August 14: R.A. 0h. 7m. 40s., S. Dec. 6° 29·1′. Comet *e*, 1889, which was discovered by Mr. Davidson on July 21, has been observed from Rome, the Lick Observatory, at Turin by Signor Porro, who describes it as "splendente," and at other places. Its position on August 16 for Berlin midnight (which, it may here be noted, is Greenwich 11h. 6m.) is given by Prof. Krueger as R.A. 15h. 35m. 3s.; N.P.D. 73° 53′.

The death is announced of Father Curley, S.J., late director of the observatory at Georgetown College, near Washington.

Mr. George Phillips Bevan, J.P., F.G.S., died on the 3rd inst. at Yaldhurst, Lymington, in his sixtieth year. He was a D.L. and J.P. for Brecknockshire, and a Fellow of the Geological, Statistical, and other learned societies. Mr. Bevan was the author of a great number of handbooks and guide-books, which are very popular. He also wrote industrial geographies of Great Britain, France, and the United States; edited the series of works on "British Manufacturing Industries," and, in conjunction with Sir John Stainer, wrote the "Handbook to St. Paul's Cathedral."

The late Dr. Joseph Rogers, well known in connection with Poor-law reform, has, it appears, left a sum of £500, which is to be invested in Consols, and the dividends applied, at the end of each successive ten years, to the payment of a prize, to be called the "Rogers Prize," to the writer of the best essay on the Treatment of the Sick Poor of this Country and the Preservation of the Health of the Poor, or either of such subjects. The judges of the merits of such essays are to be the President for the time being of the College of Physicians and the Master for the time being of the Apothecaries' Company, or such two or one of them as shall consent to act, and if none of them shall act, then the Vice-Chancellor for the time being of the University of London. And Dr. Rogers directs that if, at the end of any such period of ten years, no such essay should have been written in respect of such period, or if, in the opinion of the judges, none of the essays shall merit a prize, then the trustees shall apply the dividends and accumulations for such ten years for the benefit of the Medical Benevolent College, or some kindred institution to be selected by the trustees.

The following are the arrangements for the forthcoming meeting of the British Association at Newcastle-on-Tyne:—At the first general meeting, on September 11, at 8 p.m., Sir F. Bramwell will resign the chair, and Prof. Flower, the president-elect, will assume the presidency, and deliver an address. The following are the presidents of the sections:—(A) Mathematical and Physical Science, Capt. W. de W. Abney; (B) Chemical Science, Sir I. Lowthian Bell; (C) Geology, Prof. James Geikie; (D) Biology, Prof. J. S. Burdon-Sanderson; (E) Geography, Col. Sir F. De Winton; (F) Economic Science and Statistics, Prof. F. Y. Edgeworth; (G) Mechanical Science, Mr. William Anderson; (H) Anthropology, Prof. Sir W. Turner. On Thursday evening, September 12, there will be a soirée; on Friday evening, September 13, Prof. W. C. Roberts-Austen will deliver a discourse on "The Hardening and Tempering of Steel"; on Saturday evening, September 14, Mr. B. Baker will deliver a discourse on "The Forth Bridge"; on Monday evening, September 16, Mr. Walter Gardiner will deliver a discourse on "How Plants Maintain Themselves in the Struggle for Existence"; on Tuesday evening, September 17, there will be a soirée; and the concluding meeting will be held on the afternoon of Wednesday, September 18. Excursions to places of interest in the neighbourhood of Newcastle will be made on the afternoon of Saturday, September 14, and on Thursday, September 19.

The Society of Arts offers prizes amounting to £150, and 20 of the society's bronze medals, for objects of art or workmanship to be exhibited in the forthcoming Arts and Crafts Exhibition, which will be held at the New Gallery, Regent-street, from Oct. 7 to Dec. 7. The judges will be empowered to distribute the money, or such proportion of it as they see fit, in any sums they think will best meet the relative merits of the exhibits, at the same time paying due regard to the cost of production. The whole sum will only be expended in case of works of sufficient merit being forthcoming. The prizes will be awarded to craftsmen, not professional artists, and the work must have been executed in the United Kingdom or its dependencies. The objects submitted for competition may be the work of one workman, or of several workmen working in combination. They need not necessarily be the property of the workmen sending them in, as manufacturers or employers may exhibit on behalf of the workmen; but in that case, besides the name of the manufacturer, the names of all the workmen engaged on the work must be given, with a statement of the portions respectively executed by each. Full information, with forms of application, may be obtained from Mr. Ernest Radford, secretary of the Arts and Crafts Society, 44, Great Marlborough-street, W.

The Association for the Improvement of Geometrical Teaching has begun the formation of a library of reference of mathematical textbooks. It is, of course, intended chiefly for works of recent date; but it contains a loan collection of older works, lent by Mr. F. Hockliffe, of Bedford, among which may be mentioned Cocker's "Arithmetic," Tacquet's "Elementa Geometriæ," and D'Chales's "Elements of Euclid." The library is at present under the charge of Mr. C. V. Coates (2, Prince's Mansions, Victoria-street), who will be glad to receive donations of books, pamphlets, &c., on behalf of the association.

Mr. John Aitken has been visiting the Ben Nevis observatory for the purpose of investigating, in conjunction with Mr. Omond, the number of dust particles in the atmosphere. It appears that the numbers varied from 350 per cubic centimètre about noon to 500 at 3 p.m. The purest air previously examined by Mr. Aitken was on the Ayrshire coast, and gave 1,260 dust particles to the cubic centimètre. Extended observation will in all probability establish the fact of the singular purity of the air at this height, as compared with that at lower levels; and that the numbers of dust particles will be greatest at the Observatory in that part of the day when the ascending currents up the heated sides of the mountain are strongest. Dr. Angus Smith in his essay has already established the theory that the air in high regions is remarkably free from dust, and Prof. Tyndall has demonstrated the fact by his experiments in Alpine regions.

The Cameron prize in therapeutics of the University of Edinburgh has been awarded to M. Pasteur in recognition of the high importance and great value in practical therapeutics of the treatment of hydrophobia discovered by him.

In Birmingham some members of the police are told off to seize and dispose of ownerless dogs found straying about. The dogs are destroyed by means of prussic acid, and are then cremated in the furnace used for burning up the refuse from the sewage.

Mr. Edison is in Paris, and Mr. Edison has been "interviewed." Asked about his invention for seeing at a distance, he said (or rather is reported to have said):—"I am, and have been, at work at an invention which will enable a man at Wall-street not only to telephone to a friend near the Central Park, say, but to actually see that friend while speaking to him. That would be a practical and useful invention, and I see no reason why it may not soon become a reality. One of the first things I shall do on my return to America will be to establish such an apparatus between my laboratory and the phonograph works. I have already had satisfactory results in reproducing images at that distance, which is only about 1,000ft. Of course, it is ridiculous to talk about seeing between New York and Paris. The rotundity of the earth, if nothing else, would render that impossible." Mr. Edison does not pose as a savant, it seems. "Men of that sort are a great success at explaining in learned language what other men have done; but it is the simple fact that all their formulated knowledge put together has never given the world more than two or three inventions of any value. Then about inventions in general. I'll give you my idea. It is easy enough to invent wonderful things, and set newspapers talking, but the trouble comes when you try to perfect inventions so as to give them a commercial value. That's the only sort of invention I go in for."

It appears that so long ago as 1873 M. A. Pellerin described in the *Comptes Rendus*, the method of forming armature cores of discs of soft iron insulated. It would not appear that any patent subsequent to this can be valid, even in the United States.

The International Congress of Electricians commences its sittings on August 24, in the Salle at the Trocadéro.

The London and Southwark Subway is nearly complete; but some little difficulty with a water-logged bed of gravel has been experienced, and the work has had to be carried on by the pneumatic method. The rails are down between King William-street and St. George's Church, and an electrical train will shortly be tried experimentally.

Dr. H. Meyer has arrived at Zanzibar for the purpose of making another attempt to ascend to the highest summit of Killimanjaro. He will afterwards proceed to explore Mount Kenia.

Darwinism is a name that has come to stop. It appears that Dr. J. Steiner, Professor of Physiology in the University of Heidelberg, has set himself to apply to his special subject the Darwinian methods and processes which have borne such striking fruits in morphology. He begins with the nervous system, and his treatise, of which the first and second parts are published, is hailed by many of his fellow-workers in Germany as a new departure in physiological science, fraught with important results for medicine, theoretical and practical. Vieweg and Son, Brunswick, are the publishers.

Dr. R. Schäfer and Mr. H. B. Woodward call attention, in the August number of the *Geological Magazine*, to the pressing need of an "International Record of Palæontology." New species of fossils are being daily described in various countries, and it is of first importance to the student that an authentic register should be preserved. It was one of the objects of the *Geological Record* to secure such a register; but as this annual has not been sufficiently supported, it is now suggested that the Palæontological Record should be taken up by the International Geological Congress.

The Cockroach. — There is an interesting account in this month's issue of *Knowledge* of the habits and history of "the poor beetle which we tread upon," more correctly named the common cockroach. Comparatively few people know that this familiar of the kitchen is not by any means a native of these climes. It is an importation from the warm and sunny lands of Asia, brought over perhaps something like two centuries ago. The first arrivals must have reached this country as stowaways on board ship, and finding themselves in congenial surroundings they multiplied apace. Now they seem almost everywhere, but for a long time after they swarmed in the kitchens of town houses they were unknown in the country. No doubt if they had been natives of a similar climate they would have quickly reached even remote villages, but they fortunately have delicate constitutions and cannot stand exposure to cold. Many people must have noticed that it is only in hot summer weather that they are seen far away from the warmth of the kitchen fire. It is this need for a high temperature which causes them to concentrate where it is most constantly maintained. Cool larders and pantries are comparatively secure against their attacks in spite of the fact that they would find better fare therein than the crumbs and particles upon the kitchen floor. Their common description as "horrible black beetles" is a curious misnomer. They are not black, nor are they beetles; the only part of the description which is at all applicable to them is the epithet "horrible," with which few will quarrel.

Messrs. Pitkin and Niblet have presented to the Royal Society an ingenious device for ascertaining the amount of firedamp present in the airways of a mine. The instrument consists of two thermometers, one of which is of the ordinary type, but the bulb of the other is covered with platinum black. If the two thermometers are together placed in an atmosphere containing a hydro-carbon, the second thermometer will indicate a higher temperature than the first, as a slow combustion of the hydro-carbon takes place within the pores of the platinum black, raising its temperature and that of the bulb it covers. This rise of temperature is a function of the quantity of hydro-carbon present.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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WHAT DO WE SEE?—LIGHTNING.

[30239.]—While I do not agree with your able correspondent, "F.R.A.S.," that all metaphysics is logomachy, I had no intention of getting into a metaphysical discussion as to whether it is the brain, or the mind, or something different from both, that sees. I was only dealing with that which is seen—a question which I think belongs rather to physics. If I admitted that we see with the brain, it may not be the less true that what is seen is the picture on the retina. I cannot see Saturn's rings except by means of a telescope, but the rings are not in the telescope but on the planet. So I may be unable to see anything unless my brain is active, and yet the thing seen may not be in the brain. The difference between "F.R.A.S." and myself is that he regards the picture on the retina as one of several causes or accompaniments of vision, whereas I regard it as the thing seen; and I think the optician practically so regards it, though he may not express his belief theoretically. Whenever he wants to alter the thing seen he examines by what means he can make the desired change in the picture.

If there was anything in the ear which bore a similar resemblance to the thing heard, "F.R.A.S.'s" analogy to the sense of hearing might have some force. But sight is unlike all the other senses in this respect. It is in the eye alone that we meet with anything resembling the perception that follows or accompanies its presence, which we can alter in various ways by proper appliances, and every alteration in which is followed by a corresponding change in the thing perceived. Sound can of course be increased by proper appliances, and we may hereafter find means of increasing or diminishing tastes and smells; but the resemblance of these appliances to optical instruments is remote.

Reverting to the original question of direct vision by means of an inverted picture, of course, if the picture is not seen, but connected with vision in some wholly unknown manner, there is no special difficulty in supposing that the resemblance between the picture and the thing seen stops at this point, and that one is erect while the other is inverted. I can hardly believe that Nature has taken so much pains to produce an invisible picture of a visible object. If I never saw the sky except through an inverting telescope, I should never discover that the telescope was an inverting one. This is the condition in which (rightly or wrongly) I suppose all men to be. Our eyes are inverting telescopes through which we see everything, and what we see is in reality not the things themselves, but the inverted pictures of them.

An observation as old as Scheiner throws, I think, considerable light on this question. Place a small but well-illuminated object (a pin's head will do) so near the eye that it is out of focus and considerably enlarged. Introduce between it and the eye a piece of paper or cardboard pierced with three pinholes close together. Three pins' heads will now be seen instead of one. Stop the right pinhole, the pin's head on the left immediately disappears. Stop the left pinhole, and the pin's head on the right disappears. My explanation of this is that all objects being inverted, when I suppose that I am stopping the pinhole on the right I am really stopping that on the left, and vice versâ. It will not be easy, I think, to explain the fact otherwise.

With regard to another question now mooted in your columns, I may mention that some years ago I had an excellent opportunity of observing a thunderstorm from a distance, and I was strongly under the impression that the lightning flashes had a perceptible duration, and that I could determine the direction of the motion, which in nearly all instances was from the cloud to the ground. The thunderstorm took place some five miles from the elevated ground on which I was standing. It would be interesting on such occasions, however, to inquire as to whether different observers agreed as to the direction of particular flashes. If an observer standing beside me thought that it had proceeded from the ground to the cloud, while I was of the contrary opinion, the value of estimates of direction would be much lessened.

Llandudno, Aug. 10. **W. H. S. Monck.**

OCCULTATION OF JUPITER ON AUG. 7.

[30240.]—This interesting and somewhat rare phenomenon was fairly well seen in Portland. Clouds hid the actual disappearance; but the planet was seen immediately before, on what would be the line of lunar circumference. As the sun was shining very brightly, the satellites were not seen. The reappearance was well seen throughout. The satellites in the order of their position—viz., the 3rd, 2nd, and 4th, the first being in the shadow of the planet, was not seen. When the body of the planet had half-emerged from the bright edge of the moon, the appearance was very striking, like a huge protuberance on the lunar limb; when the entire Jovian system had fairly escaped from behind, it presented a very beautiful spectacle—one long to be remembered by those who saw it. The writer hopes that some of the young people to whom he had the privilege of showing the phenomenon, will have their astronomical proclivities promoted, so as to join the L.A.S., and thus methodically pursue the attractive and elevating science. Such phenomena often prove the starting point of a useful scientific career. The aperture used on the above occasion was a 4·5, with a power of 70.

Aug. 6. Occultation of 5758 B.A.C. The immersion of the above star was well seen at Portland. The disappearance was not instantaneous as usual; but the star lingered, and gradually passed from sight, suggesting duplexity in the line of the moon's radius. The emersion was not observed, owing to the interference of buildings.

W. R. Waugh.

[30241.]—It was impossible to observe the disappearance here, owing to the intervention of clouds; but the reappearance was well seen, the planet's disc appearing bisected by the moon's limb at 7h. 57m. 59s. G.M.T., and apparent contact ceasing at 7h. 59m. 24s.

The low altitude of the objects prevented me bringing to bear a more powerful instrument than a 3½in. refractor. The times of the emersions of the satellites were consequently uncertain; but No. 2 was picked up at 8h. 4m. 24s., being then an appreciable distance from the moon's limb. My station is N. 52° 30′ 10″; west 1° 53′ 15″.

Fred. Ward Nash. F.R.A.S.
Birchfield, Birmingham, Aug. 7.

[30242.]—The occultation of Jupiter, which took place on Wednesday evening, August 7th, was observed here under circumstances as favourable as might be expected after the weather of the two previous days. Owing to the cloudy nature of the sky, the moon was not visible till 6.30 p.m., and on account of the brilliancy of the setting sun the planet could only be discerned with difficulty with the telescope after 6.45, disappearing at intervals behind cirro-stratus clouds. Fortunately, at about 7, the moon and planet were visible in a fairly clear sky. The planet was seen to disappear at about 7h. 3·75m. The disappearance apparently occupied 10 seconds; but, owing to the bad definition caused by the tremulous state of the atmosphere at so low an altitude, these figures can perhaps hardly be relied on. Unfortunately, at 7.45, a shower of rain came on, and the cloudy state of the sky prevented the reappearance at 8.1 being seen. At 8.20 the moon and planet again appeared, Jupiter being well separated from the moon's bright limb. The three visible satellites were plainly seen, although in such close proximity to the moon.

The refractor employed was a 3in. Dollond, with power of 40. **F. L. Kitchin.**
Sea View, St. Bees, viâ Carnforth, Aug. 8.

[30243.]—The disappearance and reappearance of Jupiter were seen here on the evening of the 7th inst. During immersion, the clearly defined curve of the moon's limb seen on the disc of Jupiter changed later to a serrated edge, the dark projections increasing and lessening in height, one centrally placed, shooting up double its height shortly before Jupiter was finally covered by the moon. It seemed to be a kind of inversed edition of "Baily's Beads," probably the result of atmospheric agencies. The emersion of Jupiter was preceded by that of Satellite No. III. No. II. and No. IV. followed after Jupiter; but a cloud intervened before these two reappeared, No. I. being behind the great planet. As timed here, Jupiter was seconds in disappearing and 90 seconds reappearing.

Hendon, August 12. **P. F. Duke.**

[30244.]—I do not know whether any of your contributors have noticed a very curious phenomenon with regard to the occultation of Jupiter on Wednesday last. I live at Newport, Mon., in [illegible] 3° W of Greenwich, consequently Jupiter [illegible] have disappeared behind the moon's dark limb at 6h. 50m. 30s. p.m. Instead of this, to my great surprise, it disappeared about 6h. 54m. 20s. p.m., that is, about four minutes too late. I watched the egress very carefully, and noted the time when Jupiter came out; but in this case it issued exactly to the second, viz.—7h. 50m. 30s. p.m.

I do not know whether to assign this phenomenon to refraction, or to an error in the almanacs. The former seems the likelier cause, as the moon had at the end of the occultation risen out of the mists near the horizon, in which she was enveloped at the commencement. I cannot think the latter reason is right, as every almanac I have seen gives the same time, both for ingress and egress. I observed the occultation with powers of 150 and 200. Jupiter appeared as a very faint object, before sunset, at the ingress, but he could be seen plainly issuing from behind the moon at the egress.

Newport, Mon., Aug. 10. **J. H. Canning.**

[30245.]—The following are the particulars of my observation in this locality:—From low altitude of planet, I was unable to use my 6¼in. Calver reflector, so fell back upon my 3in. refractor, power 60. A heavy broken cloud persisted around the horizon, from S.W. to S.E., and two-thirds to the zenith, which made it appear a hopeless case; but within three minutes of the event, fortunately, a rift occurred, over which only drifted thin, filmy cloud, but which in no way interfered with distinct vision. Jupiter stood isolated with pale light, until the dark edge of the moon entered his disc, which advanced slowly and stately, until he was obliterated —this occupied, roughly, about 1¼ minute. The satellites at this stage were not visible—caused, I should think, from full daylight, gauzy cloud, or both combined, and probably from low optical power used. Reappearance, as gradual—impression, as though something was growing out of the bright edge of the moon. Both at disappearance and reappearance, the eye could realise and almost detect the motion of the moon.

A friend (not cognisant of where it would first appear) saw it emerge with ordinary vision. Markings on planet perfectly clear. The strong moonlight overpowered the satellites, rendering them not visible, until they had advanced about the width of the diameter of the planet from the edge of the moon, and then they shone as minute, clear points of light—the difference in the magnitude of these were conspicuously perceptible—No. 3 considerably the largest in appearance, colour of the other two more blue, whilst 3 was about the tinge of Jupiter. As reappearance advanced, the surface of the planet was more dull at the immediate side of the moon than at its own off edge, resulting no doubt from the contrasting and unequal light of the contiguous bodies. Altogether it was a very interesting phenomenon—a singular contrast between it and an occultation of a fixed star, rendering it an experience any telescopist may desire to gain.

Southampton. **S. S.**

ζ BOOTIS.

[30246.]—I know, of course, as well as Mr. Holmes (letter 30200, p. 482) that the measures I quoted of Schiaparelli's are two years old; but I also gave an estimated distance and angle for the present time. The measures he quoted of ζ Coronæ and 42 Comæ are also two years old. The latest measures I have of 42 Comæ are by Mr. Leavenworth with a 10in. Alvan Clark at Haverford College. He gives 9·6° : 0·55″ ; 1889·09. The distance and angle would be about the same now; ζ Coronæ would be about 204° 0·65″ now; μ^2 Boötis about 93° : 0·80″. Jedrzejewicz's distance is only an estimate. **H. Sadler.**

WHY HAS THE MOON NO POLAR CAPS? —TO MR. HOLMES.

[30247.]—In answer to queries in letter 30001, I will as briefly as possible say a few words; but firstly I have received no *Journal* of the L.A.S. with the article referred to, and was not aware till now that it had been published.

The grounds for my saying that "Venus has not cooled down so much as our earth" are that, while about the same size, she is so much nearer to the sun, and also has an atmosphere of nearly double the density.

There seems to be ample evidence that it is more extensive than ours, and so persistently cloud-laden that we seldom see the actual surface, and cannot easily map it. Webb says, "There is very sufficient proof of the existence of a vaporous envelope." Herschel agreed that the extension of the horns beyond a semicircle was due to refraction through an atmosphere, and Mädler traced them for 200°, and even 240°, showing a refraction about one-sixth stronger than ours. Neison has estimated the density of the atmosphere at 1·892, ours being unity; and Main, in his "Rudimentary Astronomy," says, "It may mitigate the intense heat of the sun, which yet must be far too great for the existence of plants and animals" like ours.

With regard to the atmosphere of Mars being more attenuated and showing signs of glaciation, Webb says, p. 150, that Dawes considered it of "only moderate density." It is not heavily cloud-laden, and "the disc is so well seen through good telescopes that maps of the surface have been made," the sea and land surfaces named, the polar snow caps distinctly visible, and detail often seen up to the limb. South, with an 11¼ achromatic, even saw an occultation of a star where the image was "neatly dichotomised on emerging." Main says "his climate must be considerably colder than our own."

The waxing and waning of the Polar snow-caps during the winter and summer is well known (see Webb, p. 147), but whether they would be "more conspicuous than those of our earth at a similar distance," I could not say.

The reason why the Martial "snow-caps" are not both over the true poles seems to me due to the cap forming on the nearest available land, shoal, or island to anchor it to a *floating cap on deep water would drift about and melt*. But if formed on shoals or islands in a sea, it would probably cause the complicated and lobate forms noticed by Secchi (Webb, p. 148).

Mr. W. F. Denning, in a most valuable letter on Mars, June 3, 1886, "Nature," p. 105, says that he considers "the atmosphere of this planet is extremely attenuated." He also refers to a brilliantly white bordering to the land and sea surfaces so striking as to vie with the Polar snows. Webb, again, on p. 149, says, "Some of the principal Continents are occasionally bordered with white, as though snow or clouds." Now these quotations exactly confirm my views in *re* the lunar maritime ranges being formed of snow deposit.

Vast littoral deposits of snow are what we should *expect* to see on any globe which was approaching a stage of glaciation. What says "F.R.A.S."?

Regarding the asteroids, or, rather, I should say, planetoids, I said they were "presumably" but little over the temperature of space, and hence "probably" refrigerated to the core. Surely one may draw a few easy inferences regarding these small bodies?

To the question as to how it is, if the moon is covered with snow forms from pole to pole, we yet see no trace of vapour, I reply that I do not accept as final Lord Rosse's conclusions as to a maximum equatorial temperature of + 300° C.

Neison, at p. 41, says that Lord Rosse himself did not "regard his results" as "affording any trustworthy means of determining the lunar temperature with any exactitude."

The maximum temperature is "not proven," and I accept meantime the conclusions arrived at and publicly expressed by Prof. S. P. Langley, director of the Allegheny Observatory, and Prof. C. A. Young, of Princeton, who consider that, instead of a temperature of + 300° C., the maximum is probably lower than melting ice, and may be as low as freezing mercury.

Prof. Langley has for years specially studied the question of lunar reflected and radiant heat, and his work on it will be out ere long, I hear.

I am not qualified to go into such an abstruse matter; but would point out that the question as to whether ice or snow would vaporise on the moon depends, firstly, on the temperature; and, secondly, on whether lunar ice and snow are absolutely identical with ours? With us they cease to vaporise at about minus 70° or 80° C., even in vacuo.

What I am endeavouring to do is to show that from the character of the surfacing alone we may get a clue as to the present condition of our satellite; that a theory of glaciation will not only release us from many insuperable difficulties, but solve for us the many peculiar features that are now enigmas. But it is so hopeless to explain all piecemeal, by notes and letters, that I am having a small edition of the theory printed, about 100 copies, 50pp. 8vo., with diagrams, so as to lay before astronomical societies and leading astronomers.

With the rupee at 1s. 4½d., and tea literally nowhere, I can't afford the luxury of a large edition; but, if anyone desires a copy, I have no doubt Messrs. Thacker, Spinks, and Co., publishers, Government Place, Calcutta, would print a few extra, and forward at cost price on receipt of a foreign postcard. I fancy 2s. 6d. will about cover all, perhaps postage too. I will write them of it.

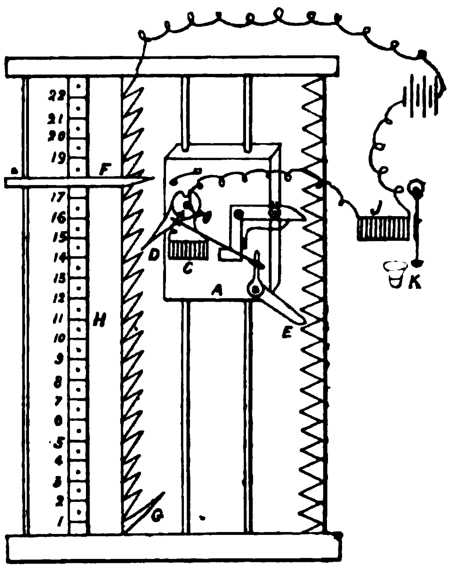
Regarding the absence of water and water forms on the moon, does Mr. Holmes look on it as surfaced by "organic rocks"? Prof. Judd, in his "Volcanoes," pp. 305-6, tells us there is no water, because there are no signs of sedimentary rocks, rivers, &c. He also clearly *demonstrates* to us that without water there can be no volcanoes. Luckily, he leaves us the organic series, and if Mr. H. can surface the moon by these alone, I—well, I cave in.

According to my idea, the entire surface and all its many peculiar formations, is snow, and the only exception is where Dr. Klein and Co. see, as *minute black* objects, a few high mountain peaks rise to the surface of the snow winding-sheet.

Sibsagar, Asam, July 6. **S. E. Peal.**

A TELE-INDICATOR.

[30248.]—Having seen in one of your recent issues the description of an instrument named a tele-indicator (page 431) for indications of water-levels, &c., I have given a rough drawing of one which would be simple if practicable. It is simply a block, A, raised up the slides by a lever, B, actuated by an electro-magnet, C. As soon as the contact piece D rises above the tooth the current stops, and the lever B falls back from C, catching another tooth; the block A being held up by the ratch E until D makes contact again by falling into the tooth. When it reaches the pointer F, it is thrown back and held by a spring, whereby, letting the block fall to the bottom, when the contact piece is replaced by the cam G, ready to repeat the current waves or successions ringing an electric bell according to the number of teeth it rises.



I should be very glad if any of our electrical friends would let me know if this is practicable, or point out my errors. **Weir.**

THE DANGER OF WATER FILTERS.

[30249.]—The report of Dr. G. T. Swarts, on page 411, is a strong one against the use of filters. Filtration through sand at the water companies improves the quality of the water, and I do not believe the sand is changed very often: the top part only is scraped off and washed and returned. Now, why should domestic filters do harm to the water instead of good? I have had a practical experience in these filters, extending over a period of six years, and have inspected hundreds of them in private houses, and from the state they were in I should say the people had far better be without one. But we will not suppose Dr. Swart kept the filters he was experimenting with in such a state, but gave them a fair trial; then, why the increase of organisms? There must be a reason, and I attribute it to the use of animal charcoal, which, with a very few exceptions, has been used by filter makers for the last 20 years as their medium. Animal charcoal contains phosphates, and phosphates are the very food on which these organisms thrive best; and recently nearly every filter maker has taken to use asbestos cloth somewhere in the body of the filter, and this cloth contains in its meshes small particles of organic matter, such as straw, &c., which decompose when they are soaked in the filter. However much care is taken to get this cloth pure, it will not remain long so, as it has such a peculiar clingy nature it will pick up the first dust and dirt that comes in contact with it, which cannot be good in the body of a small filter where the water remains often a long time stagnant. To obviate the water laying in the filter and becoming stagnant, I made a small filter to attach to the tap, and used a small quantity of very fine medium spread over as large a surface as I could obtain, with means so that the medium could be quickly and easily removed; but the filter stopped up in such a short time it was of no practical use.

This led me to the conclusion that tap filters were of two classes—those that filtered and got stopped up; and those that did not filter, but run for ever without stopping. This last class do not filter at all, hence a gravity filter is the only one on a small scale that can do much good; but it must be looked after by the owner. The medium must be easily removed, and replaced by a new one; it must not contain anything that can directly or indirectly contaminate the water, and such a filter has not yet been made to my knowledge. I have noticed all the faults in existing filters, and am trying to make one with as few faults as possible, if any, and hope soon now to have such a one ready. The following is the analyses of two samples of water. The first is water taken from the Thames at the Custom House before filtration, and the second is the same water after having passed once through the medium which I intend to put in this filter. You will notice there was a faint trace of phosphoric acid in the original water, and the filtered water contains none. This medium is a mineral.

ANALYSES.

Physical Characteristics:—

	Unfiltered.	Fltered.
Colour when examined in a tube 2ft. long	Muddy, very opaque	Pale blue, clear.
Suspended matter	Very heavy	None.
Smell when heated to 100° F.	—	None.
Taste ,, ,, ,,	—	None.
Hardness before boiling (Clark's scale)	16°	15°
,, after ,, ,,	10°	8·5°

Chemical Results:—

		Grains per Gall.
Total solid matter	23·80	20·16
Loss on ignition after deducting combined carbonic acid	·56	·28
Total mineral matter	23·24	19·88
Chloride of sodium	1·96	1·96
Lead	None	None.
Copper	None	None.
Iron	None	None.
Phosphoric acid	Faint trace	None.
Nitrogen as ammonia	·0090	None.
,, albuminoid ammonia	·0041	·0017
,, nitrates	·2370	·2350
Oxygen absorbed by organic matter from solution of permanganate of potash.... at 80° F. in 2 minutes	·0056	None.
Do. do. do. do. in 4 hours	·2000	·0224

(Signed) R. H. Harland, F.I.C., F.C.S., Public Analyst to the Greenwich Board of Works and to the Mile End Vestry.

Of course, the medium used must be such as will give no earthy salts which the water can dissolve, or else we should have waters showing mineral matters such as Mr. G. E. Davis quotes in his article on "Water Softening," on which I will, with the Editor's permission, say a few words.

Water Softening.

Mr. Davis's able paper confirms my experience. I was asked to soften 100,000 gallons of water per 12 hours. The water gave the following results in analysis, and I have also added the results of the analysis of the softened water:—

	Hard.	Softened.
Temporary hardness	25°	1°
Permanent ,,	12	·5
Total	37	1·5
	Grains per gallon.	
Total solid matter	66·08	77·28
Loss on ignition	·56	5·88
Total mineral matter	65·52	71·40
Carbonate of lime	13·00	·50
Sulphate of lime	2·88	None.
Sulphate of magnesia	17·55	Mere trace.
Chloride of sodium	1·96	2·00
Sulphates present as sulphate of potash and soda	Heavy...	Very heavy.

The above was softened with caustic soda, and the cost of soda per 1,000 gallons at the then market price would be about threepence. This water was for use in steam-boilers only, and the reply my clients gave me was this: "The matter of expense we are afraid puts an end to the business."

Sulphate of magnesia does not in practice seem so difficult to remove as carbonate of magnesia. Lime precipitates the carbonate of magnesia, but it redissolves as hydrate of magnesia. Flocculent precipitates, like magnesia gives, are more difficult to deal with on a large scale than granular precipitates. They choke a filter up soon if filtered, and if you try settling-tanks you can hardly get them to settle, as the slightest agitation keeps them floating about.

I will give an example of a water that from a chemical view is very easy to soften, but in practice it is found much more difficult.

The following are the results of the analysis of this water:—

	Grains per gal.
Carbonate of lime	21·70
Sulphate of lime	1·87
Carbonate of magnesia	2·30
Iron	2·24
Chloride of sodium	1·90
	30·01

This water pumps clear, and on admixture with lime-water, gives a flocculent precipitate floating in a water the colour of pea-soup; it is not wanted for boilers, but must be free from iron and perfectly clear after treatment.

The results of experiments with small quantities of this water were very satisfactory, but it turned out a much more difficult matter when treated in the same way on a larger scale.

C. E. Gittins.

St. George's House, Eastcheap, Aug. 5.

VACCINATION—ITS SEQUELÆ.

[30250.]—At the Cardiff Police-court recently—before Mr. T. W. Lewis (stipendiary), Dr. Paine, and Mr. J. le Boulanger—Benjamin Gadfield, of 8, Clive-street, Canton, was summoned for refusing to have his child vaccinated. The defendant said that he had a lad at home, twelve years of age, who had been vaccinated, and had never been well since. It was, indeed, improbable that he would ever be able to do a day's manual labour in the course of his life. His health was perfect until vaccination; shortly afterwards his "blood broke out all over his body." He (defendant) had also buried two children, one two months and the other three months, after vaccination. His wife, he admitted, was a delicate woman, but she had never suffered through anything of this kind. He himself had never been vaccinated, and was in perfect health. The Stipendiary held that the excuse was a reasonable one, and dismissed the case.—William Mills, Elm-street, was summoned for a similar offence, and excused himself on the ground that he had conscientious objections. It was too painful a subject, he said, to go into in open court, but he handed the Bench a cutting from a newspaper which referred to his own sister. The Stipendiary remarked that there was nothing to show that the disease from which the young woman was suffering was the result of vaccination. The defendant admitted this, but said his suspicions were that that was the cause. The Stipendiary fined him 1s. Defendant said he would refuse to pay, and an alternative of seven days' imprisonment in default of distress was imposed.

An infant, the first-born of a "healthy young couple," has just been brought to me, covered with scabs and pustules, who was vaccinated three months ago with lymph taken from a child, the progeny of a couple *both syphilitic* (this, however, was not known to the operator, though known as a fact to me), the consequences of which vaccination will probably, in the words of that most just Commandment, the Fourth, be "visited upon its (the infant's) children unto the 3rd and 4th generation."

Again, a child of healthy parents, four years old, vaccinated when three months old, presents this appearance—i.e., each of the four cicatrices of vaccination has a bright, scarlet-red, elevated, dry, shining pimple or papule; over the greater part of the body, notably on the thighs, abdomen, and chest, these pimples cause an intolerable itching which no amount of scratching can relieve. This condition has existed at least three years, the papules being in appearance identical with those of syphilis in its earliest form.

The Lydney Dispenser.

RAILWAY COUPLING APPLIANCES.

[30251.]—In reply to "Vauxhall," who intimates that I am only a new subscriber, I may tell him that I am not only in possession of the number he quotes—viz., 1,100, but have been a subscriber for 8 or 9 years previous. The article he refers to merely gives the outlines of the whole appliances in one number, and in a jumbled-up manner. Now, as the Government is at present being pressed by deputations of M.P.'s, and otherwise, to introduce a compulsory clause into the Railway Regulation Bill to compel the adoption of some safety appliance, through the recent enormous increase of accidents through coupling and uncoupling, I thought the time opportune, and "Ours" the most suitable paper, with C. E. Stretton the most able correspondent to describe and give his own opinions as to the merits or demerits of those appliances that he thought might be selected by the Board of Trade for universal adoption. This Act would be an aid to suffering humanity.

Old Hand.

THE ARMAGH DISASTER.

[30252.]—It was mentioned in a recent issue of the "E.M." that the four railway servants charged with manslaughter in connection with the accident at Armagh would be tried at Dublin at the Assizes, which commenced on the 6th inst. Yesterday (Friday, 9th) the inspector in charge of the train was put upon his trial, when the jury disagreed, and were discharged; a new trial will, therefore, have to take place. The general details of the accident will be fresh in the minds of your readers; but it may here be mentioned that an excursion train consisting of fifteen carriages required to run over gradients of 1 in 75 should have been worked by a six-wheel coupled *goods* engine, and not by a four-coupled engine; and most certainly the driver sent with such a train should not have been a man who had never driven over the line before, and who did not know the gradients. Under those circumstances, and together with the fact that the engine was provided with soft bad coal, I am not surprised that the train "stuck" upon the incline. Acting upon rule 370 A, the inspector in charge decided to divide the train, intending, after taking the first part to the top of the incline, to return for the second portion. Smith's vacuum brake was applied and held the whole train upon the gradient of 1 in 75; but when the pipes were uncoupled, that brake being non-automatic, was rendered useless, and the rear part of the train ran back, coming into collision with the following passenger train, and 78 persons were killed and 260 injured. It is hardly necessary to point out that if the brake had been automatic the accident would never have occurred: and if the block-system had been in use the ordinary train would not have been allowed to start from Armagh until the special train had arrived at the next signal-box. Out of 519 miles of line, the Great Northern Company of Ireland only works 23 miles upon the block system, and that company has not one single engine or vehicle fitted with a continuous brake fulfilling the "conditions" of the Board of Trade. Under such circumstances it certainly has throughout appeared to me that the system of working is far more at fault than the unfortunate railway servants who have to be tried for manslaughter.

For very many years I have pointed out in your columns the necessity for the use of automatic brakes and the block system, and it is well known that several Bills have been introduced in Parliament to enforce their use. It is satisfactory to find that one result of the Armagh Disaster is that such a Bill is now being quickly passed into law. However, it would have been much better if such a law had been passed some years ago, and before such accidents as Penistone, Hexthorpe, and Armagh occurred.

Clement E. Stretton.
Consulting Engineer Assoc.Soc.
Holyhead, Aug. 10. Enginemen and Firemen.

"DREADNAUGHT" LOCOMOTIVE ON PENNSYLVANIA RAILROAD.

[30253.]—The new English locomotive "Dreadnaught," which has just been imported by the Pennsylvania Railroad, isn't as symmetrical and pretty as some of the American engines now in use, but she has a decided air of usefulness about her, and there seems but little doubt that she was built for business. The wonderful records ascribed to English engines, and the great amount of puffing that they have received in both that country and America, influenced the officials of the Pennsylvania Railroad to purchase one of the most noted of the British machines, and bring it to this country for a thorough and practical test.

The Dreadnaught is a duplicate of one of the most famous engines in all Europe. She is a compound engine and has three cylinders, one low-pressure inside and two high-pressure outside, two pairs of driving wheels, unconnected, and substitutes for the old-time link motion, with eccentrics on the driving axle, a valve motion, in which the connecting rod is the first attachment and source of motion to the valve-gear.

The engine is run by an English engineer, and is accompanied by a machinist from the shops at Crewe, whose duty it is to see that it is given all the advantages possible on the road. At 6.52 o'clock one morning, loaded with an unusually heavy train, the Dreadnaught left Johnstown and started merrily off down the mountains towards Pittsburg. The distance, seventy-three miles, was run in the usual time, three hours and thirty minutes, and little difficulty was experienced except in starting on [illegible] of [illegible] The engine has been tried a the eastern division of the road, and after a few runs over the middle division will be tried over the Fort Wayne and Panhandle routes. When asked as to the success of the new engine, Superintendent Pitcairn said:—"I really can't answer that question very satisfactorily. We have brought the engine over here, and we intend to give it a thorough and practical test over all our roads. The idea is to find out whether English engines really are better than ours. The Dreadnaught so far has been doing all right. She hasn't stalled on any of our heavy grades, so far as I know, and seems to have a good deal of speed. One disadvantage is the slowness with which she gets under way, and that, you know, is an important point with us on this end of the line. I am really unable to predict the final result of the test. It is too early yet. We are after improvements in engines, however, and if we find something better than we are now using we will not be slow to adopt it. The Dreadnaught does not use so much coal as our old engines, there being a saving of something over eight pounds of fuel to the train mile. This, of course, is a consideration, other things being equal."

Difficulty in starting has been found in nearly all the trials of the Dreadnaught so far. This results from the fact that the starting of the train must be done with the high-pressure cylinders—and under some circumstances only one of them would be of any practical use—as the low-pressure cylinder would be inoperative till it received steam from the high-pressure ones. Hence, on starting the Dreadnaught, or any similar engine with a heavy train on a grade or a greasy rail, the hind or high-pressure drivers slip and the engine remains stationary until the high-pressure pistons have performed a stroke or two and have given the low-pressure piston a supply of steam. The low-pressure cylinder then lends its aid to start the train, and both pairs of drivers being now utilised, the engine moves off.

The Dreadnaught, in working order, weighs 95,200 pounds, and her tender (empty) weighs 27,000 pounds. Her driving wheels are six feet three inches in diameter. Her outside cylinders are 14 x 24 inches, and her inside (low-pressure) cylinders 30 x 24 inches.

The Dreadnaught has taken a train weighing, with engine and tender, 464,000 pounds, up a grade of seventy feet to the mile, four and one quarter miles long, at the rate of thirty-three miles an hour. She has pulled a train weighing 544,000 pounds from Euston to Crewe, 158 miles, in three hours and thirty-four minutes, including two stops, or at the rate of 44·3 miles an hour, and without stoppages forty-six miles an hour—very fair speed for a train providing accommodation for 350 passengers and their baggage and hauled by one engine. Outside of England no train of anything like this weight is run at forty miles an hour, including stoppages. Her coal consumption is twenty-nine pounds per mile, evaporating nine and one-half pounds of water to one pound of coal. All of these figures have been surpassed in the performance of other engines of this class.

San José, Cal. **S. H.**

AMERICAN ORGAN v. HARMONIUM.

[30254.]—I cannot ask the Editor to repeat for a third time my unanswered query as to "why" expression cannot (as is asserted) be obtained on the A. O., for I know well that those who have written on the subject have shown their want of knowledge—that is, those who say that expression cannot be obtained. I repeat what I said years ago—as much expression as can be obtained on the harmonium can be got out of the A. O. (I have not the slightest interest in the sale of either). "Country Solicitor" (p. 502) does endeavour to answer what he is pleased to call my "pertinent question"; but I trust he will excuse me if I tell him that he is mistaken in saying that A. O. reeds will "not stand the blowing." On the others I do not intend to waste a line; they will not or cannot answer my question "Why?", and so far as I am concerned they may twaddle on for ever, for, as I said above, I have no interest in the matter—except a regard for truth.

Organon.

[30255.]—In his letter on p. 502 your correspondent, "A Country Solicitor," says that "to get the full benefit of Mustel's exquisite blowing the soles of one's boots are a nuisance." Does the trombonist take off his coat in order to obtain expression? It seems to me that there is some exquisite nonsense here, and also some clever advertising, with not a little want of good taste, as there can scarcely be space to give the programmes of all the "musical evenings" held by your readers. Surely "A Country Solicitor" understands that the reeds of an American organ are "so thin" because they are used on a suction wind; they could be made as thick as some people's heads if necessary. There is a good deal of "exquisite blowing" about, but it has all been exposed in the "E. M."

Not to be Humbugged.

[30256.]—I quite agree with "Country Solicitor" (p. 502) in his high appreciation of the Mustel instrument, but I cannot agree with him in his opinion of the capabilities of the American organ. Is he aware of the fact (facts are stubborn things, remember) that the expression stop has been applied to the American organ, and that it can be applied, without any practical difficulty, to every American organ under the sun? The knee swell is, as a rule, the substitute, and furnishes a means of expression which is easily managed by the majority of players on the American organ. As regards the reeds in the American organ, I can venture to assert on good grounds, they are superior in quality of the metal of which they are constructed to many of the reeds that are used in the majority of harmoniums. Practical men are also fully aware that the American organ reeds are subjected to as much, if not more, pressure of wind as harmonium reeds. The former may be a trifle thinner; but taking into consideration the quality of the metal used in American organ reeds, this fact goes to show up the fallacy in entertaining the opinion that American organ reeds will not stand blowing when the expression stop is in use. The idea is rather absurd. A thin reed, constructed of good metal, will stand more blowing than a thicker reed of inferior metal. All the correspondents who have written, and who intend to write, on this subject, would do well to adhere to facts, and give the preference to the opinion of practical men. The majority of players, either on the American organ or harmonium, are not, as a rule, practical men. Those who manufacture organs and harmoniums know best the capabilities of these instruments. In the matter of construction a good player is only a mere theorist. He understands how to manipulate the keyboard, and beyond that his knowledge is as a rule, mere theory, and therefore not practical. His opinion must be taken for what it is worth, and his knowledge of the capabilities of the American organ must be measured according to his practical experience. There is also something more to be said. Many players on the American organ do not understand properly the use of the various register stops. I have had this fact proved to me on several occasions. To be fair, let those who prefer the harmonium have one by all means; but let them not despise and run down the capabilities of the American organ until they have attained a thorough knowledge of its construction. Why don't Mr. Casson and your correspondent "998" come forward and answer the plain question which "Organon" has put to them on p. 459? I know the reason. It is plain. They cannot answer the question satisfactorily, because of existing facts.

Swansea. **G. Fryer.**

EIFFEL TOWER AND THE CONVEXITY OF THE SEA.

[30257.]—Mr. John Hampden's letter (p. 506) is only another specimen of his crude theory, founded on no evidence worth having. So many abler pens than mine have already refuted him, that it is scarcely worth while to flog a dead horse. Mr. Hampden says that "a passenger on the Orient liner, *Iberia*, saw Port Said light, which is about 60ft. high, at 7.30 p.m., then 90 miles distant, and that at midnight the ship was alongside the lighthouse, having sailed 324 miles in 24 hours."

Mr. Hampden does not think it worth while to mention the name and occupation of his correspondent, and how he came to be certain that the light he saw at 7.30 p.m. was that of Port Said, and that it was then 90 miles distant. Nor does he explain how it was that the *Iberia*, making 324 miles in 24 hours, or 13½ miles per hour, managed to get over the intervening 90 miles between 7.30 p.m. and midnight, which would have required a speed of 20 miles an hour, which the *Iberia* cannot do. Nor does Mr. Hampden think of correcting his traveller's erroneous statement that Port Said electric light is about 60ft. high. It is really 176ft. high. The explanation probably is that Damietta light is, roughly, about 50 miles from Port Said, and the traveller probably saw it at 7.30 p.m., when 10 to 15 miles distant, and at midnight woke up and found himself at Port Said—a very different way of looking at it. Mr. Hampden finds fault with our nautical tables. He would do better if he set to work to correct them.

T. S. Kennedy.

[30258.]—Mr. John Hampden states that a correspondent tells him that the Port Said light was seen when ninety miles from the ship; but he omits to mention at what distance above the horizon the observer was placed. It makes all the difference if he were at the masthead or on deck, the masthead of a P. and O. being about 160ft. above the level of the sea. Now, Sir, I have a slight acquaintance with the place in question, having for four years been cruising from the Levant to Gibraltar, and I assert, from personal knowlege, that the light at Port Said cannot be seen from the deck of a vessel at the distance of ninety miles. Anyone who has ever been to the East of Gibraltar will tell you that objects at a distance there are as difficult to see as they are in the Atlantic, or, for the matter of that, in any other sea. To me, as a sailor, without a theory to air, this gentleman's argument seems to be absurd, to put it very mildly. Could he but come with me as far as the Cape of Good Hope, I would engage that, on his return, the readers of "Ours" would have quite another story from him, instead of the "horse-marine" yarn he has hold of now.

T. E. Kerrigan, R.N.

Wrentham, Suffolk.

[30259.]—It is, of course, useless to think of altering the ideas of one who is so positive of their correctness as Mr. Hampden is; but, to an unprejudiced observer, a very beautiful proof of the convexity of the sea is to be found in the well-known fact that the light of a light-vessel, which is 35ft. to 40ft. above the water, when looked at from the limit of its range—say, about 10 miles—may be clearly seen from the bridge of a vessel, and be quite invisible from the deck.

I saw a similar thing recently while observing the flashing light of Ailsa Craig Lighthouse from Kildonan, in the south of the island of Arran, a distance of about 16 miles, as it disappeared when I was on the beach, although it was distinct and bright when I looked at it from a bank 5ft. or 6ft. high. **G. H. S.**

SCALE AS A CAUSE OF BOILER EXPLOSIONS.

[30260.]—In your country, I believe, you have an official examination of every case of boiler explosion, which used to be done very well by the Association of Steam Users; but although the elaborate illustrated reports which are "printed for Her Majesty's Stationery Office" may do something to prevent explosions, I believe that something is very little. Here we think that scale is a very important factor, although it should be borne in mind that preventing the formation of scale is not all that is required. If the scale-making matter is prevented from adhering to the metallic surfaces of the boiler, it is nevertheless present in the boiler, and must be got rid of, or it will do serious damage.

With some kinds of water, it is doubtful if anything so far known, mixed with the water, will prevent scale on some parts of a boiler, although much will depend upon the construction of the boiler. Good judgment, therefore, would, in cases where it is difficult or impossible to entirely prevent the formation of scale, lead either to the use of a type of a boiler that can easily be come at in all its interior parts for removing the scale, or one so constructed that the circulation of water prevents scale formation in parts where it would be dangerous, and with good provisions for removing the greater part of the scale-making material from quiet parts of the boiler, while it is in the condition of dirt. If the scale-making impurities are removed from the water either before or after it enters the boiler, then, of course, no scale will be formed, and this appears to be a sensible thing to do. In fact, it appears to be right to put the matter, in point of importance, about as follows:—First, when practicable, remove the scale-making matter from the water; if impracticable to do this, then use whatever is best under the circumstances to assist in the prevention of scale, with a full understanding of the fact that the foreign matter must be got rid of; in cases where water is particularly bad, use a type of boiler from which it will be convenient to remove scale, or in which the circulation of water will be such that the scale-making matter may be removed as dirt. In regard to the deterrent effect of scale on steam making, it is almost needless to say that very few believe in the formulas given covering this point. Like many another thing, this has been enormously overrated. But when it is considered that it is impracticable to use fire sheets of more than three-eighths of an inch in thickness, for the reason that they will burn down to that thickness, it will be understood that, outside any question of economy, scale over fire surfaces is an important element of danger.

I quote some of the above remarks from a technical paper published here; but I would ask in what circumstances is it impossible to remove the "scale-making impurities?" If filtering will not do, the water can be easily raised to the required temperature in an accessory boiler or tank (often by the aid of exhaust steam or escaping furnace gases), but it pays always to devise some means of taking the "scale" out of the water instead of allowing it to form in the boiler.

Broadway, New York. **D. G. F.**

VARLEY'S SKETCHING TELESCOPE—DENT'S MERIDIAN INSTRUMENT—LOGARITHMS.

[30261.]—"F.R.A.S." is, I believe, correct in the tradition that Hornor used the sketching telescope for his panorama. He had a tent rigged up at the golden gallery on St. Paul's in 1821, and I always understood that he used this instrument; but "F.R.A.S." does not give the same construction that I have heard of it—viz., that the telescope hung in gimbals at the object end, with an adjustable mirror above the object-glass. A diagonal eyepiece was used, and a plain piece of glass was inserted in the focus of the outer lens, on which was a small black dot, which was traced round the outline of the landscape reflected in the mirror; the lower end of the telescope was fitted with the pencil, or tracing point, with a spiral spring behind it, so as to follow the oblique positions of the telescope.

Dent's meridian instrument (69254) is the dipleidoscope. It should be set on a carefully levelled stand, with its face to the south, and adjusted in the meridian, which is best done by a watch set to true local time, allowing for equation, or using the time in your issue on the last Saturday in the month under the heading "Sun," column "Souths." With this instrument you can use an ordinary telescope; when the sun is approaching the meridian you get two images of the sun reflected from the internal surfaces of the prism. Note the first contact of these images, and as one passes over the other, note the moment of separation, or the last contact; the mean of these is the correct apparent time, to which apply the equations, and you get true local time. It may also be used with a bright star, only with a little more calculation. It is a pretty instrument, correct in theory, and, if carefully used, will give the time correctly within a few seconds.

To the tiro in the use of logarithms (69246) the subtraction of a larger from a smaller number is very puzzling, but a little practice soon overcomes the difficulty. In your correspondent's first line of figures + is evidently meant for ×. In the multiplication sum he does not complete the addition, viz.—

94·785 = 1·97674
6·8798 = 0·83758

652·11 = 2·81432

The division sum is more puzzling, as the divisor is larger than the dividend, and the quotient larger than either. The indices are also puzzling in such fractions as he quotes. I correct a trifling error he has made in taking out his logarithms.

Log. of 0·02132 = 8·32879
" 0·098764 = 8·99460

" 0·21587 = 9·33419

"Logarithm" can prove the correctness of this by multiplying ·098764 by ·21587 by long multiplication, when he will find the answer to be ·02132018468.—*Q.E.D.!* The conventional rules as to indices are simple enough, those for whole numbers being one less than the number of integers in the number; and for decimal fractions for tenths ·1 is 9, for hundredths ·01 is 8, for thousandths ·001 is 7, and so on, and in calculations it is always better to use the correct index. In the above calculation the index of the dividend is taken at 18 for the convenience of the subtraction.

Aug. 9. **A Minor F.R.A.S.**

THE ORIGIN OF ROCK-OIL.

[30262.]—In my letter (No. 30235, p. 505) I am made to say that the Holywell spring forms "a respectable ewer" instead of "respectable river," and the next line reverses my meaning by rendering "Is it therefore necessary?" "It is therefore necessary." **W. Mattieu Williams.**

COLOURED FIRE.

[30263.]—I can thoroughly endorse, in every particular, the statements made by Mr. W. H. Browne in his kind letter (p. 505), which should save the pockets of pyrotechnic amateurs who would otherwise have spent money and time in trying these useless mixtures. Unfortunately, I was in too great a hurry, or might likewise have benefited.

I am sure that we should all be greatly indebted to Mr. Browne if he would give us tried and inexpensive formulæ for the following fires for pan or case:—White, green (deep), red, blue (deep), yellow (deep), and purple; and for stars, the above colours and the pure magnesium which produces so brilliant an effect at the C.P. If he can give us these recipes, I am sure that we shall bless those bad ones which brought him so kindly to our assistance. **Pyros.**

BEST SHOE FOR HARNESS HORSES.

[30264.]—Since my last letter I have received from Admiral Selwyn a copy of the specification of his patent horseshoe, to which I have previously alluded, and, with the kind permission of our Editor, beg to send the same, as I hope it may be of interest to many of "Our" readers.

This invention is designed to enable beasts of draught and burden, such as horses, mules, and asses to be more efficiently shod than has heretofore been usual.

A horseshoe as commonly made is constructed to serve as a sole to the hoof, so that when the horse's foot is down the metal shoe intervenes between the ground and the border of the sole of the foot. This interferes with the wear that would otherwise compensate for downward growth of the hoof, and it happens frequently that, before a shoe is so far worn as to require renewal, it has to be removed in consequence of lateral extension, or forward protrusion of the hoof beyond the edge of the shoe due to growth, or the protruding horn has to be cut away, thereby sometimes exposing soft or tender parts of the foot.

FIG. 1.

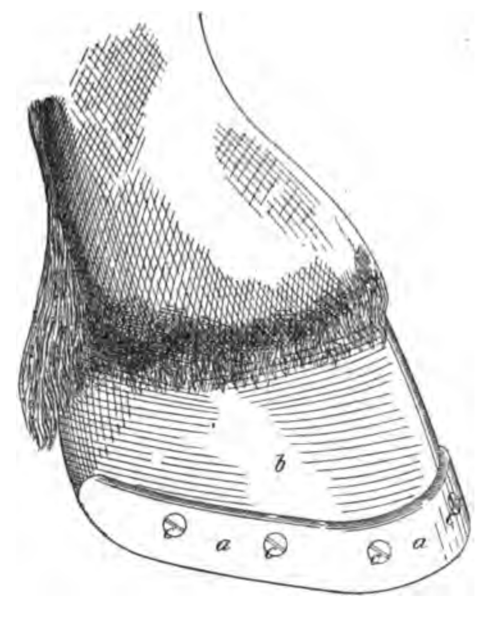


FIG. 3.

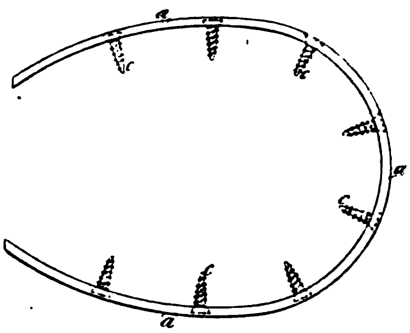
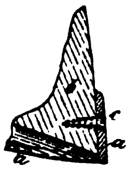


FIG. 2.



In lieu of using a shoe in the nature of a sole as above set forth, a clip-like shoe of thin metal is made that forms a covering to the lower front and side portions of the hoof, to which it is suitably secured by a convenient fastening device, such as studs or small bolts with nuts, preferring gimlet-pointed screws, in such a manner that the lower edge of the metal-plate shoe, as well as the frog and hoof of the animal's foot, may take a bearing on the ground when the foot is put down and be subject to a retarded wear. In some cases, in conjunction with screws or the like, cement of the nature of marine glue that can be dissolved by application of moderate heat is used. Such shoes as above described will give a better foot-hold than those of the ordinary kind, besides lasting longer and enabling downward growth of the hoof to be compensated by wear, whilst likewise obviating the liability that exists with ordinary shoes to lodgment of stones, snow, &c., between the hoof and the shoe.

In the accompanying illustrations, Fig. 1 is a view of a horse hoof having a shoe constructed according to this invention. Fig. 2 is a vertical section of a portion of the hoof and shoe, and Fig. 3 represents in outline the sole of the horse's foot with the lower edge of the shoe that projects below the said sole. *a* is the shoe, formed by preference of steel plate, and secured to the hoof *b* by means of gimlet-pointed screws *c*, having their heads countersunk in the shoe. Holes are first made in the hoof *b*, corresponding with the shoe-plate *a*, to receive the screws.

When re-shoeing the fresh set of shoes should have the holes in different vertical plane to those of the shoes just removed. If cement such as previously mentioned be used in conjunction with the fastening screws, it will, besides assisting to hold the shoes in place, prevent the lodgment of wet and mud between the shoe and the hoof.

Care should be taken to avoid the protrusions of the heads of the screws or other fastenings, and the upper edges of the shoes should be rounded off.

Herbert Wilkins.

OBSERVATORY — THUNDERSTORMS— RATS.

[30265.]—I can assure "Meddyg," query 69278, that if he will refer to my letter (30146, p. 435) he will find a means of making very cheaply and easily an observatory roof which will prove most satisfactory and convenient, any further details about which I shall be most happy to give. Mr. Vallance has been good enough to write in high terms of it, and speaks of adopting the method himself.

My observatory is 500ft. above sea-level. Let me ask our meteorological friends why it is that threatening thunderstorms quite nine times out of ten draw off along the Kennet Valley below or the opposite line of Hampshire hills, and leave us often parched and panting for rain, but with a sky clear above us? Is there nothing in this beyond the mere obvious law of attraction?

I have been astonished not to see the following means of enticing rats mentioned by your correspondents. It is a plan used by trappers, which I guarantee will be found equal to any oil of rhodium, and costs nothing. Simply rub an ordinary gin over with a piece of fish which is no longer in a marketable condition. This, while washing the smell off the hands, will prove quite irresistible, the rats scenting it from a distance, and licking it off greedily until restrained by the natural course of events.

Newbury. **J. M. Bacon.**

"WHY SIXTY SECONDS MAKE A MINUTE."

[30266.]—Surely Mr. Max Müller, nor the editor of the *Fortnightly Review* or of the English Mechanic, could have been quite awake when they made such a hash of this subject.

Let me assume that your extract is a true copy of the original version. Mr. M. M. says the Babylonians divided the sun's daily journey into twenty-four parasangs. . . . A parasang is about a German mile. . . . The Babylonians compared the progress made by the sun during one hour at the time of the Equinox to the progress made by a good walker, both accomplishing one hour, or parasang. The whole course of the sun during the twenty-four equinoctial hours was fixed at twenty-four parasangs, or 360°.

Do you believe that Max Müller ever wrote such rot?

The Babylonians did exactly what any people in their sober senses would have done: they divided the solar orbit into twenty-four lengths or meridians of longitude of *nine hundred* miles each, not of one mile! And instead of "a good walker keeping up with the sun," the fastest bird that ever flew never accomplished a tenth part of it in the time.

It is a great pity such inexcusable blunders should find their way into print. If the *Fortnightly Review* did not know any better, surely a scientific paper like the English Mechanic ought to exercise a little more care. **John Hampden.**

SELF-INDUCTION IN MAGNET COILS, &c.

[30267.]—While measuring the resistance of the coils of an electro-magnet the other day, the following experiment illustrative of self-induction in magnet coils occurred to me, and I thought it might be of interest to some of "Ours." The apparatus is such as any amateur electrician can make for himself. In one of the arms of a Wheatstone bridge insert a known resistance—say one ohm; in the other the coils of an electromagnet, or the primary of an induction coil. Find the position of the sliding contact-piece, so that there is no current passing through the galvanometer. (This, of course, gives the resistance of the coils.) Now break the battery circuit—either at one of the wire terminals or at the poles of the battery itself—and let the sliding piece make contact with the wire at the point previously found. On closing the battery circuit, the needle of the galvanometer is deflected by a transit current, returning at once to zero. The direction of the current is the same as it would be if the resistance of the coil had been temporarily increased. The self-induction, chiefly due to the soft iron core, opposes the current, and virtually increases the resistance for the moment.

On breaking contact with the battery a throw of the needle to the opposite direction takes place, which is caused by a current induced in the coils of the magnet in the same direction as the one just ceasing; but, of course, while the transient current passes through the galvanometer the permanent one does not affect it. Be careful to keep the magnet well away from the galvanometer, and if using the ordinary horse-shoe form, keep the armature on during the experiment, as this almost destroys the magnetic field due to the powerful magnet, and prevents disturbance of the galvanometer needle.

We often have queries in the "E. M." from amateurs relative to small electric lamps, dynamos, induction coils, &c. Might I suggest that those who are fond of experiments in electricity, and who construct their own apparatus in their spare time, would find it a far more interesting recreation if they performed quantitative experiments, and thus gained some idea of the practical measurement of electrical quantities. A large number of instructive and interesting experiments can be performed with a home-made bridge, astatic and tangent galvanometers, voltmeter, four or five Grove, chromic, or Bunsen cells, and one or two Daniells, a set of resistance coils constructed by means of a bridge from a standard ohm, &c. These may be made at home, and if well made, very accurate work may be done with them, and they will afford pleasure both in the construction and the use.

Brockley. H. C. H.

USEFUL AND SCIENTIFIC NOTES.

A Train Tell-Tale.—Prof. Milne, of the Seismological Society of Japan, has invented what the *Railway News* thinks a very interesting self-recording instrument for railway trains. "It shows when a train stops, for how long, and whether at a station, signal, or siding. It indicates also the upward and downward vibrations due to the condition of permanent way, and points out the defects in bridges, sleepers, and ballast, as well as vibrations due to oscillation of the train. The mechanism has, it is stated, worked satisfactorily in Japan, and on a journey across the American continent, and arrangements are being made for having it tried on some of the English and Scotch lines."

The Most Powerful Rolling-Mill Engines.—What are no doubt the most powerful rolling-mill engines in the world are the reversing engines that Messrs. Galloways have just made for Palmer's Shipbuilding Company, for driving a 44in. train for making angle irons, H-irons, beams, &c. The cylinders of the engines are 56in. diameter by 6ft. stroke, and are fitted with Joy's valve-gear. The steam pistons are of steel, and the crank shaft is built up of mild Siemens-Martin steel, the forgings of which weighed over 41 tons before being machined. The finished shaft has journals 21in. diameter, and is of a total length of 23ft. 6in. To meet the requirements of Joy's valve-gear the piston valve-chests have been arranged on the upper side of cylinder, which enables the cylinders to be similar in every respect, and special provision is made for expelling the water which may be carried over in the form of wet steam. The engines are of massive construction, and the whole framing is so arranged as to receive the strains in the most direct manner possible. The engines are similar, with the exception of the adoption of Joy's valve-gear, and also with the further exception that they are of larger size, to Galloway's engines previously made and supplied to many English, Continental, and American steel works. They are constructed for a working pressure of 100lb. to the square inch, and when running against suitable resistance would be fully equal to developing over 10,000H.P. The weight of the engines is nearly 300 tons. In the Antwerp Exhibition there was exhibited in model a very large rolling-mill engine, said to be of 11,000 estimated indicated horse-power; but the engines, above described, are believed to be the most powerful of any used in rolling-mills.

The Sims-Edison electric torpedo is described as follows in the *Scientific American*:—"The torpedo consists of a submerged portion attached to a float having the form of a boat. The submerged portion is a spindle-shaped copper shell containing the propelling machinery, a cable by which the current is conveyed to the electric motor and steering apparatus, and a charge of dynamite or other explosive. The spindle-shaped shell is connected with the float at the bow by means of a triangular steel frame, and at the stern by a post and an angled bar. The float, which is of copper, is made air-tight and filled with buoyant material, so that if it should be perforated it will still be able to sustain the submerged part. The triangular frame which connects the two parts at the bow extends up over the top of the float, and serves to either lift obstacles with which the torpedo comes in contact or to depress the torpedo, enabling it to run underneath the obstruction."

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[68554.]—**Engines in Accidents.**—Up Liverpool Mail at Watford, December, 1883; engine 482 Pegasus, Precedent class.

Uttoxeter. N. S. R.

[68903.]—**Pigs in Clover.**—I should say that the result of spinning the box on a lapidary's table would be to keep the pigs very much out of the "clover." W. PERREN MAYCOCK.

[68933.]—**Electrical.**—If "Doubtful" uses the oil of turpentine, he will be quite correct. There are such varieties of names going about for this substance that it is very hard to give an opinion on any of them; but, at any rate, the purest kind to be obtained should be that used.

F. W. MASON, F.S.S.

[68997.]—**Lathe.**—A wheel about a hundredweight would do for a 4½in. lathe; but, *pace* the textbooks, practice teaches that it is no disadvantage to have a heavier wheel—one as heavy as can be run in the bearings. TURNIST.

[68999.]—**Hot-Air Engine.**—Has not "O." an idea that hot-air engines may have been illustrated in back numbers? I fancy one of those illustrated in Vol. XLV. pp. 225, 270, may suit him; but there is a good deal about them in previous volumes.

M.I.M.E.

[69001.]—**Problem.**—To weigh every multiple of your lowest unit, it suffices to have the powers of three; thus—

1	..	27 + 3 − 9
3 − 1	..	27 + 3 + 1 − 9
3	..	27 − 3 − 1
3 + 1	..	27 − 3
9 − 3 − 1	..	27 + 1 − 3
9 − 3	..	27 − 1
9 + 1 − 3	..	27
9 − 1	..	27 + 1
9	..	27 + 3 − 1
9 + 1	..	27 + 3
9 + 3 − 1	..	27 + 3 + 1
9 + 3	..	27 + 9 − 3 − 1
9 + 3 + 1	..	27 + 9 + 3
27 − 9 − 3 − 1	..	27 + 9 + 1 − 3
27 − 9 − 3	..	27 + 9 − 1
27 + 1 − 9 − 3	..	27 + 9
27 − 9 − 1	..	27 + 9 + 1
27 − 9	..	27 + 9 + 3 − 1
27 + 1 − 9	..	27 + 9 + 3
27 + 3 − 9 − 1	..	27 + 9 + 3 + 1

Practically, for our English grain weights, the fifth would be better 80 than 81, the sixth 240, or ½oz., and so on. Thus, four weights carry you up to 40, and a fifth, weighing 81, would extend your range to 121; a sixth, weighing 243 to 364, and so on. The New York worthy will see he has not hit on the best four units. E. L. G.

[69010.]—**Protecting Felt Hat.**—About the best thing to protect a felt hat from the weather is to leave it at home when the weather is not suited to its constitution; but, seriously, if the querist means one of the stiff felts, he can make a cover of oil-silk or rubber-cloth to slip over his hat when it rains—I mean, when it is rainy weather. He might try some experiments with the alum and soft soap recipe on an old hat; but as stiff felts are stiffened by an aqueous solution of shellac in borax, I guess the result would not be satisfactory. Reason for guessing: Hat-makers would have puffed a waterproof hat long ago if they could have made one.

NUN. DOR.

[69017.]—**Self-steering R. D. Safety.**—I do not see how Mr. Shakespear can expect anyone to help him without more details—even if then; for he appears to me to want what a good many builders of rear-driving safety bikes would be glad to invent. D.

[69022.]—**Instantaneous Photograph.**—This query is incomprehensible, except one takes the view, which would be unpolite, that the "Amateur" is also a novice. He wants an instantaneous shutter, but which he must be left to find out, although no doubt any of those who advertise such things in the proper columns would assist him. T. C. L.

[69026.]—**Expansion Movement in Engine.** Cannot "T. C. G." fit a supplementary valve on the top of the slide-valve proper, or cannot he explain more definitely what he requires to do, and, in this case, what it is required to be done upon?

C.

[69027.]—**Brazing Hearth.**—It depends on the amount of work to be done which is cheaper; but if "Anthony, Essex" (rather an indefinite address) can get gas cheap, that would be more convenient than the forge blast, though I am not sure I understand what he means by that. H.

[69055.]—**Blue Salt.**—"True Blue" seems to be in a regular mess; however, I will do what I can to help him along. With regard to the blue solution, the following metals give this reaction, or something approaching it, on treating their acid solutions with alkalies or alkaline carbonates:—*Chromium* gives a green. If contaminated with foreign matters may be mistaken for blue, particularly by artificial light. A precipitate is first formed on addition of the reagents, but this dissolves more or less in excess. *Cobalt.*—All shades of purple, blue, greenish, dirty red, &c., according to amount of cobalt present, and according to foreign matter interfering. The reagents under discussion first produce a precipitate, which afterwards dissolves on adding a further quantity of the reagent. Much free acid or ammonium chloride or nitrate in the solution prevent the formation of the precipitate, the solution becoming coloured immediately. *Iridium.*—Under certain conditions yields a greenish or blue or violet solution with the alkalies. *Nickel.*—Yields a blue solution with an excess of the reagents. *Gold and Tin.*—If both are present a magnificent purple precipitate is sometimes produced when seeking another reaction. If solutions are very dilute, this precipitate may be so attenuated as to be mistaken for a solution. This precipitate once seen is never forgotten. *Copper.*—Produces a rich blue: once seen never mistaken. If, on the addition of the alkali, a precipitate is produced, it will dissolve again on further addition of the reagent. *Titanium*, under certain conditions, produces a blue precipitate or coloration, with alkaline carbonates. As to the black needles, the query is so very indefinite that little can be done except to guess. The query is made more obscure by your "explanation," in which you introduce the Hg. Do you mean that there is no doubt whatever that the black needles are metallic? It is not a necessary sequence to fusion with carbonate of soda. Hg amalgamates with the "noble metals," and, among others, with lead, copper, bismuth, tin, zinc, magnesium, sodium, potassium, and iron (under persuasion). When you add Hg to an unknown metal to ascertain what it is, then you are lost. What is the substance supposed to be that you start with, anyhow? There are two alloys of zinc and antimony, one of which does crystallise in black needles under the conditions mentioned by you in the issue of Aug. 2nd, but which does not "precipitate" as remarked in your original query. The other alloy of zinc and bismuth (equal proportions of each) crystallises in cubes. If any sodium or potassium chlorate be present in your fusion mixture, and if manganese be present in the substance under examination, permanganate of soda or potash might be produced, which crystallise in black or reddish needles after extraction with water. As to your "lavender bead," titanium, if contaminated with salts of iron, particularly the sulphate, will give a bead answering to this description, but which is, if I remember right, not permanent long after it gets cool. Lots of other things, if mixed, might give you any shade you like. The mere colour of a borax bead is very little identification of an unknown substance possibly containing several elements, each of which may, when separate, impart a different colour to the bead. Perhaps "True Blue" now begins to see where he has landed himself by not pushing his investigations to a final point, and he has made himself an interesting beacon to warn other young chemists, whether amateurs or not, how easy it is to become a candidate for a lunatic asylum. My advice to the querist is to throw away his blue solution, black needles, and borax beads, and begin again on a new portion of the substance, and work systematically, following the plan laid down in some standard work on analysis—in my opinion, preferably, Fresenius, than whose volumes no better work exists. KALL.

[69101.]—**Defective Sight.**—"W. F. P." squints upwards with one eye. A prism of a degree that should be determined, base downwards, will correct the convergence of the optical axes, and establish a perfect binocular vision.

AUTHOR OF "THE PHILOSOPHY OF SIGHT."

[69104.]—**Leclanche—Erratum.**—This should have meant the ordinary form, and not agglomerate form; it arose from some mistake on my part.

F. W. MASON, F.S.S.

[69113.]—**Engine Query.**—Cylinder 3in. bore, 5in. stroke, 200 revs. per minute; 45lb. pressure; cut-off about 7/10th stroke, would give you 1H.P.; length of bore 7in., slightly bell-mouthed at ends to prevent piston wearing at shoulder; cylinder walls ⅜in. thick, flanges 7/16in.; length of cylinder face 2⅝in., depth 2in.; ports—steam ¼in. by 1½in., exhaust ½in. by 1½in.; bars ¼in., lap ¼in., lead 1/32in.; traverse of valve 1in.; depth of piston 1in.; piston-rod ⅜in. diameter; valve-rod 5/16in.; crosshead pin ⅜in.; crank-pin ¾in.; shaft 1in. in journals; fly-wheel 20in. diameter—weight about ¼cwt.

W. W. C.

[69123.]—**Commutator.**—"A. A." had better get this done by some electrical engineer, as unless he is rather up in the work he is liable to fail. Take to pieces, build up with asbestos millboard, and insulate the bars with vulcanite strips.

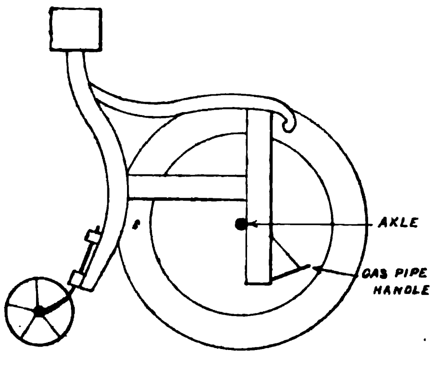
F. W. Mason, F.S.S.

[69126.]—**Electric-Bell Fitting.**—Quite unnecessary to solder them.

F. W. Mason, F.S.S.

[69132.]—**Cripple's Carriage.**—As no 'one has answered "Parish Priest," I will try to. The simplest plan would be to get a strong armchair with strong seat, and a set of bath-chair wheels and axles; bolt axle to front legs of chair, and two pieces of hard wood or iron to back legs, with holes for spindle of guiding wheel to turn in; bend two iron gas-pipes to a circle about 6in. or 8in. less than wheels, and secure to face of spokes with bolts, keeping it an inch or two from the spokes with washers or blocks, so that the coat sleeve shall not rub tire when working the machine. This bent pipe forms the handle for turning wheels to propel the machine. The steering is automatic; drawing will explain.

E. H. Julian.



[69135.]—**Cold Tank.**—Mr. Croft would prevent the hot water returning to cold tank by disconnecting the feed pipe to boiler from tank, and insert ,where disconnected a small two-gallon feed tank with ball valve.

C. E. Gittins.

[69139.]—**Chromic-Acid Battery.**—"F. G." will find plenty of objections rise to his query, forming the cells as he proposes. Use single cells.

F. W. Mason, F.S.S.

[69144.]—**Battery.**—Take two plates of silver, and coat them with some freshly-deposited chloride of silver; place them in a cell, and when a ray of light is thrown on to *one* of the plates (if a galvanometer is placed in circuit), a current will be found to be generated. You would also need a very sensitive galvanometer to detect the current from the tin plates in alcohol.

F. W. Mason, F.S.S.

[69145.]—**G.W.R. Engines.**—The reason numbers and dates do not agree is this: A set of, say 20 engines of one design, with consecutive numbers, is ordered, the construction of which may take a year or more, and are turned out one by one with engines belonging to other sets, some of which may have been on hand before and some after, each bearing the date when it is ready to leave the works. This is a better plan than numbering each engine as it leaves the works, as the number is a guide to its class; 3202—3205 were made in 1885; 3306—3232 are just coming out now. I cannot give any reason why they should skip so many numbers; but the management of the loco. department of this line is altogether of a curious character. There are no engines between the following numbers: 1700 and 1801, 1853 and 1901, 2220 and 2301, 2380 and 3202, 3232 and 3501. There are many other gaps, especially in the earlier numbers. If "W. E. C. B." has seen 2529, I should be glad to hear about it.

Ixion.

[69165.]—**Bunsen Cells.**—I fancy "Bunsen Cell," if he *properly* attended to his cells, would not have anything to complain of. Though I myself have used these cells for some years, I have not had any great objectionable smell from them. Add a little chlorate of potash to your chromic acid.

F. W. Mason, F.S.S.

[69179.]—**Sand and Water Trough.**—I do not think what "C. C. E." requires can be accomplished so easily as he appears to think. It might possibly be arranged by having the sand in a vessel, to which a shaking motion could be imparted so that the sand would fall as required into the stream of water; but I think the professional glass-cutters would have adopted some arrangement if it were at all feasible, as one of the most objectionable features of their work is the continual dipping of the hand into the sand and water to bring up the cutting material. Perhaps, however, some of "our" readers can suggest a plan.

E. G.

[69180.]—**Blowpipe Lamp.**—Use good spirit up.

F. W. Mason, F.S.S.

[69186.]—**Engine.**—Horse-power per revolution

$$\frac{(4\cdot5^2 \times \cdot7854) \times (30 - 5)}{33,000} = 0\cdot024.$$

Marienberg.

[69188.]—**Condensing Exhaust Steam.**—Many thanks for replies to this, but I am not much helped by them so far. Holmann's could not well deal with so large a quantity of steam, and pump-tail pipe would not, I presume, provide sufficient cooling surface. As there is some 480,000c.ft. of steam of atmospheric pressure, or, say, 18,376lb. to condense per hour, the total heat-units will be 21,306,672. As the tail-water has a temperature of 60°, and may be heated to 90°, the difference of 30 will represent the condensing power of this water for every pound. Therefore, water required $\frac{21,306,672}{30} = 710,332$lb., or 11,389c.ft., which is slightly under the quantity deliverable by the pump. I have somewhere seen that a square foot of thin iron tube surface will condense per hour per degree Fahr. of difference 0·07lb. of steam, the *mean* difference being $212 - 75 = 137°$. This would imply a condensation of $137 \times 0\cdot07 = 9\cdot59$lb. per square foot per hour, so that, supposing the full action of *all* the condensing surface could be obtained, $\frac{18,376}{9\cdot59} = 1,917$sq.ft. of cooling surface—if, indeed, so much is necessary—would be required. How to obtain so large a surface is the question. The tail-pipe is 13in. diameter, so that it would take 564ft. in length to get up the surface, which is, of course, out of the question. Nor could the force-pipe be thus used, for, although long enough, yet, being of great thickness to resist pressure of column (300 yards high), it would be a bad conductor and altogether too expensive to jacket. Nor would it do to lead the exhaust steam direct into the tail-water, as in this way only very imperfect condensation takes place, and large quantities would escape from the surface uncondensed. A condenser consisting of a large number of small tubes, through which the tail-water passes, and round which the steam circulates and condenses, seems the only way, to my mind, to meet it; but it would be an expensive apparatus, and after all, difficult to make its whole surface effective. Some parts of it would be more effective than others, owing to the irregular flow of the water through the small tubes, and the entry of the exhaust steam at one point. A simple, cheap, and effective device is the desideratum.

M.

[69192.]—**Deodorising Carbon.**—Try paraffin wax. You will never be able to deodorise the white carbon (crude naphthaline) as even the pure kind still has its odour. You might alter the smell of it, by altering the nature of the substance, but only by that way.

F. W. Mason, F.S.S.

[69193.]—**Chromic-Acid Cells.**—After soldering with spirits there are little interstices and cavities containing drops which any amount of superficial cleansing will not remove. The wire is consequently slowly eaten into, the corrosion being in many cases hastened by electrolysis.

W. Perren Maycock.

[69198.]—**Dry Battery.**—Plaster of Paris with little oxide and chloride of zinc.

F. W. Mason, F.S.S.

[69202.]—**Ozonised Water for Mouth Wash.**—This is a solution of of hydrogen peroxide.

F. W. Mason, F.S.S.

[69205.]—**Electric Light Battery**—Three cells will do it exactly; but I should advise the use of four. A Fuller gives 1·5 E. M. F. with 0·6 ohm v.

$$\frac{1\cdot5 \times 3 = 4\cdot5}{0\cdot6 \times 3 = 1\cdot8} = 2\cdot5 \text{ amp.},$$

and a 5 c.p. lamp takes from 2· to 2·5 ampères.

F. W. Mason, F.S.S.

[69211.]—**Measuring Steam.**—I should think the best way would be to get at the number of horse-power required to work any set of machines (one or more, as the case may be), and to find the average power thus used by each tenant. It might then be fair to charge, say, 1s. 9d. per day of ten hours for each such horse-power.

Marienberg.

[69213.]—**Ginger Beer**—The amount of alcohol in a sample depends upon the amount of sugar that has undergone fermentation. It may vary from 1 to 8 per cent. The ginger-beer plant you talk of, consists of a low class of growth (viz., the fungi); it is termed Saccharomyces mycoderma. When this plant is immersed in any saccharine solution, it sets up what is termed the alcoholic fermentation, which consists of alcohol and carbon dioxide. I should myself consider the beverage so obtained as wholesome; but I cannot say, candidly speaking, that I much admire it. I, at any rate, should never recommend it.

F. W. Mason, F.S.S.

[69214.]—**Bell Indication.**—There are plenty of electric contacts in the market, surely, to meet your purpose. Use with an ordinary bell and battery, and connect up.

F. W. Mason, F.S.S.

[69220.]—**Silent Alarum.**—Join up shocking coil and batteries to an electric alarum clock, and join the secondary terminals (by means of conducting wires) to two copper wristlets (made to fit tight on the wrists). On going to bed set clock, and at what time that is set you will wake up right enough. If you require further particulars, shall be pleased to give; or advertise your address, when shall be able to give more clearly.

F. W. Mason, F.S.S.

[69215.] — **Reproducing Photographs.** — Copied, of course. The miniatures are taken 12 on one plate, by having 12 lenses to camera.

Sm.

[69222.] — **Discharge from Ear.** — If your correspondent under the above heading will write me, I think I could recommend something which may give him relief, or, further, effect a cure.

42, Park-road, Clapham, S.W.

H. H. J.

[69222.]—**Discharge from Ear.**—In medical parlance, otorrhœa (an earflowing); cause, scrofula; remedy, medicines calculated to remove, or at least to modify, the constitutional tendency. An allopathic antiseptic recently discovered by a high chemical *savant*, and which he has named "salufer"—i.e., sodium-silico-fluoride—would probably prove a useful lotion if applied in a higher dilution than than named on the label. It would flow down through the perforated tympanum (see Dr. Hayward's diagram) by gravitation if the patient were to recline so as to place the aural passage somewhat in a vertical position, providing that the Eustachian tube-opening in the throat is not closed by a diseased condition. The silicon, which is in a form about equal to the first dilution of homœopathy, would, independent of its local action as an antiseptic, probably exercise a most beneficial action on the scrofulous constitution; but a frequent change to others of the medicines of the art is, I expect, essential for permanent recovery. Amongst these sulphur and calcarea are prominent; mercury, iodine, and their combinations are important; while a salt often named in the columns of the "E. M."—bichromate of potash—has been productive of great things in otorrhœa, according to that "Materia Medica of Homœopathy" issued by the Liverpool Hahnemannian Publishing Company. Although I give the above information, yet "Barum" would act wisely if he were to consult some aurist skilled in the homœopathic system of medicine; for it is probable that some one or more leading symptoms as to the state of his general condition and constitution would afford most valuable indications for the selection of the medicines and their rotation. As to whether the stopping of the teeth or the decay of the teeth has influenced the state of the ears, the former has often given me much subject-matter for thought, seeing that the friction under powerful pressure of the two grinding surfaces must result in a production of gold particles, infinitesimal or atomic in diameter, and in a condition similar to the nitrated form of gold—a powerful agent curatively, at all events, according to the works of standard authors, both of ancient and of modern medicines, and to these "Barum" is referred. N.B.—A caution. Bichromate of potash is a most powerful poison, and must, therefore, be used only in its homœopathic, highly-diluted form.

The Lydney Dispenser.

[69225.] — **Electric Lamp.** — Why not try Westaway's (Lewdown, N. Devon) patent? They, I know, are a success. Any coach-builder should have them, I should think.

E. Ward-Bussell.

[69225.]—**Electric Lamp.**—The cost for your project will be as follows:—Two 5c.p. lamps at 3s. 6d. each, 7s.; eight cells at 3s. each, £1 4s.: total, £1 11s. The solution for them would cost at the rate of 3s. 6d. per 12 hours' light. You could, of course, have a suitable lifting arrangement for your battery elements, so that you could raise them out of the solution when not required. The labour they take in cleaning and recharging could be done easily in one hour, so that your stableman himself could do this in his everyday work. The length of time the lamps last is about 1,000 hours. I cannot inform you now where you could see such a fitting out; but about 12 months ago I superintended the fitting up of an electric light in the inside of a carriage, and it worked first class and was very successful, but where my client is now I do not know; but still, if you like to advertise your address, I shall be pleased to let you have full details. The weight of the batteries would be about 20lb. to 24lb.

F. W. Mason, F.S.S.

[69226.]—**Electro-Plating.**—The larger the surface capacity of your elements the larger your current (providing, of course, your outer or external resistance does not far exceed that of your battery itself). It is only on this point and that of its conductivity that your carbon contributes to the current of your cell, as the carbon is not *acted* upon by the solution: it simply serves, as it were, as a door for the flowing out of the current. I do not recommend at all the bichromate battery for platers—in fact, it is only a very few platers that use it. When more cells are joined together (if this joining be in series) it is for the purpose of gaining a more intense current; but this of course depends upon the operator's object. Of course, the more cells you have, the more labour, trouble, and expense you are liable to. Any further information shall be pleased to give. F. W. MASON, F.S.S.

[69226.]—**Electro - plating.**—Do not use a bichromate battery. I find the following exceeds all others for plating, being constant, very little local action, and regular, and would last about six or eight months one charge:—Stone (round) jar, with cylinder of ($\frac{1}{64}$in. thick) copper, porous cell, and zinc rod. In outer cell nearly fill with three gallons water, to which is added 2lb. sulphuric acid, 1oz. nitric acid; in porous cell, concentrated solution salt (NaCl) and water. One gives good results for ordinary work; but connect a few cells up for intensity—i.e., copper to zinc of next cell. You can deposit a very large amount in a short time. Best way generally to use three cells, with three coppers and three zincs connected together. A cheap set can be made by using, for outside jar, a 3lb. jam-pot and zinc rod 7in. by ⅜in. from electric-bell battery—those with wires cast in them; porous pot 7in. by 2in. Cost of six cells:—

6 outside jars, at 1d.	0s.	6d.
6 zinc rods, at 3d.	1	6
6 porous cells, at 4d.	2	0
6 sheets copper and 6yds. stout copper wire	1	0
	5	0

E. WARD-BUSSELL.

[69228.]—**Water Purification.**—Lime or lime-water will soften any of the London Water Companies' water, and if properly added in the right proportion, also purifies the water; both the lime added and the lime in the hard water are converted into chalk, which is insoluble in water; 11·25gr. of quicklime should be added to the gallon of water, or one gallon of clear lime-water to nine gallons of the hard water. Having no medical knowledge, I cannot say if soda would be injurious to the system; but I should think it could not be good even to take a minute quantity every day. C. E. GITTINS.

[69231.]—**Pyrotechny.**—The boiler-tube ought to answer very well. I have used it for small mortars. Let the tube you use for the 5in. be stout enough. Put a welded ring neatly on mouths.

Hungerford. W. G. CLIFFORD.

[69231.]—**Pyrotechny.**—T. Pearce will find that the lap-welded boiler tubes make excellent mortars from which to fire shells. Care should be taken to have a fairly thick metal, say $\frac{3}{16}$in. to ¼in. thick. I had a mortar for 6in. shells made from a piece of boiler tube 20in. long, ¼in. thick, shrunk on to a cast metal foot, and which answered the purpose splendidly. PYRO.

[69232.]—**Batteries.**—My practical experience with the nitrate of soda battery does not, I am sorry to state, warrant me in giving it a recommendation. Why not use bichromate solution, or add a little chlorate of potash to the chromic-acid solution? F. W. MASON, F.S.S.

[69233.]—**To Mr. Bottone, or Others.**—The secret is the ventilation of the armature.

F. W. MASON, F.S.S.

[69235.]—**Melting Brass.**—You had better use a coke blast furnace; spirit no good.

F. W. MASON, F.S.S.

[69238.]—**Dynamo.** — To MR. BOTTONE. — Procure 75 Pacinotti ring-punchings 4⅛in. diameter. Mount them on brass spiders to make an armature 3in. deep. Wind this with about 2lb. No. 20; this will have a running resistance of about 0·5 of an ohm. To balance this as a shunt machine you would need at least 10lb. No. 24 on the fields. As you have on No. 16 I should advise you to wind it as a series machine, putting on about 4lb. on each limb, and then connecting the limbs in parallel, taking care, of course, to connect in such a manner as to get the pole-pieces respectively N. and S. Each 4lb. would have a resistance of about 0·8 ohms; on connecting these in parallel the resistance falls to half, or 0·4 of an ohm. You may reasonably expect to get 6 ampères at 50 volts pressure, or enough to light six lamps of 48 volts at a speed of about 2,000 revs. per minute. It will absorb about ½ to ¾H.P. S. BOTTONE.

[69239.]—**Emptying Tank.** — Since a 12in. pipe is approximately equal to four 6in. pipes, the choice is not difficult. SM.

[69239.]—**Emptying Tank.**—A single 12in. pipe will empty your tank in half the time two 6in. ones will, because it has twice the area.

J. BALL.

[69239.]—**Emptying Tank.**—A circular opening 12in. across is four times the size of one 6in.; therefore, your 12in. pipe would empty the tank twice as fast as two 6in. pipes of the same length—without reckoning the greater friction, &c., in the smaller pipes. MU. NU.

[69239.]—**Emptying Tank.**—You must be trying to take a rise out of someone, as every schoolboy knows that it would take four 6in. pipes to equal the area of the 12in. pipe, so that consequently it would take twice the time to empty the tank with two 6in. pipes that it would with a 12in. one. F. W. CANNON.

[69239.]—**Emptying Tank.**—Inasmuch as the areas of circles vary as the squares of their diameters, and as the square of 12 (144) is four times the square of 6 (36), it is obvious that one 12in. pipe would be as effective as four 6in. ones, and therefore twice as effective as two such pipes. A pipe of 8½in. diameter would be almost precisely equivalent to two 6in. pipes. PERCY W. STANLEY.

5, Billson-street, Poplar, London.

[69239.]—**Emptying Tank.**—The time taken to empty the tank with two 6in. pipes would be twice as long as the time taken to empty it with one 12in. pipe. First, suppose that there are two 6in. pipes, the total area through which the water could flow would be $9\pi + 9\pi = 18\pi$. Next, suppose that there is one 12in. pipe instead of two 6in. pipes; then the total area through which water can flow would be 36π. Now 36π is to 18π as 2 is to 1—that is, the area in the second case is twice that in first case; therefore the time taken to empty the tank in the first case is twice that in the second case.

NIL DESPERANDUM.

[69241.]—**Organ Blowing.**—You will find the "Otto" answer your purpose best. They suit most purposes, and run remarkably well.

F. W. CANNON.

[69242.]—**Pigments.**—I can sympathise with your correspondent in the matter of carmine, the successful manufacture of which seems to depend on many conditions; such as the kind of cochineal to be employed, whether it is to be used whole or in powder, the quality and quantity of the water, the temperature and the time of its application, the chemicals added, and even the state of the weather at the time of the operation are all said to have an important influence on the result. I think the cheap carmine comes mostly from Germany, but wants the brightness and velvety softness of the best French or English carmine, and both German and French are inferior to the best English in depth and intensity of colour. From the numerous experiments I have made I believe that purity in the chemicals employed to precipitate the carmine is of the first importance. A trace of iron or lead very much degrades the colour. I have but little difficulty in getting a sufficient quantity of the colour to pay; but I must confess that my result is inferior in tint to the best English or French carmine. P. O. V.

[69243.]—**Dynamo.**—You will get good results if you put 2lb. No. 20 on the armature.

S. BOTTONE.

[69244.]—**Electric Lighting.**—Lighting your shop with two 16c.p. lamps from a hand-power dynamo, with or without accumulators, would be impracticable. To make a satisfactory accumulator requires a knowledge of trade secrets. Your best plan would be to buy reliable accumulators, and have them recharged when exhausted. At least two makers in London undertake to do this for a nominal sum. C.

[69244.] — **Electric Lighting.** — Two 16c.p. lamps of 48 volts will need accumulators giving at least 2 ampères and at least 24 volts; in other words, at least 12 cells. Now, if you want the cells to run for five hours a night, they must give off at least 2 ampères per hour, or 10 ampère hours. The charging current must have an E.M.F. of 2·5 volts per cell, or 30 volts. So if you had a dynamo giving a charging current, say of 10 ampères at 30 volts = 300 watts (and this is very little), you would need to exert at least ½H.P. for one hour to charge your accumulators. You will see by above rough calculation, that you could not do this by hand.

S. BOTTONE.

[69245.]—**Marking - Ink.**—If you allow the nitrate of silver to act on the fabric for 24 hours, and then boil that fabric, you will not have the fabric rotted. You could also use the following method:—Stamp the fabric with a strong solution of ferrous sulphate, and then immerse in a solution of tannin. F. W. MASON, F.S.S.

[69245.]—**Marking-Ink.**—If "S. W." wants to make some indelible ink for marking linen, let him try this: Add caustic alkali to a saturated solution of cuprous chloride until no further precipitate forms; allow the precipitate to settle; draw off the supernatant liquid with a siphon, and dissolve the hydrated copper oxide in the smallest quantity of ammonia, and then it may be mixed with about 6 per cent. of gum dextrine for use. E. P.

[69245.] — **Marking-Ink.**—The use of silver nitrate in marking-inks is obsolescent, both on account of the expense and of the unsatisfactory character of the product. The aniline inks, however, which have to a limited extent superseded the older forms are, though perfectly reliable, open to the almost fatal objection that they could not be combined in a single fluid to the moment of use, two bottles being therefore required. But these are now in their turn giving way to what it seems reasonable to hope will prove the marking-ink of the future, being easily made, simple in use, thoroughly reliable, and last, not least, producible at a cost not in excess of ordinary good writing-ink (say 1s. per gallon). PERCY W. STANLEY.

5, Billson-street, Poplar, London.

[69245.] — **Marking-Ink.**—Inks for marking linen may be divided into two classes—viz., those used with types, and those used with a pen. When a pen is used it should either be a clean quill or a gold one; steel pens, owing to the chemical action of the ingredients of the ink on the metal, not unfrequently cause the writing to fade, and so prove a failure. A good receipt for type marking ink runs as follows:—Sulphate of manganese 1dr., water 1dr., powdered sugar 2dr., lampblack ¼dr. Triturate these ingredients together in a mortar, and stamp on the linen with types. Wash the part when dry with liquor potassæ, dry again, and wash with plenty of water. An ink for use with a quill pen runs thus: 50gr. nitrate of silver, ½oz. distilled water, 1dr. gum arabic, ½ scruple sap green; dissolve. The linen to be written on must first be wetted with the following pounce, dried and rubbed smooth. Pounce: sub-carbonate of soda 1oz., water 8oz. Marking ink, without using nitrate of silver, may be made thus: Moisten the linen with chloride of tin (fresh solution), and write with a neutral solution of salt of gold. The following ink is from an old recipe, and I can safely recommend it to all who require a good wearing, and at the same time non-injurious, marking fluid. It requires no pounce or mordant, as it is often termed, but is fixed with a hot iron, or by being held near a good fire till the writing darkens: Nitrate of silver ¼oz., bi-tartrate of potash ¼oz., mix; add 2oz. liquor ammoniæ, dissolve powder in this, and then mix in 2dr. of white sugar, 5dr. of powdered gum-arabic, ¼oz. archil, and water to make up 3oz. by measure. J. WEST.

[69246.]—**Logarithms.**—Proceed as in ordinary addition or subtraction; the only peculiarity being that while the mantissæ are always positive, the characteristics are sometimes negative, and then must be added or subtracted as in algebra—e.g., in your first example, put down 8, and carry the 1 to the next column, which will make the new characteristic 2 (as it clearly should be, since the product of the given numbers will evidently have two digits to the left of the units place). But if your first log. had been $\bar{1}{\cdot}97674$, the + 1 carried would have neutralised the − 1, making the new characteristic = 0. In your example of subtraction, you must "borrow" as in ordinary subtraction, and take 10 from 13, putting down the remainder, 3. In the next step you "repay," as usual, by adding 1 to the next figure—only, as this is negative, you must "add" algebraically. In this way the + 1, combined with the − 2, gives − 1 for the lower figure, which, taken from the upper − 2, leaves − 1 for the characteristic of the result, which, therefore, is $\bar{1}{\cdot}33565$. Most elementary works on trigonometry, or more advanced works on algebra, explain the use of logarithms. MU. NU.

[69246.]—**Logarithms.**—As there are two or three mistakes in this query, it is difficult to answer with certainty. I give the two calculations required, worked in full:—

(1) 94·785 × 6·8798.

$$\begin{array}{lcrcr}
\text{Log. } 94{\cdot}785 & = & 1{\cdot}9767396 & & \\
\text{Log. } 6{\cdot}8798 & = & 0{\cdot}8375758 & & \\
\hline
 & & 2{\cdot}8143154 & & \\
 & & 2{\cdot}8143142 & = & 652{\cdot}10 \\
\hline
 & & 12 & = & 2 \\
\hline
 & & & & 652{\cdot}102
\end{array}$$

(2) 0·02132 ÷ 0·098764.

$$\begin{array}{lcrcr}
\text{Log. } 0{\cdot}02132 & = & \bar{2}{\cdot}3287872 & & \\
\text{Log. } 0{\cdot}098764 & = & \bar{2}{\cdot}9945987 & & \\
\hline
 & & \bar{1}{\cdot}3341885 & & \\
 & & \bar{1}{\cdot}3341722 & = & 0{\cdot}21586 \\
\hline
 & & 163 & = & 8 \\
\hline
 & & & & 0{\cdot}215868
\end{array}$$

YOUNG ANALYST.

[69247.]—**Richter's Dream.**—A. Griffiths will find Richter's dream in Carlyle's second article on Richter, which is contained in Vol. III. of Carlyle's critical and miscellaneous essays. LANGDEN.

[69247.]—**Richter's Dream.**—If Mr. Griffiths means the passage, "God called up from dreams a man into the vestibule of heaven, &c.," he will find it in Proctor's "Universe and the Coming Transits," p. 204. Proctor ascribes the "dream" to the German poet, Jean Paul (nobly translated by our own prose poet, De Quincey)." If Mr. Griffiths will send me his address, I will send him a copy of the passage as quoted by Proctor.

Ballisodare, Ireland. J. E. GORE.

[69248.]—**Cutting Boiler.**—Line it round, and then cross-cut it by hand, and afterwards trim the edges of plate with a flat chisel. F. W. CANN

[69249.]—**Indian Railway Problem.**—If you had to reach a point on the line distant m miles from the foot of perpendicular, the change from boat to rail would take place at a distance $cp(36 - p^2)^{-\frac{1}{2}}$ from the foot of perp., where p represents the rate of rowing. This is simply a case of the minimum value of a function of one variable, and is independent of m. Hence, on starting, you land $\frac{c}{2\sqrt{2}}$ miles from foot of perp., and, on finishing you get off the line $\frac{b}{\sqrt{3}}$ miles from foot of the other perp. These are obtained by giving p the values 2 and 3, of course, replacing c by b in the latter instance. The solution may also be obtained by equating to zero the partial diff. coefficients of the expression for the whole time—that is:

$$\tfrac{1}{2}\sqrt{(c^2 + x^2)} + \tfrac{1}{3}\sqrt{(b^2 + y^2)} + \tfrac{1}{6}(a-x-y).$$

Portsmouth. A. M.

[69249.]—**Indian Railway Problem.**—In this problem the distance a may be disregarded, provided it is greater than $x + y$. Then we have to find what is the gain in time by travelling along the hypothenuses instead of along the other sides of the two triangles. In the first part of the journey the gain equals—

$$\frac{c}{2} + \frac{x}{6} - \frac{\sqrt{c^4 + x^2}}{2}.$$

Differentiating and equating to zero we get—

$$1 - \frac{3x}{\sqrt{(c^2 + x^2)}} = 0, \text{ whence } x = \frac{c}{\sqrt{8}}.$$

Similarly we have—

$$1 - \frac{2y}{\sqrt{(b^2 + y^2)}} = 0, \text{ whence } y = \frac{b}{\sqrt{3}}.$$

These values of x and y give a maximum gain in time, and therefore reduce the time to a minimum. By taking the whole time occupied in the journey, that is—

$$\tfrac{1}{2}\sqrt{c^2 + x^2} + \tfrac{1}{3}\sqrt{b^2 + y^2} + \tfrac{1}{6}(a - x - y)$$

and finding the minimum value by differentiating, &c., the same result is obtained, but the process is much longer. W. J. A.

[69249.]—**Indian Railway Problem.**—Does not this prob. resolve itself into this? What is the value of x and y, respectively, when

$$\frac{c}{3} + \frac{x}{6} - \frac{\sqrt{c^2 + x^2}}{3} \text{ is a maximum}$$

$$\frac{B}{2} + \frac{y}{6} - \frac{\sqrt{B^2 + x^2}}{2} \quad ,, \qquad ,,$$

Working out the first we get—

$$\frac{c}{3} + \frac{x}{6} - \frac{\sqrt{c^2 + x^2}}{3} \text{ a maximum}$$

$$c + \frac{x}{2} - \sqrt{c^2 + x^2} \quad ,, \qquad ,,$$

If u = total time in reaching that point—

$$\frac{du}{dx} = \tfrac{1}{2} - \frac{x}{\sqrt{c^2 + x^2}}$$

$$\tfrac{1}{2} - \frac{x}{\sqrt{c^2 + x^2}} = 0$$

$$3x^2 = c^2$$

$$x = \frac{c}{\sqrt{3}}$$

Similarly, we get— $y = \frac{B}{\sqrt{8}}$

A. R. M.

[69249.]—**Indian Railway Problem.**—Since, when the speed is uniform, *time = distance traversed ÷ speed*, we have for the whole time occupied by the journey—

$$\frac{\sqrt{c^2 + x^2}}{2} + \frac{a - (x + y)}{6} + \frac{\sqrt{b^2 + y^2}}{3}.$$

Denoting this expression by u, and taking the partial differential coefficients of u with respect to x and y, we get—

$$\frac{du}{dx} = \frac{x}{2\sqrt{c^2 + x^2}} - \tfrac{1}{6}.$$

$$\frac{du}{dy} = \frac{y}{3\sqrt{b^2 + y^2}} - \tfrac{1}{6}.$$

From $\frac{du}{dx} = 0$, we obtain $x = \frac{c}{\sqrt{8}}$, and from $\frac{du}{dy}$ $= 0$, y [illegible]. These values of x and y, substi- [illegible] $\frac{d^2u}{dy^2}$, produce positive results, the [illegible] greater than $\left(\frac{d^2u}{dx \cdot dy}\right)^2$— since [illegible] zero. Hence, $x = \frac{c}{\sqrt{8}}$ [illegible] imum.

J. R. C.

[69249.]—**Indian Railway Problem.**—Referring to the figure drawn by "M.I.C.E.," we have the length of the diagonal $= \sqrt{b^2 + y^2}$, and this divided by the rate gives the time required to reach the railway $= \frac{\sqrt{b^2 + y^2}}{2}$ hours. The distance traversed by rail is $(a - x - y)$ miles, and the time is therefore $\frac{a - x - y}{6}$ hours. Also, after leaving the rail $\sqrt{c^2 + x^2}$ is the remainder of the journey to be accomplished, a distance which takes $\frac{\sqrt{c^2 + x^2}}{3}$ hours. The whole time, therefore, required to make the journey from one bungalow to the other is $\frac{\sqrt{b^2 + y^2}}{2} + \frac{a - x - y}{6} + \frac{\sqrt{c^2 + x^2}}{3} = T$. In order that T may be a minimum we must have

$$\left(\frac{dT}{dx}\right) = \frac{x}{3\sqrt{c^2 + x^2}} - \tfrac{1}{6} = 0. \quad \therefore x = \frac{c\sqrt{3}}{3} \text{ miles.}$$

$$\left(\frac{dT}{dy}\right) = \frac{y}{2\sqrt{b^2 + y^2}} - \tfrac{1}{6} = 0. \quad \therefore y = \frac{b\sqrt{2}}{4} \text{ miles.}$$

The usual tests show that these values correspond to a minimum value of T. By substituting these values in the expression for the time, we have

$$T = \left(\frac{b\sqrt{2}}{3} + \frac{a}{6} + \frac{c\sqrt{3}}{6}\right) \text{ hours.}$$

Camberwell. A. H. G.

[69251.]—**Proving Pump.**—An ordinary solid plunger pump is best for your purpose, worked with a hand lever or wheel and crank. On a large scale a set of three pumps is used. If you will let me know what pressure you require to work to, I will forward sketch of accumulator.

F. W. Cannon.

[69252.]—**Hard Water.**—You are rather too near the surface. You may do better by boring deeper, perhaps worse: it depends upon the soil. You can soften by filtering or distilling.

F. W. Cannon.

[69252.]—**Hard Water.**—Hard to state unless a sample of water is seen. Is it a temporary or permanent hardness? If you were to advertise your address, and then send me a sample of the water, I would (gratis) examine it and give you my advice. F. W. Mason, F.S.S.

[69252.]—**Hard Water.**—It is impossible to say what is the best way to soften a water without knowing the cause of its hardness. Try lime-water first—one part of lime-water to ten parts of the hard water; try again one and a-half parts to ten parts hard water, allowing the mixture four or five hours to settle and clear before using. If neither of these do any good, try the reagents suggested on page 429, July 19. Only a few grains per gallon of these should be used—experiment will teach you the best quantity. The water must be allowed to settle and clear, the same as if lime was used. Not knowing where your well is, or the nature of the ground in which it is sunk, one cannot tell if you would obtain better water by going 12ft. deeper. I should be inclined to think you are drawing surface-water from a layer of gravel, by the way in which you say it acts. C. E. Gittins.

[69252.]—**Hard Water.** — The possibility of softening the water from your spring depends entirely on the nature of the hardness. If this is caused by chalk (calcium carbonate), then the water is what is termed temporarily hard, and may, to a great extent be remedied. If, on the other hand, calcium sulphate is the cause of the trouble, the water is designated permanently hard, and will be found to thoroughly deserve its name. Calcium sulphate ($CaSO_4$) is soluble in 400 parts of water, and is a very common impurity in spring water. Calcium carbonate ($CaCO_3$) is almost insoluble in pure water, but readily dissolves if carbonic acid be present. Water containing calcium carbonate when boiled deposits this salt on the sides of the vessel, and so becomes soft. By this action the so-called boiler crust is formed. Calcium sulphate is not deposited when the water containing it is boiled, but remains in solution. Boiler-crust may be checked by adding a small quantity of sal-ammoniac to the water, soluble chloride of calcium and volatile carbonate of ammonium being formed. To soften water rendered hard by dissolved carbonate, add a little lime to it; this will neutralise the excess of carbonic acid, and so precipitate the chalk. Sinking your shaft another 12ft. to remove the difficulty depends for its success entirely on the nature of the ground through which you pass. This, of course, can only be determined by actual experiment.

J. West.

[69253.]—**Shop-Front.**—If you do not trouble the surveyor he will trouble you; so best see him first. F. W. Cannon.

[69256.] — **G.W. Narrow Gauge.** — Mixed gauge ends at Exeter, St. David's Junction; begins again Lidford to Plymouth North-road, Devonport Junction, and Friary Junction; then again at Truro to Penzance and Portreath branch. Princetown and Helston branches are narrow-gauge only.

Uttoxeter. N. S. R.

[69257.]—**Developer.**—How can one say? It may be fog. It may also be a deposit of aluminum hydrate owing to insufficient washing before using the alum bath—i.e., if you alum before fixing.

Sm.

[69257.]—**Developer.**—To "Sm" or Mr. Bottone.—I do not think that hydroquinone is adapted for use with bromide paper. If you can refer to the *Photographic News* for April 12, 1889, you will find an exhaustive paper on comparative trials of developers by Lyonel Clark, and the conclusion arrived at is that hydroquinone is the poorest of the three—viz., pyro, ferrous oxalate, and hydroquinone. For a really good mode of developing bromide paper see *Photographic News* for July 19 and 26. A good recipe for hydroquinone developer is that given by Thomas, which I reproduce here. Solution No. 1.—Hydroquinone, 160gr., sodium sulphate 2oz., citric acid 60gr., potassium bromide 30gr., water to make up 20oz. Solution No. 2.—Sodium hydrate 160gr., water to make up 20oz. Use equal parts of each. For the development of opals or bromide papers dilute this last developer with an equal quantity of water. S. Bottone.

[69259.]—**Electric Lamp.**—The salt used was most likely bichromate of potash, not chromic acid, as this latter is deliquescent, and therefore would not crystallise. Let the elements stand for half a minute in a vessel containing sufficient boiling water to reach a little over half-way up the zincs, then when all the crystals are dissolved off take out and allow to dry. Charge the battery with a mixture as below: Water 1 pint, chromic acid 3oz., sulphuric acid 3oz.; mix and allow to cool before using. This battery will light any lamp between 9 and 12 volts, equal to about 5 or 6 candle-power.

S. Bottone.

[69260.]—**Telephones.**—See that your supports are firmly fixed, good connections, and adjust both instruments again. F. W. Mason, F.S.S.

[69260.]—**Telephones.**—It is not stated whether batteries have been used in conjunction with these. Presuming that such have not been used, it is just possible that there is too much play for the ferrotype plates, so that after the first few vibrations they shake out of place. Put a washer ring of card between the plate and the cover, and see whether that mends matters. S. Bottone.

[69261.]—**Collodion Positive Limelight.**—Under the circumstances, I should advise you to use gelatine plates. Use the limelight unshielded, and you will be able to get almost instantaneous pictures if you have a good lens. You will find a good recipe for getting gelatine positives in the *Photographic News Almanac* for the year 1886, page 65, under the heading "Positives on Gelatine Plates." S. Bottone.

[69262.]—**Humidity.**—It takes a certain fixed quantity of water vapour to saturate the air at any given temperature. That quantity is taken as standard and called 100. Hence, when we speak of the humidity as being 80° we mean that $\frac{80}{100}$ or $\frac{4}{5}$ of the saturating quantity of water vapour are present in the air. The instrument most usually employed for measuring the atmospheric humidity is the wet and dry bulb hygrometer, also known as Mason's hygrometer, and on the Continent as August's psychrometer. Description and cuts of this can be found in Deschanel's "Natural Philosophy," or Ganot's "Physics."

S. Bottone.

[69264.]—**Midland Locomotives.** — Midland single engine No. 26 was illustrated in the English Mechanic when the new design came out in 1887. The new 34 class are the same in outside appearance, but 2in. larger wheels and ½in. larger cylinders—that is, 18½ by 26, and 7ft. 6in. wheels. They only burn 21lb. of coal a mile. Loco.

[69265.]—**Decomposing Water.** — Taking it roughly that 1,404 ampères at a pressure of 4 volts will be needed to decompose 1lb. of water in one hour, this is equivalent to 5,616 watts, or, say, 7½H.P., or 247,500ft.-lb. per hour.

S. Bottone.

[69265.]—**Decomposing Water.**—One pound of water consists approximately of ⅑lb. of hydrogen and ⁸⁄₉lb. of oxygen. In uniting with the oxygen the ⅑lb. of hydrogen would give out 6,892 units of heat — that is, it would do 6,892 × 772 = 5,320,624ft.lb. of work. In order to decompose a pound of water, either by electricity or otherwise, 5,320,624ft.lb. of work must be spent in overcoming the chemical affinity of the oxygen and hydrogen.

J. Ball.

[69266.]—**Pilsener Lager Beer.**—Before commencing a description of the manufacture of lager beer, it must be premised that the mash-tuns used are fitted up with elaborate rake machinery to insure the most thorough mixture of their contents, and are also provided with a false bottom perforated with small holes fixed a few inches above the real bottom of the tun. Crushed malt is placed in the tun, and water at a temperature of 100° Fahr. is allowed to flow under the false bottom in the proportion of 900 parts of water to 336 parts of malt—i.e., 2¼ barrels per quarter. The rake machinery is set in motion, and the whole thoroughly incorporated. So soon as this is accomplished a fourth of the mash (malt and all) is pumped into a copper and boiled for half an hour. This is run back into the mash-tun boiling hot, and the contents of the mash-tun again thoroughly mixed. Another fourth is pumped up, boiled, and mixed with the mash. In some breweries a third fourth is treated in a similar manner. The temperature of the mash will now have risen to about 140° Fahr. The whole is allowed to stand for a short time, and the wort drawn off. This wort is now boiled, and run boiling hot into the mash-tun, the whole well roused, and allowed to stand an hour or an hour and a half. The wort is now strained off into the copper, and the grains well washed with another quantity of water at 160° or 170° Fahr., equal to that used for mashing. This is effected by sprinkling the hot water on to the grains by means of a sparge, which is a horizontal tube mounted on a hollow axis, and perforated with fine holes—one half at one side, and the other half on the other. On hot water being run into the tubular axis, the horizontal pipe revolves on the principle of a Barker's mill, and scatters a fine spray of water evenly on the surface of the grains. This washing water passes through the grains, and runs to the wort in the copper. Hops are now added to the contents of the copper, and the whole boiled for two hours. The wort strained from the hops is cooled by being run into shallow vessels, and finally by passing through a refrigerator, until its temperature is lowered to 42° F. It is now run into the fermentation vessels (which are large, shallow troughs) to a depth of 6in. or 8in., and low fermentation yeast added in the proportion of from 1¼ to 2¼ parts to each 3,600 parts of wort. Fermentation commences, and is allowed to proceed until the original gravity of the wort is reduced one-half. This occupies from ten to sixteen days, and the temperature of the fermenting wort is never allowed to exceed 45° F., this being prevented by floating pails containing ice in the wort. The beer is run into large stone vats, and kept in cellars at a low temperature for some time until it becomes bright and clear. It is then casked off or bottled for consumption. The bottled lager is almost invariably Pasteurised—that is, the bottles are placed in cold water, the temperature gradually raised to 140° F., and kept at that temperature for a short time. This kills the germs which would otherwise develop and spoil the beer. As lager beer contains a large amount of albuminoid and unfermented matter, it is peculiarly liable to go bad; hence the great care in storing it and keeping it at such a low temperature. Below 50° F. the false ferments which cause beer to go bad do not thrive.

W. J. Sykes, M.D., F.C.S.

[69268.]—**Arc Lamp.**—You will not get a satisfactory arc light with less than 12 such cells. The rods should be about ⅛ to 3/16in. in diameter. There is an excellent description of a suitable arc lamp, easily made by an amateur, in Cassell's *Popular Educator*, Vol. V. Section vi. of "Voltaic Electricity," with an accompanying engraving, Fig. 35.

S. Bottone.

[69271.]—**Sulphonal.**—Sulphonal is the newest hypnotic. The name is a short substitute for the chemical name "Diethyl-sulphon-dimethyl-methane." Baumann and Fischer have worked out the chemical history and constitution. The following extract is taken from the *Pharmaceutical Journal*: — "When hydrochloric acid gas is passed through a mixture of mercaptan (C_2H_5SH) and acetone (C_3H_6O) in the proportion of two molecular weights of the former to one of the latter, the product is a liquid insoluble in water. It is treated with permanganate solution, by which the S of the mercaptan group is oxidised to SO_2. After heating and filtering while hot, the new compound —sulphonal—separates on cooling.

Bocking, Braintree. F. H. Blomfield.

[69271.]—**Sulphonal.**—This preparation is an oxidation product of the union of ethyl-mercaptan with acetone. It is represented by the following formula $(CH_3)_2 = C = (C_2H_5SO_2)_2$. It is a very stable body, resists acids and alkalies, and possesses neither taste nor smell. It is five times more soluble in boiling than it is in temperate water. Pure sulphonal should be white, inodorous, not bitter to the taste, and should, when forming a saturated solution with water, show no change for an hour when treated with a solution of potassium permanganate. Sulphonal is being used as a hypnotic with at present favourable results, though time alone can definitely assign it its proper place in the list of agents already employed for the purpose of inducing sleep.

J. West.

[69272.]—**Dynamo for Arc and Incandescent Light.**—It is usual to employ series-wound machines for arc lighting, and shunt-wound or compound-wound machines for incandescent. The reason for this is that it is frequently required to vary very considerably the resistance of an incandescent light circuit, by turning on or off a number of the lights. Hence the dynamo must be able to regulate its output according to the requirements. This a shunt, or better, a compound-wound dynamo can do, but a series cannot. The armature winding is the same in either case; but in the series machines the F.M.'s are wound with a coarser wire, having only ⅜ the R. of the A.; while in the shunt machines the F.M.'s are wound with many coils of a finer wire, having from 300 to 400 times the R. of the A. A sketch of the two modes of coupling up is given in the "E. M." at p. 428 of this volume. A compound-wound machine will serve both purposes very nearly equally well.

S. Bottone.

[69275.]—**Harvest Spider.**—Having at the present moment 120 to 130 spots raised by this vicious animal, I think I have some experience in the matter. They always attack me when my preventive is not handy. The following will keep them off:—Take of eucalyptus oil 2oz., carbolic acid (pure) 40gr., sp. ammon. aromat. 1oz. Put a few drops of this mixture over the stockings and underclothes once or twice daily before going out, and no "harvester" will come. If the mischief is done, use a powder puff well charged with Allen and Hanbury's antiseptic powder, which will allay the itching in a few seconds.

F. R. S. E.

[69275.] — **Harvest Spider.** — Kükenmeister considers this insect (Leptus autumnalis) to be one of the grass mites. He states that it lives in dry grass, corn, on gooseberry bushes, and also upon man in July and August. It is very troublesome to reapers. It nearly resembles the Itch acarus, and secretes a specific poison, rendered more irritant by the hirsute limbs. Having gently inserted the point of a fine needle in each puncture, squeeze the swelling, and apply a touch of laudanum with a camel-hair brush occasionally. Ladies and persons with delicate skins seem to suffer most, as this insect penetrates more deeply into the flesh.

Eos.

[69275.]—**Harvest Spider.**—I must leave the "definite information" as to history and nature to other writers, and can only treat of protection from, and cure for, this annoying autumn pest. With us in Somersetshire, as soon as the bug is felt vinegar is applied to the place, and I can speak of the beneficial effect of this application; and, as a bee-keeper, should think, if the cause of the irritation is "formic acid," the same as from a bee sting, that "Grimshaw's apifuge" would have the same powerful effect that it has when applied to a recent puncture by that insect the bee. I have heard, on good authority, that rubbing the legs from the ankle upwards with walnut leaves is a certain protection from their attack, and think the application of "apifuge" would protect you from this insect, as it does me from the attack of the most furious bee. I intend to try this remedy if occasion arises this season.

J. I. S.

[69276.]—**Cement for Bicycle.**—Buy it: it is cheap enough. Will cost you more to make it in small quantities.

Sm.

[69276.]—**Cement for Bicycle.**—Let "P.E.D." try a sixpenny tin of the New Glue Co.'s "water-glue," liquid and waterproof. It will answer his purpose so far as fixing tires is concerned; but I fear there is nothing short of remoulding will efface cuts. The article is much used here, and will be found advertised in the Sale Column.

Bradford.

[69276.]—**Cement for Bicycle.**—To make good cement, get 1lb. of good old bicycle tire, cut in small pieces, melt in an old pan, and stir with a stick occasionally. Let the pan be plenty large enough, as the rubber swells. Get ½lb. of old or waste guttapercha (as new is rather dear), and stir it in as soon as the rubber is melted. Be careful, for if you heat the rubber much after it is melted, it will remain sticky and will not set. Then get 1lb. of Swedish pitch, and stir it in; then pour out on a flagstone, or in a metal dish, with a good thick coat of whiting on. If too hard, remelt and add 2oz. or 3oz. of tallow. The rubber makes an abominable smell while melting. It will not do for cuts. You must get threepennyworth of bisulphide of carbon from the druggist, and a bit of pure rubber from the stationer's the size of a small hazel nut (one pennyworth), cut in very small pieces, put in bottle with carbon, and shake often. It will make a jelly. If too thick, add more bisulphide.

Cycle Repairer.

Whole-Meal Bread.—Miss May Yates says that whole wheat-meal bread may be at once distinguished from brown bread that is made with white flour and bran. The bran has a spotty appearance when it is added to white sponge, whilst whole wheat-meal bread has a soft brown colour *all through*, and when properly made the bran cannot be distinguished in the crumb, even when viewed under a magnifying-glass.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

68799. Another Old Locomotive, p. 311.
68801. Checking Blood Flow in Animals Accidentally Killed, 311.
68803. Snake and Animal Poisonous Secretions, 311.
68806. Electrical, 311.
68833. Kansas, Mo., America, 312.
68846. Shadowgraphs, 312.
68847. Galloway Boiler, 312.

68990. "Mona's Queen" Paddle Wheel, p. 400.
68998. French Metal Factories, 400.
69002. Bricks, 400.
69005. Clock Cleaning, 400.
69006. G.E.R. Single Drivers, 400.
69008. Cubical Contents, 400.
69016. Papier-Maché Lining for Tea-trays, 400.
69021. Screw-cutting, 400.
69024. Gauging Keys, 400.
69029. Tablets for Warnerke's Sensitometer, 401.

QUERIES.

[69279.]—**Fan or Windmill.**—What is the greatest amount of power to be obtained from a fan or windmill, 4ft. circumference, and propelled by wind, travelling at a rate of 40ft. per second?—Cycle.

[69280.]—**Smith's Bellows.**—Can any of "ours" tell me how to cut the leather to fit a smith's bellows? I cannot get a nice fit, as the leather always bulges at the side creases, and does not fold neatly.—Vulcan.

[69281.]—**Mackintosh.**—I have about 50 grey india-rubber (?) mackintosh sheets, which are used on hospital beds, and consequently get soiled. Hitherto I have cleaned them with turpentine, which I fancy is injurious. What ought I to use instead? Time and expense are both considerations, as the sheets should be frequently cleaned.—E. Wyn.

[69282.]—**Malleable Castings.**—Is there any brother-reader that could tell me how to make malleable castings? I have a small Salamander crucible. Or is there any composition that could be made fluid, and that could be welded to wrought iron?—New Subscriber.

[69283.]—**Razor and Scissors Grinding.**—Is there any kind reader that could inform me with what stone and finishing-off wheel to grind razors and scissors? I have stone and rough emery wheel, but the razor roughs like a saw. Should be pleased if anyone could tell me what stone and finishing-off wheel?—New Subscriber.

[69284.]—**To Mr. Bottone.**—What lamp ought I to get for a battery of 12 Judson cells when using your depolariser, and if I use half the cells, must the voltage alone be halved, or must I get one with half the ampères? Size of cells inside, outer carbon, 2¾in. by 6in., porous pot 7 by 2, zinc rod 7in. by ½in. What wire to use for lamp 12yds. distant.—D. Roberts.

[69285.]—**To Mr. Bottone.**—I want to fix a 2½in. bell, 6yds. distant from a switch, so that I can wake up another person. It may ring for a minute or more each morning only, but not in the day. I do not want an expensive continuous ringer; they are too expensive when a switch does as well. What size wire, and how many cells, and how connected would greatly oblige, and how long before recharging.—D. Roberts.

[69286.]—**Wells System.**—Will some reader kindly explain the Wells system of measuring distances with an ordinary dumpy level without the aid of chain or tape? Also what are the best works on surveying?—Thalia.

[69287.]—**Coil.**—I have a coil partly made of 23 soft iron wires, 2¼in. long. Space between ends is good 1¾in. and over ⅜in. space from edge of ends to the core. What wire must I use to get the longest spark, and how much? Also cost, and if note-paper, paraffined or painted with brown, hard varnish, would do to insulate with. Also what condenser?—D. Roberts.

[69288.]—**Hospital.**—It having fallen to my lot to have to do with the planning of a new hospital for 50 beds and knowing next to nothing on the matter, I shall be thankful for a recommendation of an elementary work on the subject. I want information concerning the sanitary arrangement and principles affecting the general disposition of parts of the building, &c.—E. Wyn.

[69289.]—**A Chemical Question.**—Is it always the case that when a solid becomes gaseous cold is produced, and, on the contrary, when a gas becomes solid heat is evolved? For instance, am I wrong in supposing that when oxygen at 1,000° Fahr. is passed over BaO at the same temperature, the O being rapidly absorbed and the oxide becoming peroxide, that heat is produced, and consequently the temperature of the BaO raised, and, on the contrary, when BaO_2 is heated to, say, 1,400° Fahr., the oxygen is suddenly evolved, and the peroxide reduced to oxide. Does this result in a loss of heat or reduction of temperature?—A Workman.

[69290.]—**Turbine.**—Will "T. C., Bristol," kindly give me the following information? I have a fall of water 30ft., and want to erect a water-wheel or turbine: sufficient supply to fill an 8in. diam. pipe. The water conveyed in pipes 200yds. from feeder, which is on side of a mountain? What diameter and width water-wheel do you recommend, and also what power can be obtained? Which will take the most water for same power, water-wheel or turbine, and what is the difference in cost?—T. P. W.

[69291.]—**Bunsen Cells.**—In the "E. M." of Aug. 2, in reply to query No. 69165, Mr. Bottone recommends chromic acid, chlorate of potash, and sulphuric acid to be used as depolarising liquid in Bunsen cells. Would he kindly say how many volts, and what current a well-made pint cell should give? For a porous pot to be efficient if filled with water, how long should it take to let all the water run out? In several papers and books I see that the bichromate of potash cell is spoken of as only suitable for giving short currents, but that on being allowed to rest the E.M.F. soon recovers itself. Now, I have tried chromic-acid cells, and find but little diminution in the E.M.F. for an hour at least. Does this difference in efficiency lie in the using of chromic acid instead of bichromate of potash, and does the bichromate cell really soon run down? What is the smallest E.M.F. and current requisite to run a steady arc light, and what would probable candle-power be?—Chasseur.

[69292.]—**Paris Exhibition Locos.**—Will some correspondent kindly give a description of the various locomotives in the exhibition, more particularly the foreign ones? If accompanied by drawings it would be much more acceptable.—Ixion.

[69293.]—**Ringed Snake.**—On what can I keep a ringed snake from the New Forest? It will not eat bread nor drink milk.—R. G.

[69294.]—**Photography.**—Can anyone help me out of this difficulty? I have been taking a photograph of a house with a large tree in front. In the middle of the tree there is a large dark blurr, which, therefore, comes out light in the print. Is it likely that this might have been caused by my pouring the developer (Edwards' hydrokinone) on to the middle of the plate, because that is what I did? Is there any way of remedying it? I have tried intensifying it, with bichloride of mercury and ammonia, but that has no effect? It disfigures the plate entirely, otherwise it is a good negative.—Denton.

[69295.]—**Extracting Scent, &c.**—Wanted information on the extraction of scent, &c. Also on the healing and other properties of herbs. Are there any books published?—Pansy.

[69296.]—**Ginger Wine.**—Could any reader give me information as to how a good ginger wine is made by the fermentation process, and also where a reliable work on the manufacture of British wines and cordials can be obtained?—Thos. Byrne.

[69297.]—**Nomenclature of Mathematical Formulæ.**—Can any reader kindly inform me how to name the following expressions (I am quite familiar with their meaning)?

$$x^{-1},\quad x^{-\frac{2}{3}},\quad x^{\frac{3}{10}},\quad \&c.,$$

And also work out for me all the successive differentials of $(P + x^2)^3$]x.—Self-Taught.

[69298.]—**To Mr. Bottone and Others.**—I intend making a pair of "E. M." telephones. I have two bars of ½in. round iron, 6in. long. Will they do for the magnets? How much wire should I put on each, and what size should it be? Will thin iron plates be best for the diaphragms, or is parchment the proper thing? If parchment, can I prepare it to stand the moisture of the breath, &c.? Also how many batteries shall I want at each end of a 50yd. line wire; and should I want less if I used permanent magnets? Is a microphone transmitter the proper thing to use, or will one instrument act both for transmitter and receiver?—W. Holle.

[69299.]—**Chamber Organ.**—In your issue of July 26th, Mr. Robinson specifies for a two-manual organ. Would he kindly reply if the swell stops all run through; also what he means by no separate pedals to be used? And lastly, what such an organ as the one specified could be sold for?—Rus in Urbe.

[69300.]—**Photos of Locomotives at South Kensington.**—In the collection of models of machinery at South Kensington there is a frame of photos. and documents illustrating railway history. One photo. represents a large 4-coupled bogie engine and tender of an apparently recent date. As no description is appended, I shall be glad if any correspondent will identify it.—N. S. R.

[69301.]—**Electric Conductors.**—What is the three wire system?—And how does it act? There are now being laid in Regent-street bare cables, or rather ribbons, arranged in three groups, of about twenty for each of the two outsides, and some smaller number, ten or twelve perhaps, for the middle. They are only insulated by resting at intervals on glazed divisions of earthenware; and no doubt all will go well so long as water can be kept out of their iron covered channel. But why three leads? There is some method of running dynamos in couples; how is it that the current can be conveyed by unequal conductors?—for if any two of those three leads are positive, the negative must have more to do. Is there any published description of the system?—Lux.

[69302.]—**Tennis Ball.**—How are tennis balls made? I am told they are stitched in a press. Is it so? and what kind of press is used?—Tennis.

[69303.]—**Coir Yarn.**—Can any of "ours" tell me how coir fibre is spun into coir yarn as imported; and give an idea of the cost of machinery to spin one ton per day? There is steam power on the spot.—Eureka.

[69304.]—**Copying Composition.**—I should feel much obliged if some reader of the English Mechanic could give me the recipe for a copying composition (similar to the ABC copier), the impression on which does not require washing off when the number of copies required are all printed; also ink for same.—Albion.

[69305.]—**Moulds.** - Will any of "ours" kindly inform me how I can make metal moulds for casting small aluminium and other metal trinkets?—Trinket.

[69306.]—**Brighton Engines.**—Will Mr. Dendy Marshall, or "P. H. N." give the numbers, and classes, and dates of the following engines:—Austria, Banmore, Banstead, Bishopsgate, Brading, Chailey, Cheapside, Chipstead, Deptford, Isfield, Oxted, Purley, Stamford, Streatham, Sydenham, Telford, Westham, Willesden, Terrier. They are all tanks, I believe. And expresses Newport and Norwood.—E. P.

[69307.]—**Preserving Centipede.**—I have a centipede preserved in a bottle. By accident, the sealing wax has got knocked off the cork; all the liquid has evaporated. Would some reader be kind enough to tell me what kind of liquid to fill the bottle with again?—Insect.

[69308.]—**Old Clock at Rouen.**—Is the claim of the clock over the Rue de la Grosse Horloge, to be the oldest at work and most durable machine, supportable? Also what was the change made in 1712, and is it now regulated by pendulum, or an improved balance? According to Eugene Noel, in the "Tour du Monde," its wheels, all of iron, and some exceeding a mètre in diameter, have hardly been stopped in five centuries, but for the above alteration, which he describes as giving it a "balancier," a century after Galileo had discovered the isochronism of the pendulum. Surely it must have had a balance originally, like other clocks of its age. It was 42 years' old when striking the hour for Joan of Arc's execution! What a pity nobody had invented phonographs five centuries earlier!—E. L. G.

[69309.]—**Rate of Interest.**—Will thank any correspondent to inform me how to calculate the rate of interest upon a loan. Interest and part principal payable each calendar month to extend over a series of years. To illustrate, loan £400, monthly payment £6, term of years 10.—Rob. Harris.

[69310.]—**Japanning Eyelets.**—Can some reader oblige me with the best known method of blacking or japanning small eyelets?—Black.

[69311.]—**Electric Wind Vane.** — How is this managed? Suppose there are 32 contacts at the base of a rotating shaft carrying the vane with wires from each leading to a dial at a distance, will there be an electromagnet behind the dial actuating a finger in front, and will four or six Leclanché cells give sufficient battery power? But supposing the vane axis to rest for some time with connections actually in contact, that would soon run down the battery. It would be an objection to have to press a button before observing the dial, though that might meet the difficulty. —Cotswold.

[69312.]—**Gas or Hot-Air Engine.** — I am a country watchmaker, and have for several years done a good deal of electro-plating. As nearly the whole of my work consists of replating worn articles, I am desirous of using a small engine for driving my polishing lathe, as the work in preparing goods that are much scratched is very laborious. I think ½H.P. would be ample for my purpose. I should be very grateful to any reader who has had experience of both engines which would be best for my purpose. Another point is this, I find the prices quoted for ½H.P. gas-engines to be from £40 to £45, but engines are frequently advertised in our columns at from £10 to £15 second-hand. Now what I wish to know is, is it reasonable to expect to obtain an article for, say, £15 capable of doing my work for this sum, or may I expect to obtain something almost useless? I can afford the latter sum, but £45 is entirely out of my reach. I may add that I do my plating now with the aid of batteries, but if I can obtain an engine, I should try a dynamo.—Plater.

[69313.]—**Brighton Engines.**—Can anyone give me names and numbers of the following Brighton engines—new ones?—24, 25, 26, 27, 28, 31, 35, 36, 37, 43, 44, 49, 51, 54, 55, 56, 57, 58, 69, 75, 76, 81, 84, 94, 97, 101, 102, 103, 105, 106, 108, 110, 113, 116, 118, 119, 120, 123, 124, 125, 126, 129, 130, 131, 133, 134, 137, 139, 141, 143, 144—146, 148, 152, 155, 156, 158, 159, 160, 162, 163, 166—171, 173—185, 199.—H. W. S. R.

[69314.]—**Silicated Carbon.**—Will some one kindly describe how the blocks of this material, so largely used in filtering, are made?—J. Henry Thomas.

[69315.] — **Injection Water and Loss by Vacuum.**—Will readers kindly refer to query 69068, p. 422, and note that "5in. stroke" should be "5ft. stroke." Should be glad of answers. - Georgetown.

[69316.]—**Pipeclay.**—Can pipeclay, such as common claypipes are made of, be obtained in a soft state, fit for making into small articles? Also I should like to know if a kitchen stove would do for baking small things made of pipeclay in?—M.

[69317.]—**Pure Yellow.**—Is there any dye that will show yellow only in spectroscope when examined in solution by day or lamplight? All mine show green and red as well as yellow, unless when made so strong as to be nearly opaque.—B. J. G.

[69318.]—**Filter for Soapy Water.**—We have about 3,000gal. per hour of soap, &c., and water running from a Russian bath which we are requested to separate, and to keep the soap on our side, and only allow the water to run into the river which is not used for domestic purposes. Will any reader kindly give particulars of some good, quick mediums, how many, what thickness, and how many superficial feet would be required for the above quantity and time? Any other necessary particulars will oblige.—Georgetown.

[69319.]—**Pendulum.**—I am much obliged by the answer of "F.R.A.S." (p. 501) to my questions? Will he kindly say if the following is correct? Supposing a pendulum made on the principle figured at p. 32 of "Young's General Astronomy," and the length of steel from the point of suspension to the bottom of the steel frame to be 33·5in. Also steel from top of zinc tube to centre of bob, where it is fixed, to be 34·5in.; then, taking it to be tempered steel, would the length of the zinc tube be ascertained by the simple proportion as ·29417 : 12395 : : 68 in steel : 28·68 in zinc?—Tempus.

[69320.]—**Zinc Depositing.**—I have a large quantity of steel wire to be galvanised, No. 12 B.W.G. As the ordinary way of galvanising will spoil the temper of the wire, which is required for a special purpose, I want to know if it is possible to galvanise it by electricity. I have a depositing machine giving 10 volts of 300 ampères, and a vat 100ft. long, 4ft. wide, and 8in. deep. Is it possible to get a coating of zinc on the wire by drawing it between anodes hung in series the entire length of the vat, the wire to be drawn off reels one end of vat and wound as it comes out? If any of our practical readers think it can be done, I shall be glad of a few hints as to the best solution to make up, the way to make contacts in vat for the wire to pass over, and the number of wires that could be done at one time with a machine of the size mentioned.—First Query.

[69321.]—**Taper Camera Bellows.**—Wishing to make a set of taper bellows for ½-plate camera, would any one give me a few hints and directions as to best material and way to make the same, and also the best composition for blacking the inside of camera, lens, &c.—B. Tydemann.

[69322.]—**Production of Ozone in Quantity.**—I want to put up an apparatus of some kind to produce ozone in large quantities. What kind of arrangement would you advise? I thought of using an influence machine with several plates or discs.—Ozone.

[69323.]—**L. and N.W. and G.E. Express Locomotives.**—Would anyone kindly give rough sizes—i.e., length of boiler, diameter of driving wheels, and height from wheel base to top of boiler—of the Earl of Stafford (the one shown at recent exhibition) and one of the Doncaster express engines?—J. C. S.

[69324.]—**Dynamo for Lighting a Lamp.**—Will anyone tell me if I can light a 5 or 10c.p. Edison-Swan 10-volt lamp with Siemens armature, ⅞ diam., 3in. long, laminated, wound with about 4oz. No. 18 in shunt, with F.M.'s, which are 3in. long, ½in. thick, and 3in. high, and 2in. for wire, and 1in. for the armature, 2lb. No. 22?—Right Proportions.

[69325.]—**Acoustical.**—Would some one kindly explain the following common experience? When my opposite neighbour has her window open, I hear her piano all too plainly, though my window be shut. But when her window is shut I cannot hear it, even with mine open. Yet (the windows being similar) there is precisely the same obstruction to the sound in both cases. Now, how is it that the sound is more easily intercepted when near its origin (and therefore stronger) than it is at a distance where it is feebler? One practical consequence of this seeming anomaly is that sounds are more easily shut in than shut out, from which it further results that it is usually difficult to secure quietness by means under one's own control.—Mu. Nu.

[69326.]—**Best Paraffin Lamps.**—Will any experienced reader kindly inform me how the circular burner lamps, such as the lamp Belge and others, answer? Some years ago I went in for the Silber and Doty lamps, but they soon went out of favour. Are these a real improvement?—A Country Dealer.

[69327.] — **Photographic.** — How can I find the equivale[illegible]d back focus of a portrait lens? If a lens works a[illegible]s that a fourth part of the back focus, or the equivale[illegible] focus? If I take a portrait with a lens working at F4, and another with a lens working at F 11, would the one taken with the slow lens give as brilliant a print as the one taken with the rapid lens?—H. Walker.

[69328.]—**New Telephones.**—Now that some of the telephone patents have nearly run out, would it not be a good time to introduce suggestions in receiving and transmitting instruments, giving the latest information of the best forms of instrument?—Country Dealer.

[69329.] — **Ice - Making Machine.** — Would any reader describe how to make a really good trustworthy ice making machine to use without ice? The nitrate of ammonia process is not reliable.—T. Maccall, M.D., Morecambe.

[69330.] — **Medical Coils.**—To Mr. Bottone. — I have made two medical coils, one like the one Mr. Sprague gives in his work, "Electricity," with four layers of No. 20 silk-covered primary, and six layers of No. 24, and six of No. 26, and four of No. 30, coupled together at finish of No. 24 and with beginning of No. 26, &c., and the beginning of No. 24 secondary is soldered to No. 20 primary at the commencement. I get with one or two bichromate of potash cells a good spark with clapper screw point, but cannot get a current on the secondary at none of the terminals; yet a current with battery through the secondary wire with a galvanometer shows no leak in wire. I have also done one from your book and same battery with same results. Can you kindly tell me the reason? The battery is in series.—One in a Fix.

[69331.]—**Sulphate of Mercury Cell.**—I have tried to work a Clark's gas-lighter with a sulphate of mercury cell, using protosulphate and water; the salt turns a bright yellow, but very weak current, so much so, that there is no spark. Have I used the proper salt? I don't wish to use silver chloride if possible.—B.

[69332.]—**Ribbon Steel.**—Will some reader tell me how to take the temper (or elastic spring) out of ribbon steel, so that I can give it a special set or shape, and then restore it to its former elasticity.—Steel Spring.

[69333.] — **Parallax of the Sextant.** — Will "F.R.A.S." or some other of your numerous mathematical correspondents kindly inform me how to estimate amount of error due to parallax of the sextant, in using it to take the angular positions of near objects? My sextant (by Troughton) is an 8in. nautical one. The mirrors are 3½in. apart face to face with the arc at zero. I have made a sketch plan of a town in South America with it, taking angles as close as a chain distance from points of observation, and I want to plot it. A friend has referred me to Heather's "Mathematical Instruments." This I have read, but the author does not give any formula. It appears that parallax varies with the amount of deviation and vanishes altogether whenever the centre of the index glass is in a direct line between the object and the eye. By this it appears to be greatest for angles taken at both ends of the arc; but I do not understand in this case of "varies with the amount of deviation." The difficulty appears to be shirked in all books treating of the sextant that have fallen into my hands.—S. W.

[69334.]—**Micro. Objective.**—I am anxious to construct these for my own use, and should be very glad of the following information. 1. What is the pitch and diameter of the Society thread, and of the thread by which the correction for thickness of cover is made? 2. What curves and what kinds of glass are used for ¼in., 1-6in., ⅛in. with or without immersion fronts? Information as to other objectives would be esteemed a favour.—H. J.

[69335.]—**Defective Vision.**—Can any kind reader explain this? Right eye normal in every respect. Left eye rather shorter sight, but possessing double refraction. An object is seen as two objects, one vertically above the other at an angle of about 1°, the lower image being much brighter. What kind of spectacles would cure it?—H. J.

[69336.]—**Furnaces.**—Where are rules to be found for furnace construction, giving proper proportions for firegrate, height of chimney, &c., for different fuels? How is the focus or point of most intense heat ascertained?—H. J.

[69337.]—**Catgut.**—What is the breaking strain of fresh catgut?—H. J.

[69338.]—**Selecting Grindstones.**—Would some reader tell me the best way to select a grindstone? Of six stones I have worn out during the last few years, there was but one but what had a soft place in it. Is there any way to detect this before fixing?—IRONMONGER.

[69339.]—**Water Power for Electric Light.**—Can anyone tell me how to make use of a river which flows within 50yds. of my house? I wish it to drive a dynamo by means of a water-motor of some kind. The river is subject to the usual ups-and-downs of floods and dry weather. In the latter circumstances, however, there could be no lack of water other 50yds. distant where some rocks cause a waterfall. Any hints as to whether a dam is necessary, or if a water-motor could be fixed at the fall itself, would be highly esteemed. The dynamo would not exceed 100c.p.—BOBADIL.

USEFUL AND SCIENTIFIC NOTES.

The Functions of the Cerebellum.—Is the cerebellum an organ for the storage of cerebral events which have become automatic? Do we first of all receive with the cerebral cortex and then practise with the same brain-bark, and afterwards relegate to the cerebellum, as to a limbo, those things of which we are so tired of being conscious? Are all performances of the cerebral cortex conscious acts, and those of the cortex of the cerebellum unconscious? And so might questions, more or less unanswerable, be postulated without end. The functions of the little brain are scarcely known at all; even the dependence of the equilibrium on its existence may be called in question on the data supplied by pathology. It is perfectly certain that no obvious signs of nervous disease need exist when the lateral lobes are the seat of even extensive mischief. Some regard the cerebellum as the terminal organ of all visceral sensation, and on this assumption it has been thought that the curious 'perturbations in visceral epilepsy are to be ascribed to perversions of the vitality of the grey matter of the little brain. Anything is possible for the cerebellum. The most gifted imagination might guess strange things, yet pathologyc ould perhaps find exact counterparts.

The Public Safety Signal.—Under this name a system of police signals and alarms has been introduced into this country from the United States, and has been working for some six months past in Islington in connection with the Upper-street Police-station. The system consists of numbered signal-boxes, which are affixed to a wall, and are placed at convenient distances from each other on every police beat. Each box contains telephones and automatic signalling instruments, and is electrically connected with the police-station. Each policeman is provided with a key which opens the box, and with two special signalling keys, with which he can automatically transmit messages by inserting them in apertures without opening the box. From any box a policeman can send a request to the station-house for aid, or for an ambulance in cases of accident. He can also converse with his officers at the station by means of the telephone. In emergencies, however, the chief dependence is placed on the automatic signals, which are quicker and surer than telephonic message. Each police-station is provided with an ink-registering instrument, which automatically records the messages sent from the street boxes. Attention is called between the station and the boxes, or *vice versâ*, by electric bells.

The Tierra Seca Gold Process.—A method of extracting gold and other metals from their ores on the dry system, without the aid of water or chemicals, has been invented by Mr. William L. Card, of the United States. The system consists in the employment of a current of air and gravitation, in appropriately arranged machines. There are four types of these machines—namely, a small hand-worked prospecting machine for testing the richness of gold and mineral deposits on the spot; a machine for concentrating refractory ores; a machine for extracting free gold from alluvial and placer soils; and a machine for extracting free gold from crushed quartz. The principle underlying each of the machines, however, is the same, although differently carried out to suit the requirements of each case. As a general principle the crushed ore is fed into a hopper, whence it is admitted on to a series of inclined sieves, which in some cases are vibrated and in others remain stationary. A fan or blower is used to force a blast of air underneath the sieves and upwards through them. In one case, however, the air is drawn upwards through the sieves by a fan placed above the machine. As the crushed ore falls on the sieves it is kept in a state of continuous but gentle agitation, and the blast is so regulated as to drive off the dust-like particles of earth, while the gold or other metals, by reason of their superior gravity, remain at the bottom of the sieves. The particles of gold are caught by the sieve on the top of the incline, but if any small particles should pass beyond it they fall into the second or third sieve.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, August 14, and unacknowledged elsewhere:—

W. S.—T. Daniel—Frank Burkitt—T. Pearce—Vindex—P. B. L.—Inter. B.Sc.—Diapason—W. H. Knight—Mallor—J. H. Rowney—G. R. S.—S. Watmuff—T. Radmore—Shaver—True Blue—A Four Years' Subscriber—B. C. S.—E. N.—A Fellow of the Royal Astronomical Society—Eureka—J. A. Wilson.

NEWSAGENT. (Any of our advertisers who supply outfits for beginners in photography will also recommend suitable handbooks; but, if you wish to have a look at some books first, get a list from Piper and Carter, Furnival-street, Holborn, W.C.)—YOUNG ANALYST. (The only way, we believe, to obtain a post in any Government department is to watch for the advertisements of competitions about to be held, and then, after applying at the Civil Service Commission, Cannon-row, Westminster, for the requisite papers, take a seat as a candidate, and do your best to pass "high up" in the examination. You must understand that it is not merely necessary to pass the examination, but to win a place by means of marks, for not unfrequently one mark in some branches is all the difference between success and failure.)—E. J. W. (If you will make your query a little more definite, it may possibly be inserted, and then probably would be answered. What do you mean, for instance, by "fly locomotive engines"?)—IGNORAMUS. (A mixture of blacklead and washed fat—hog's lard, say—is about the best lubricant for parts of bicycles. A tallow candle will do very well if you melt it in a basin by pouring boiling water on, and when cool skim off the fat. Melt it at least once more, and mix the fat with an equal bulk of finely powdered blacklead. 2. As to "getting the driving-wheel into a line with the frame," you had better let an expert look to it, for you must not tighten up the chain so much as to twist any part. You will find a great deal of information on such points in the last ten volumes or so.)—A TEN YEARS' SUBSCRIBER. (The *Blacksmith and Wheelwright* is published monthly at 84, Reade-street, New York. The price is one dollar a year, plus the postage here—that is, it would be, say, 5s. 6d. in this country.)—H. AIZEMANN. (For all we know you can make up any of the batteries, and all the useful ones have been fully described in back numbers. You say you have tried the Leclanché and found it "not quite powerful enough" for your purpose, but you have omitted to tell us what that purpose is, or give any idea of what it is you want to do.)—BICYCLE PARTS. (For much information about the plant necessary for nickel-plating see pp. 8, 57, 104, 124, 147, 170, Vol. XLVII. If you turn out as many as eight machines a week, it will not pay to bother with the battery process, which is rarely well done in the case of nickel. You want a dynamo and a proper polishing plant. No doubt it is cheaper for you to send the work out.)—W. A. L. (Messrs. Crosby Lockwood and Son, Stationers' Hall-court, E.C., have three useful works on electro-plating in their list: Watt's "Electro-Deposition," a voluminous work; the same author's well-known "Electro-Metallurgy," one of the Weale's series; and Urquhart's "Handbook of Electro-Plating." Sampson Low and Co., Fetter-lane, publish the work by Roseleur and Wahl; and Messrs. Longmans, Paternoster-row, publish Dr. Gore's "Art of Electro-Metallurgy.")—ELECTRO. (See previous answer; but as to cost of apparatus, that altogether depends on what you want to do. You will, however, find much information on the point in back volumes.)—M. ("The Elementary Textbook of Zoology," by Dr. C. Claus, edited by A. Sedgwick, M.A., is published by Swan Sonnenschein and Co., Paternoster-square. It is in two volumes, and is, no doubt, an excellent textbook; but perhaps Nicholson's "Manual of Zoology," published by Blackwood and Sons, would suit you.)—W. H. J. (Simm's work on the "Astronomical Telescope" might probably be picked up at a bookstall, or by inserting an advertisement.)—NOVICE. (You want to make an electric machine "suitable for a young woman" suffering from paralysis. You will find details of all sorts of machines in back numbers; but whether you would be justified in trying a tiro's hand on a case of paralysis is doubtful. Look up the indices.)—WOODWORK. (There are many remedies for baldness in back numbers—that is, in the shape of preventives; but you might try the simple method of rubbing in paraffin oil; or the decoction of box-leaves mentioned on pp. 13, 72, Vol. XLVI.)—JONTO. (The Doty gas-light was described in No. 1,199; the Ludigen some time ago.)—W. J. C. (Richards's works on Woodworking Machinery, published by E. and F. N. Spon, are perhaps the best. Procure a catalogue from them—125, Strand—and also from Crosby Lockwood and Son, Stationers' Hall-court, E.C., as they publish a work by M. P. Bale which may suit you.)—M. G. (The remedy given over and over again for rheumatism is to drink freely of hot water, and to avoid beer and other alcoholic liquors.)—R. SMITH. (Methods of tinning brass have been frequently given—see indices; but if you want to keep some parts free from the tin you must employ a "resist"—that is, a varnish which will prevent the tin depositing on the surface protected, and which is readily removed when the other parts are tinned.)—J. H., Todlaw. (The kind of engine tell-tale you appear to want was actually illustrated and described on p. 361, so recently as June 28 last.)—ORGANIST. (See Hints No. 4 above.)—A READER OF "E. M." (Attend the classes at the Finsbury Technical College; pass the City and Guilds Technological examinations, and then apply for work to an electrical engineer. We cannot say whether it is possible for you "to work your way up"; but you can certainly try.)—M. A. (We think you would be well treated by the Britannia Company, or by Buck and Hickman. The other people are evidently unreliable. Better state your experience and requirements to your lathe-maker, and take his advice on the point you mention. A great deal depends on the worker, and it is impossible to say offhand which is "best," especially as it is a matter on which some of our best correspondents differ, and will, we expect, continue to differ.)—VANDAL. (We have not received the sketch. 2. Because correspondents are unreasonable—correspondents on railway matters especially so.)

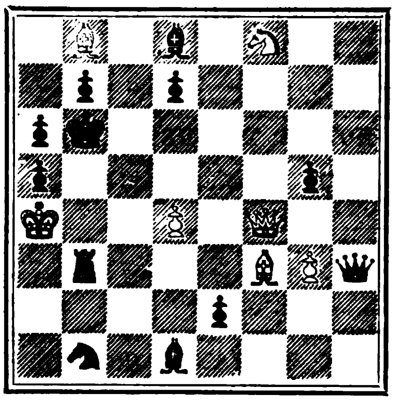
It may seem incredible, but it is nevertheless true, that by simply wearing one of HARNESS' ELECTROPATHIC BELTS thousands of men and women have been completely cured of the most obstinate cases of Nervous Weakness, Rheumatism, Gout, Sciatica, Lumbago, Torpid Liver, Indigestion, Constipation, Sleeplessness, Hysteria, Internal Weakness, &c. Those who are in search of health and strength should not hesitate a moment, but either call at the Electropathic and Zander Institute, and personally examine the multitude of original testimonials, and see the Belts scientifically tested, or write at once for Pamphlet, which may be had free on application to Mr. C. B. HARNESS, President, the Medical Battery Co., Ltd., 52, Oxford-street, London, W. (corner of Rathbone-place). All Mr. Harness' Electropathic Belts and other appliances are guaranteed genuine. Consultation and advice free.

CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCLXII.—BY J. KEEBLE.

Black.



White. [7 + 12

White compels Black to mate in two moves.

SOLUTION TO 1,160.

White.	*Black.*
1. Q-Q 6.	1. B takes P (*a*).
2. Q-Q 3 (ch).	2. B takes Q mate.
2. Q-K 5 (ch), &c.	(*a*) 1. P or R takes Kt (*b*).
1. R takes Kt (ch), &c.	(*b*) 1. P takes Q (*c*).
2. Q-Q 5 (ch), &c.	(*c*) 1. P-Q R 3, or Q-Kt sq (*d*).
2. Kt-Q B 3 (ch), &c.	(*d*) 1. P-K Kt 7 (*e*).
2. Q-Q 4 (ch), &c.	(*e*) 1. Q takes B (*f*).
Q-K 6 (ch), &c.	(*f*) 1. Q-B sq.

MR. GLEAVE, the author of Prob. 1,161, has discovered that there is no solution if 1. — Kt moves. This problem, therefore, will not be included in Solution Tourney.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,160, by A. Dean, Janus, J. C. B., and Fr. Fernando; to 1,159, by J. Bryden (triple, and two duals), James Ough, W. Jay (triple and dual), J. C. B. (triple), Janus, and E. P. Cockerton (excellent).

A. DEAN.—You are mistaken as to there being no solution to 1,159, as after 1. Q-K R 8, Kt takes Q, 2. R-Q 6 (ch). We appreciate the great industry you have shown in the analysis; but you overlooked this reply of White's. As to 1,157, we find we were in error in thinking your solution incorrect, except that you omitted the defences 1. K-B 3 and 1. K-Q 4, or 2.

J. W. READ.—In your attempt at 1,160, W K escapes at Q Kt 5 after Black's second move. There are now but one more three-mover and one two-mover to publish to finish the tourneys.

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⁎ It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

Holloway's Pills are the surest preventives of the many maladies engendered by warm weather, profuse perspiration, free living, and other excesses. They throw out all impurities from the system, rouse the torpid liver, and stimulate the sluggish kidneys, whereby the weary invalid recovers both strength of body and elasticity of mind.

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The remittance should be made by Post Office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

Vols. XXVI., XXX., XXXII., XXXIV., XXXVI., XXXIX., XL. XLII., XLIII., XLIV., XLV., XLVI., XLVII., and XLVIII., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

Yes, the Ruptured will still find Dr. SHERMAN at his London Office, 64, Chancery-lane, where his wonderful success draws the afflicted from all parts of England, and where you and all others should go who entertain the hope of ever being cured. Send for his books, English and American, post free, 6d., and inform yourselves.—[Advt.]

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Important.—All kinds of **Scientific Properties**, Apparatus, Instruments received for others or cash by A. Caplatzi, Chenies-street, Tottenham Court-road.

Wanted old foreign and colonial **Postage Stamps**. Will give good exchange. No recent issues excepting high values required.—Collector, 125, Coltman-street, Hull.

Spade-mill **Water-Motor**, one or two horse-power, wanted, Wheeler's, Preston, make preferred. Exchange Lathe or Gas Engine.—Royal Railway Hotel, Chester.

Gas Engine, 8H.P. Otto, complete; also two man-power Otto, perfect working order. Offers.—W. Hutchinson, Liversedge.

Electrical Plate Machine, 16in., by Newton, with accessories, in case, also pair of 15in. globes on stands. Offers.—W. Hutchinson, Liversedge.

Wanted, 5in. screw-cutting Lathe, for **Tandem** Tricycle, Bicycle, Watch, Timepiece, any kind of domestic machinery, new. Part cash.—Monkhouse, 7a, East-street, Bromley, Kent.

Thorough good 4H.P. **Beam-Engine**, without flywheel. Can take half cash and good Stocks and Dies to value of £9.—Noy, Boiler-maker, Hythe, Colchester.

Complete volumes "**Contemporary**," English Mechanic, "Literary World," and others, offered for standard work or scientific instruments. Particulars to J. B., 36, Windsor-terrace, Glasgow.

Zuccato's **Papyrograph**, complete. Exchange for Fletcher's Gas Furnace, Burner, and Bellows.—Lord, Leyland, Lancashire.

Tricycle, Starley Brothers', part plated, and equal to new, front steerer; suit lady or gentleman. Exchange.—17, Pitlake Bridge, East Croydon.

Slide-Rest, 4in.—5in., for Microscope, Gas Stocks and Dies, Facile, or Rover, child's Bedstead, or Carpets, Air Gun.—J., 17, Boone's-road, Lee, Kent.

About one-horse **Gas-Engine**, new condition, guaranteed. Exchange anything useful worth £50.—P. M., City Buffet, Edger-street, Princess-street, Manchester.

To be sold cheap or exchanged, lot of **Engineer's** Tools, small Fan, suitable for heating or ventilating purposes, large Bichromate Bottle Battery, Medical Coil, Printing Press, Lady's Watch and Chain, and Organette. Offers.—S. A. R., 31, Salisbury-row, Walworth, S.E.

Organ Builder.—Four-stop **Soundboard**, made by Bryceson Brothers, London; good as new.—Johnson, 1, Union-street, St. Paul's, Bristol.

Will exchange two volumes "**Boy's Own Paper**," good condition, for anything useful. Carriage paid.—F. Beaumont, Booking Clerk, Radcliffe, Lanc.

Will exchange three large **Microscopes** for Galvanic Battery, or street Novelties, to the value of £9.—48, Cemetery-road, Gt. Yarmouth, Norfolk.

Nickel-Plating Plant (two tanks, 30in. long). What offers? Exchange to value £5. Simple instructions given free.—Cyclist, 26, Salisbury-road, West Kilburn.

Ship Chronometer, by Harrison. Exchange for good Equatorial Mounting for 5in. refractor.—Newcomb, Borrowash.

Musical Box, new, 6 airs. Offers Electrical wanted. Morling, Stoke Works, near Bromsgrove.

Wanted, **Electric Reading Lamp**, complete, cheap, cash or exchange.—Morling, Stoke Works, near Bromsgrove.

"**Dr. Rees' Cyclopædia of Arts, Sciences**, and Literature," in 39 vols., and 5 vols. of Illustrations, in splendid condition, bound in calf. What offers? Exchange good Dynamo.—Crossland, 39, Northgate, Blackburn.

What offers for Booth's **Mitre Machine**, Ethoxo-Limelight Apparatus, Tylars (12 by 10) Slide, 1-1 Portrait Lens; Wanted, rear-driving Safety, Camera, Lenses.—Edward Rouse, Hethe, Bicester.

Three new **Portable Leclanche Cells**, cost 4s. each; also new Gassner Dry Cell. Want Sprague's "Electricity," or offers.—J. Ball, 18, Redshaw-street, Derby.

Powerful **Battery**, consisting of 12 corrugated carbon cells, in ebonite box, fitted with handsome switch, giving 24 volts for 15 hours, cheaply charged, cost £10 5s. Exchange to value £3, part cash. Apply—W. Rose, 2, Commercial-road, Lowestoft.

Exchange 5 by 4 mahogany, sliding body **Camera**, splendid Portrait Lens (Marion's), Stand, Printing Frames, and Cash, for good 4-wick Lantern, state maker.—Bradshaw, Guildhall-street, Thetford.

Ship Telescope, leather body, object-glass 2¾; maker, Cox, Devonport. Will exchange for ½-plate Rectilinear Lens.—S. Clark, Wormwood-hill, Kirton-in-Lindsey.

Exchange double-barrel **Breechloading Gun** for ½-plate Camera and Lens, or value 40s.—Finlay, 11, Bothwell-street, Glasgow.

"**English Mechanic**," from Vol. VI. to Vol. XLIII., few bound, rest unbound, tied up in volumes with indexes. What offers?—77, Lavender-hill, Tonbridge.

Sewing Machine, No. 8 Wheeler-Wilson, treadle, nearly new, cost £7 10s., for Lancaster's ½-plate Instantograph.—14, Washington-street, S. C. Road, Dublin.

Sewing Machine, high arm, improved Singer, with cover, cost £4 19s. this month. What offers?—Wells, 4, Haven-lane, Ealing.

"**Engineer**," 1881 to 1887, inclusive, clean for binding (about 196lb.) Offers to Coburg House, College-street, Putney, S.W.

"**Practical Mechanic's Journal**," 1858 to 1870, 12 volumes complete for binding (32lb.) Offers to Coburg House, College-street, Putney, S.W.

Tricycle (Cheylesmore). Exchange Microscope or Lathe, or offers.—Roberts, 6, Pitlake, Croydon.

Slide-valve **Cylinder**, complete, lagged, ¾in. bore, 1in. stroke. Exchange Model Boiler, or Crank shaft and Bearings. Offers.—Cashford, 1, Albert-road, Ramsgate.

Overhead Motion, fast and loose pulleys, 3-coned flat speed pulley, and hanger brackets, gun metal journals, perfect. Offers.—Cunningham, 66, Victoria-square, Liverpool.

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Gas Lamps, five improved patent, new, splendid light, save fifty per cent. in gas. Exchange anything saleable. Address, Sharpe, 9, Beck-street, Nottingham.

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Silvanus Thompson's "**Dynamo Electric Machinery**," Bottone's "Dynamo: How Made," "Watts' Metallurgy," "Walker's Practical Dynamo Building," twelve corrugated carbon plates, 7in. by 2in., Edison lamp motor castings, thermometer, and electric bell. Exchange for two Magneto Generators and Bells, or offers.—Geo. Payne, Broxburn, Linlithgowshire.

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THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

New Illustrated Price List of **Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

Billiards or Bagatelle, or Requisites for ditto, or Billiard Work.—Hennig Bros., High-street, London W.C.

Manchester Electrical Stores.—Medical Coils, Magnetos, Bells, Cells, Wires, Fittings, Chemicals. Best terms.—J. Bentley, 7, Newton-street.

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Microscopy.—Instructive list of really high-class botanical preparations, with sample, 2d.—Walter White, Litcham, Swaffham.

Cyclists.—Use "Graphine" on your chains; no grease, will not hold dust, 6 stamps, free.—Wolff and Son, Falcon Pencil Works, Battersea, S.W.

Lard Oil, 3s. per gallon.—69, Commercial-street, E.

G.M. Fittings, cheapest house in London.—69, Commercial-street, E.

Cyclists.—Anti-vibration Safeties, Tandem Safeties and Tricycles. Send for list.—Bradford Cycle Co., Ltd., Bradford, Yorkshire.

Bellows for Cameras, all kinds. Price list, 1d.—J. Thomson, Camera Maker, Portgordon.

Write for **King, Mendham and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

6d. prepays three insertions of a 20-word advertisement in *Morning News*, Belfast. Established 1855. Specimen free.

Hats made easy. Braces made perfect. Fits all sizes. Six stamps.—T. Rawson, Heaton-lane, Stockport.

Vertical Engines, newest designs, with or without boilers.—The Grantham Crank and Iron Company, Limited, Grantham.

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Unbleached **Violin Strings**, tone pure, strength marvellous; six for 12 stamps.—Craven, 39, Jamaica-road, S.E.

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Photographic Sets, Magic Lanterns, and other Apparatus supplied. State requirements.—Henry Ebbage, 344, Caledonian-road, London.

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Palmer's Renowned Prescriptions, 2s. 6d. Cure quickly Urethral Diseases, &c. Thirty years' celebrity. Blood purifying pills included.—Above.

Handy **Pair of Steps** and useful Long Ladder combined, 10s. 6d.—Taylor and Co., Driffield. Lists free.

Pulleys, Blocks, Shafting, Belting supplied and erected. Estimates free.—Stamford Engineering Works, [illegible] road, Shepherd's Bush.

Smoke Knight's Herb Tobacco.—Splendid flavour, delightfully fragrant. Neither injurious (like ordinary tobacco) nor expensive. Quarter pound (nearly), 7d. post free.—Knight, Druggist, Portsmouth.

Astronomical Eyepieces, any power, fitted to any telescope, 15s. each.—Clarkson.

Transit Instrument, by Ross, on iron stand, perfect adjustment, new condition; also others.—Clarkson.

Equatorial, by Cooke, of York, slow motions, will carry up to 4½in. telescope, £15.—Clarkson.

Universal Equatorial, with circles, on tripod stand, will suit any telescope to 4in., £5.—Clarkson.

4in. **Telescope**, Cooke and Sons, York, new condition, on tripod stand, diagonal and five eyepieces.—Clarkson.

Astronomical Telescopes, some in stock, good condition, by leading makers.—Clarkson.

Astronomical silver-on-glass **Telescopes**, Mountings made or these; also flats, finders, rack, eyepieces, mounts.—Clarkson.

Astronomical Telescopes (good) sold for private owners if reasonable prices.—Clarkson, 28, Bartlett's-buildings, Holborn Circus.

Astronomical Telescope.—Apparatus and parts made to order.—A. Clarkson, 28, Bartlett's-buildings, Holborn circus, London.

100 Memorandums, Billheads, Business Cards, Eyeletted or Gummed Labels, 1s. 2d. free.—Victoria Printing Works, Scarborough.

Glaziers' Diamonds, from 6s. 6d.; Circular and Tube Cutting Diamonds, Diamonds for Lapidaries.—Below.

Diamond Drills, from 1s. Spring Drill Stock and postage, 1s. 3d.; Upright do., 4s. 1½d.—Below.

Diamond Points for all kinds of engraving, writing, and ruling, from 2s. 6d.—Below.

Diamond Turning Tools, for truing Emery wheels and turning hard steel, from 5s.—Below.

Diamond Sparks, for China riveters, from 6d.—Woods and Toussaint, 64, Spencer-street, Clerkenwell, London.

Leclanche Batteries, wholesale or retail, perfect connection between binding screw and carbon.—23, Parade, [illegible] Vale W.

Model Engines.—Finished Parts, Castings. New Catalogue, with illustrations, post free, 6d.—Mills, Tintern-street, Sunderland.

Lathe Castings. New illustrated catalogue of plain and screwcutting, post free, 3d.—Mills, Tintern-street, Sunderland.

A 6H.P. high-pressure double-cylinder **Engine** and Boiler, with 75 tubes, shafting, two propellers, stern tube, valves, cocks, steam gauge, injector, feed pump, and fittings, all [illegible] Wheel and Steering Gear, awning and iron stanchions, for [illegible] everything complete for a 40ft. launch, all in good working [illegible] to be sold cheap.—For particulars apply to J. S., 332, Strand, London, W.C.

Dynamos, from 30s. upwards, made for any desired output. Reduced lists now ready.—H. Jones.

Manchester Gramme-type **Dynamos**, wrought iron laminated armatures, high efficiency, from 6 lights upwards.—Jones.

New Lists now ready. Over 40 Dynamos to select from. Addressed wrapper or one stamp.—H. Jones.

Dynamos, lighting, plating, storing, &c. New list, one stamp.—H. Jones, Electrical Engineer, 14, High-street, Lambeth, S.E.

The English Mech[illegible]
AND WORLD OF SCIENCE AND A[illegible]
FRIDAY, AUGUST 23, 1889.

ROTARY ENGINES.

NEXT on the list to perpetual-motion machines, in point of wasted time and useless expenditure, rotary engines may probably be placed — such, at least, is the impression caused by a glance at the Patent records and careful observation of concurrent practice. The subject, therefore, is worthy of independent examination, with a view to elicit the advantages aimed at by the inventors, who have so persistently tried to secure satisfactory results.

We must commence by pointing out some conditions by which the hypothetical reasonings of inventors are invalidated, through incompletely studying the questions under consideration, and the class of contrivance that most readily presents itself for remark of this character is that of the reactionary rotary engine, which is also the simplest of all forms. Although at the present time the Eolopile form of motor only exists as a toy, the time has been when such an arrangement was patented, and an engine on this principle applied to drive a sawmill in London. This machine had two arms, with apertures near their extremities on opposite sides, the steam being admitted through a trunnion at the centre, upon which the engine revolved. Now, this is the theory of such a motor: if a tube be supported by an axis, upon which it is capable of revolving, the tube being closed, except at its axis, which is open to a supply of steam from a boiler, then this steam, pressing equally all round the interior of the tube, will have no tendency to move it in any direction; but if an aperture is made at right angles to the axis in one side of the tube, the pressure of the contained steam against the inner surface of the pipe opposite such aperture will be unbalanced, and will, therefore, act by causing the pipe to revolve on its axis. If, therefore, the opening were four square inches in area, and the steam pressure 100lb. per square inch, there should be an acting pressure of 400lb. upon the side of the tube. This, however, there is not, for directly the steam reaches the aperture its pressure falls; but the great loss arises from the steam freely escaping from the aperture and expanding without doing any useful work. There is, in fact, no abutment for the steam to react from, and the case is similar to that of a steam-engine of the ordinary form with the cylinder bottom out. The actual pressure upon the inside of the tube cannot be greater than the resistance offered to the escape of the steam from the opening in the side of the tube, and this resistance will be measured [illegible] the velocity with which the steam gets [illegible] in the line of movement of the tube, [illegible] this velocity will be very slight in pro[illegible] to the pressure of the steam, which, [illegible]ping, will expand *in all directions.* [illegible] it is evident that the conditions of [illegible]sary for the realisation of the t[illegible]s do not exist, and the m[illegible] hopeless failure.

I[illegible] of rotary engines we are [illegible]lties arising from loss of steam [illegible]ough not to an extent so prep[illegible] just referred to. One advantag[illegible]o be gained by the rotary eng[illegible]ity, and another the eliminatio[illegible] due to reciprocating parts, and also [illegible]rm effort upon the main shaft would [illegible]ted, though this would only be secu[illegible]hen the engine is not working expansiv[illegible]y. All these points may be allowed their due weight; but it seems that their importance has been formerly enhanced by exaggerating these defects in the reciprocating engine which it was sought to remedy. The action of the crank necessitates the gradually bringing to rest of the reciprocating parts, so that there is no sudden reversal of the motion, and the work accumulated in the piston and its attachments during the early part of each stroke is given off as the stroke is completed.

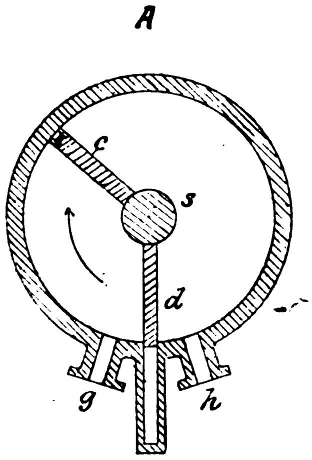
A simple generic form of rotary engine is represented by a cylinder having the main shaft passing through it longitudinally, and carrying a rectangular flap which sweeps round the cylinder under the pressure of the steam, thus revolving the shaft to which it is attached. Three forms of this class of engine are shown in the accompanying diagram, in cross-section at right angles to the main shaft. In the arrangement A, the main shaft *s* is placed concentrically in the cylinder, and carries a rectangular piston, *c*; the abutment for the steam to react from is afforded by the shutter *d*, which for a small part of the stroke is withdrawn to allow the piston to pass. In this case it will evidently be very difficult to avoid concussion in closing the shutter, and also to keep it in steam-tight contact with the shaft. The steam being admitted at *g*, and exhausted at *h*, it is obvious that if kept always open the steam would pass straight away, while the piston edge passes the ports, and to save this loss slide or other valves must be used, and in any case they must be used if expansive working is desired, and then the simplicity of construction begins to disappear. In order to avoid using the shutter, an engine was made of the form shown at C. It consisted of two toothed drums, of which one had a large tooth to act as a piston, the other being made with a corresponding gap to allow it to pass when crossing the ports, during which time, however, there was a direct flow from the steam to the exhaust port. It was hoped, by running at a very high velocity—4,000 revolutions per minute—to minimise this steam loss, the inventor altogether overlooking the fact that whatever the speed might be at which the engine was run the proportionate part of each revolution during which both ports were uncovered remained the same; furthermore, there was no such thing as keeping steam-tight contact between the teeth of the drums.

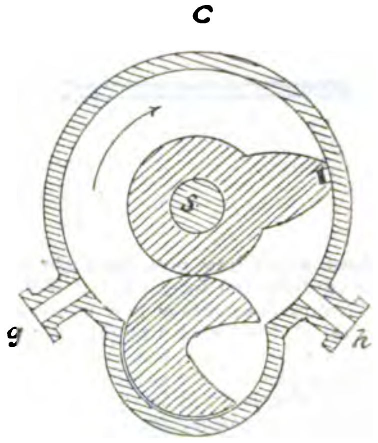
Another construction, in which the shutter is avoided, is that shown at B; in this the main shaft is placed eccentrically to the cylinder, and carries a drum, *f*, in a slot in which the piston *e* works; one side of the drum *f* is in contact with the inside of the main cylinder, and so serves the purpose of the shutter, and the piston as it revolves slides in and out of the drum *f*.

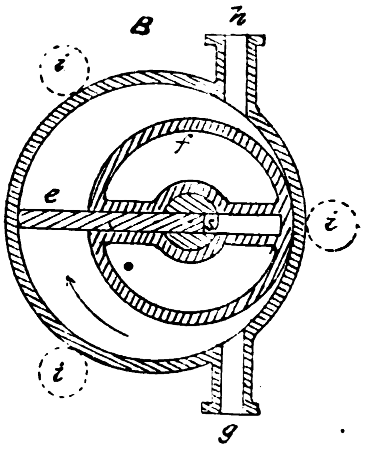
In regard to the friction, that of the piston in the main cylinder will evidently be much greater in the rotary than in the reciprocating engine; in the latter the piston in each stroke passes over the whole cylindrical internal surface; in the rotary engine A it passes over that space and both ends in addition, and the same occurs in C. In the arrangement B there is in addition to this the surface of the drum *f*, which rubs against the cylinder in each revolution; and, moreover, the capacity of the cylinder is reduced by the volume of the drum *f*, so that in this device the friction is proportionately the greatest. In order to get rid of some of this friction it has been proposed, instead of fixing the cylinder in B, to support it on rollers *i, i, i*, to preserve its position in regard to the main shaft *s*, but yet to allow it to revolve with the piston, and so reduce the rubbing surface. Ingenious as this appears, the complication involved was fatal to its adoption, as it became necessary to place slide-valves within the inner drum *f*. There is also another disadvantage in rotary engines in which the piston revolves about an axis that is not concentric with that of the main cylinder, which is that there is only a line of contact between the edge of the piston and the internal surface of the cylinder, and this it is impracticable to keep steam-tight.

There is nothing in the construction of the rotary engine to lead to the idea of its working more economically than the reciprocating engine, beyond the saving effected in piston clearance and steam passages, and its characteristic advantage is only in its small bulk, which allows of considerable power being obtained in a small space, as it can be run at very high speeds. This qualification renders it very applicable to steam fire-engines, and other purposes where economy is not the first necessity; for screw propellers of small boats, also, its compactness is a recommendation, if the surfaces can be made to work steam-tight.

One form of rotary engine, known as the disc engine, has been tried at different times, but never with satisfactory results. In this







motor the piston is a disc, which rolls between two cones, its movement being identical with that of a disc which has been spun upon its edge, and is about to fall. A partition running from the centre to one side of the cylinder and passing through a slot in the piston serves as an abutment for the steam, which acts alternately on opposite sides of the piston. It will be seen that this is about the worst form that could be conceived, so far as obtaining steam-tight contacts is concerned. The contacts between the discs and the cones against which it rolls, are naturally lines only, and the endeavour to improve this part of the machine by the use of packing strips with springs behind them merely complicated the work without any corresponding advantage accruing, and these engines at all times are more costly to make than those in ordinary use, without the introduction of any unnecessary intricacy. The case in which the piston works is not a cylinder, but a portion of a sphere, and this is not an easy form to bore out accurately.

In respect to the engines having pistons actually revolving about the main shaft as an axis, nearly all the variations have reference in some way to the provision of an abutment for the steam to react from, and in quest of some satisfactory arrangement, curious forms of steam cylinders have been devised. When two pistons are used working in slots in the inner drum *f*, diagram B, there is a likelihood that, at high velocities, their springs will not cause them to keep in contact with the interior of the cylinder, and then, of course, a very great loss of steam will ensue. In order to obviate this difficulty, the steam-chambers have been so designed that all straight lines drawn through the centre of the main shaft *s*, and terminated by the interior of the steam-chamber at both ends, shall be of one length, and so both ends of the piston are always in contact with the periphery of the vessel in which it works. In another contrivance only one end of the piston is in contact with the cylinder; but it is held up by projections at its ends working in properly-formed grooves in the cylinder ends. In the first case the difficulty of finishing the interior of the steam-chamber to a correct contour is very great, and must be done by means of a special tool; and, in the second, the introduction of the grooves for guiding the piston adds considerably to the difficulties of packing at the ends.

Taking a comprehensive view of the whole subject of the construction of rotary engines, it seems surrounded by difficulties; the work is more costly, the fitting more difficult than in any other kind of engine, and the loss of steam by leakage excessive; and to set against all this there is only the reduction in space occupied by the motor, and in very few cases will this counterbalance the objections. The reciprocating engines are, practically speaking, very far ahead of the rotary engine, but yet they are by no means perfect, and there is ample room for inventors yet to exercise their ingenuity in further improvements, and it would be of great advantage if some of them would for a while turn their attention towards steam generators.

It cannot escape the notice of any observant man in wide communication with steam-power users that boiler engineering generally is in a very backward state compared with the degree of efficiency to which steam-engines themselves have been brought. Commercial efficiency is that of the engines and boilers taken together; but certainly the boilers seem to have been neglected, whilst every nerve is strained to increase, by a small fraction, the performance of the engine itself. It is quite right that in tests the efficiencies of the two parts of the motor should be kept separate, but each part is equally worthy of consideration until the most perfect economy attainable has been reached. There is much yet to be done in using up heat which now goes to waste in gases escaping from the furnaces, and there are more favourable conditions now afforded by the revival of the forced-draught system which had for so many years been in abeyance, for if the draught is mechanically controlled its velocity will be quite independent of differences of temperature.

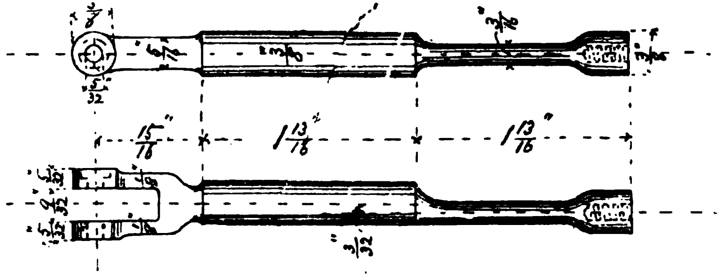


Fig 91

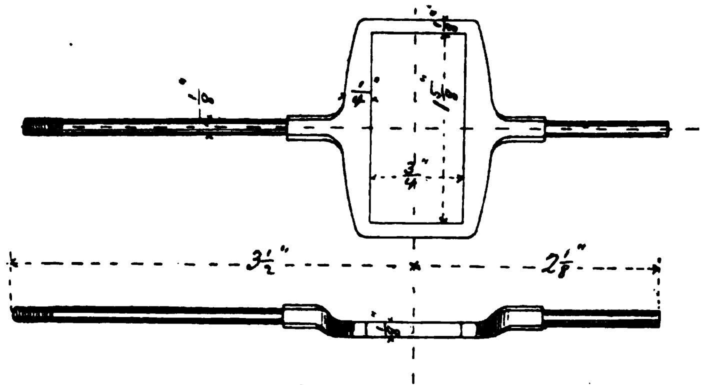


Fig 92

A MODEL LOCOMOTIVE.—XVII.

Valve-Gear—Details.

THE details of the valve gear are as follows:—

The eccentric rods are shown in Fig. 89. Four of these are required, two in each shape, but made right and left handed. The butt ends of the rods are bolted to the eccentric straps, illustrated in our last, and the forked ends embrace the eyes of the slot links. The rods are cranked by reason of the relative positions of the eccentrics and the links, which are not and cannot all be in the same vertical plane.

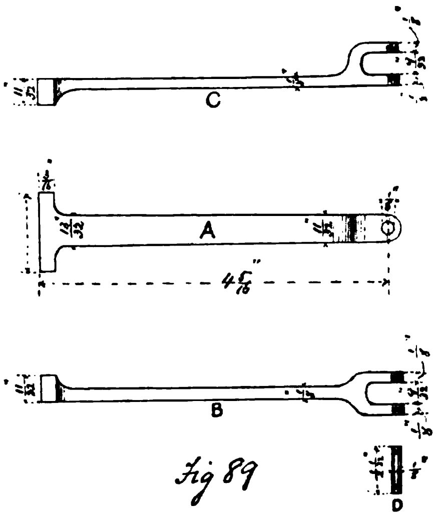


Fig 89

The parts of the link motion are always made of wrought-iron of best Yorkshire quality, and case-hardened, so that toughness and good wearing surfaces are combined. Provided iron of this quality can be procured by the amateur, the same material may well be used, and case-hardening in a small way performed. But if not, it will be better to use a bit of mild steel, as being stiffer and stronger. A bit of Bessemer steel bar drawn down will answer the purpose very well.

In such small rods, very little can be done by way of forging to bring them to ultimate shape. They may be drawn down about the central portions; but the forked ends will need to be left solid, and the butt-ends somewhat lumpy. In lining out, it will be best to mark the outline seen in Fig. 89, A, first, and file and finish the shape given in that view before attempting to mark out the shapes in the other views B and C. Having the edges, butt-ends, and forked ends filed and finished, the finished faces will afford a good basis for the marking-out of the lines re-

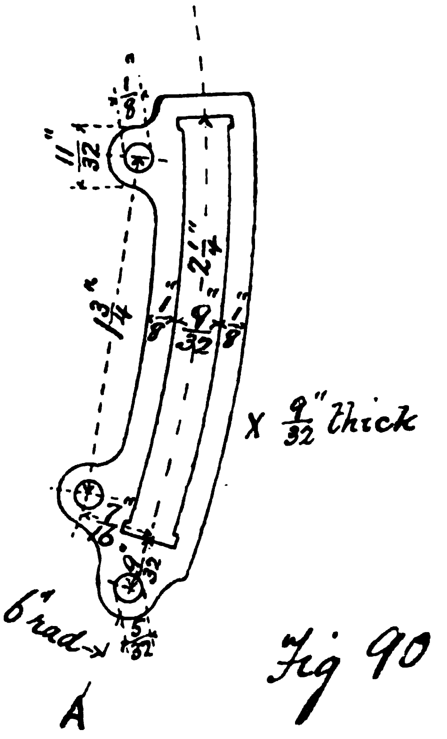


Fig 90

presenting the thicknesses of the rods, the various faces, and the outlines of the forks, and as all these lines are parallel they will be marked from

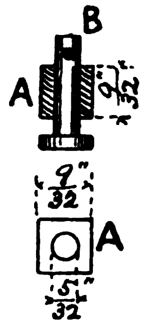


Fig 93

a level table. The outlines can then be filed, and the holes drilled.

The slot links, Fig. 90, are shaped out of plain plate $\frac{9}{32}$in. in thickness. First file or shape the

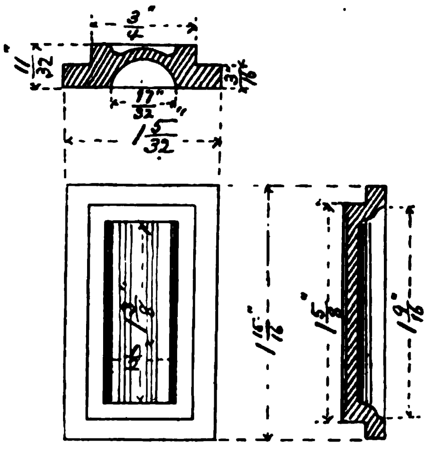


Fig 94

metal to the correct thickness, and then mark the outline of the link upon it; drill to the lines and file. The curved centre line A of the link is struck to a 6in. radius, equal to the distance from the centre of the axle to the centre of the link.

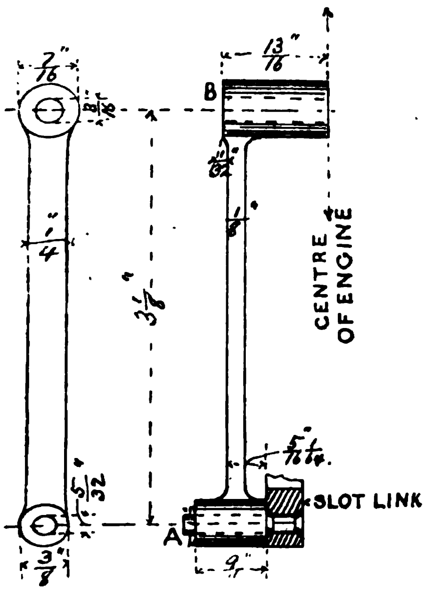


Fig. 95.

One of the pins by which the eccentric rods are attached to the links is shown in Fig. 89, D.

The valve-rods are shown in Figs. 91, 92. These are right and left-handed, made in two portions and jointed, because without this jointing it would be impossible, owing to the buckle, Fig. 92, to insert them in their places. These joints are always made by cottaring, but this would be a delicate piece of work in rods so small as ours. And if we screw them, the screw does not afford the means of minute adjustment for length afforded by the cottar, because we cannot make less than one complete turn. But this must nevertheless be our alternative, though the final adjustments may be a little more tedious in consequence.

We shall use a bit of steel for that portion of the rod in Fig. 91, and cut the fork which embraces the link, and the socket which takes the valve-rod thread, out of the solid. In order to afford sufficient room for the links and their fittings, it is necessary to throw the centres of the valve-rods farther apart, where they pass through the motion-plate, than they are at the glands and stuffing-boxes. It is this which gives the eccentric-like shape to the rods, and for this reason two chuckings are necessary to turn them. It does not much matter whether we line out the forked end before, or after the turning is done. In either case, it will be essential that the two sets of centres from which everything is worked be marked off on the ends of the rod. The forked end embraces the link closely, but with sufficient freedom to slide upon its faces. It also embraces the die block, Fig. 93 A, which slides within the link, and the pin B passes through both fork and die block. This shows one of several methods of connection, of which choice might be made.

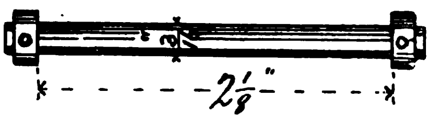


Fig 96

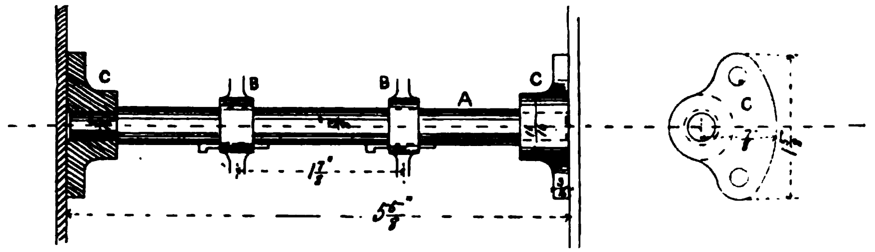


Fig. 97.

That portion of the valve-rod which includes the bridle, and passes within the steam-chest and stuffing-boxes, is seen in Fig. 93. This, being small, had better be forged solid, and the rectangular hole made by drilling around and filing. The spindle ends had better be turned before the inside of the bridle is cut out. If the process is reversed, the inside must be bridged with a bar of wood to prevent it from bending inwards when between centres.

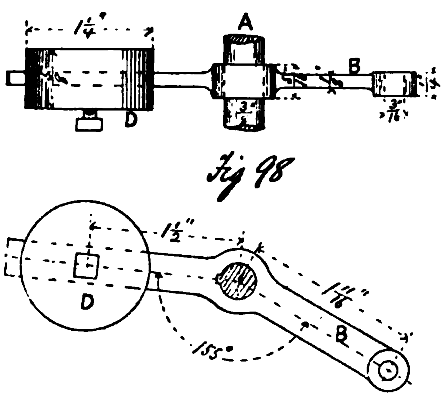


Fig 98

The valve (Fig. 94) is cut from a plain piece of wood, allowance being made for shaping or filing on each of the four edges, and is cast in iron.

We have thus established the connection between the eccentrics and the valves. We now consider the lifting links and the weigh-bar, by whose agency the reversal and the expansive working are provided for, as was explained in Art. XV. p. 492.

Fig. 95 shows one of the lifting links. There are only two of these, one to each slot-link. In many designs these are double, one being placed on each side of the slot-link, so that the force exerted is equally divided between both sides. There is not room here for such an arrangement; but by making the pins A long, and counterbalancing the links, the mechanism will not work stiffly, unless it is badly fitted. The long bosses B will also assist the free and easy motion of the parts.

The pin connection between the lifting links and the weigh-bar levers is shown in Fig. 96.

The weigh-bar A, with its levers B, is shown in Fig. 97, 98. Generally these levers are forged solid with the bar; but as this would give a good deal of trouble, I show them bored, and keyed on. Also the weigh-bar is usually supported in divided bearings; but this again involves trouble which we can dispense with in a model, and I show a solid-bored bearing, C, made in cast iron, for which a similar pattern will be required. The balance-weights D are of cast iron, cored to receive the levers, and pinched upon them with set screws.

J. H.

PHOTOGRAPHIC PRODUCTION OF COLOURS.

ALTHOUGH it is well known that the reproduction of photographs in colours is practically impossible, so far as present knowledge goes, inventors, more or less sanguine, still take out patents. The line on which success may ultimately be reached has already been described in back numbers, and it is possible that Mr. H. C. Bond, of Bromley, Kent, may have hit upon it in the specification describing his recent patent. He says his invention relates to an improved process for the true reproduction of the colours of nature in a compound photographic print, and has for its object the obtaining of the required results by natural means, without the use of the brush or any manual application of pigments, such as erystoleum, to the finished prints. In carrying the invention into practice, Mr. Bond takes three plate-glass troughs, composed of two thin sides cemented together round the rims, and held apart by narrow strips of plate glass of suitable thickness, and fills these with liquids, each of such colour as will transmit all solar rays, except those forming one of the primary colours. Thus the first will be filled with a green solution—preferably chlorophyll in alcohol—which transmits all rays but red; the second with an orange solution—preferably ferric sulphocyanide—which transmits all but blue: and the third with a purple or puce—preferably aniline puce dye—which transmits all but yellow; or he fills the three slides with such other liquids as shall be found to possess these properties. The first of these colour screens is now hung by loops attached to its upper corners immediately inside the lens of a camera, and a colour-sensitive gelatine dry-plate is exposed behind it, giving as a result a picture in which the red solar rays have had no effect at all. With the second screen a picture is obtained in which no blue rays take effect, and with the third no yellow rays take effect. On developing these images, certain striking differences are noticeable between each. From these negatives, prints are next taken by contact on paper coated with bichromatised gelatine, or on glass coated in the same manner—collotype process—and in the former case the

Fig. 1

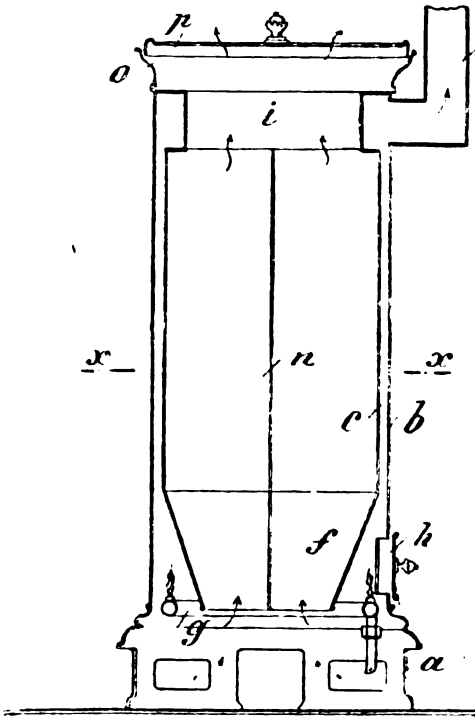


Fig. 4

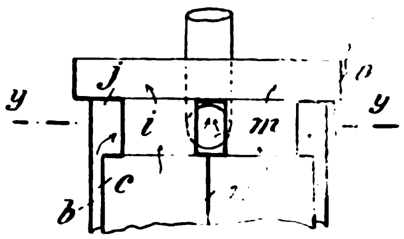


Fig. 5

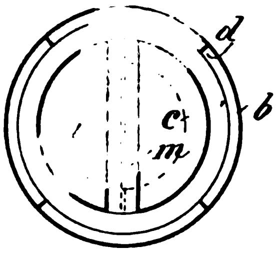


Fig. 2.

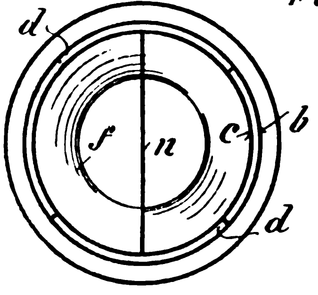
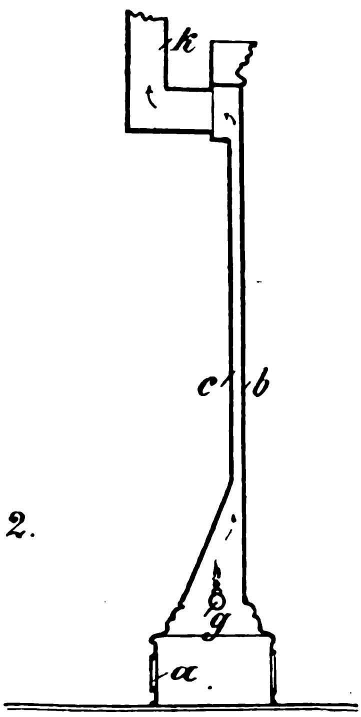


Fig. 3



mage is transferred to the lithographic stone. Each picture is now inked up with roller and lithographic ink of a transparent and brilliant character, complementary in colour to the colour of the screen under which the negative was exposed. Each colour is next printed in turn on to the same piece of paper, exactly as in chromo-lithography, and the result is that the red ink takes those parts of the picture where nothing showed through the green screen, and no effect was produced on the green plate. The blue ink takes the parts where the orange cut off the light, and the yellow ink those parts obliterated by the purple screen. The resulting point, if the colours of the colour screens and of the inks have been exactly balanced, will be found to portray all the colours of nature, as the secondary and tertiary colours and the deep tones of the shadows will be correctly given where the pure primary tints overlap. These coloured pictures may also be printed in gelatine tissue, stained to the requisite colours after development with aniline or other dyes, and the three skins superimposed for magic-lantern slides and the like.

MEIDINGER'S IMPROVEMENTS IN GAS STOVES.

THE improvements in gas stoves described below form the subject of a patent obtained in this country by Prof. Dr. Heinrich Meidinger, of Carlsruhe, in the Grand Duchy of Baden, Germany. The chief object of the invention is to provide a stove that will give a good heating effect with gaseous fuel. Prof. Meidinger causes the hot products of combustion of the fuel gas to ascend vertically through a narrow channel or passage, the transverse section of which has the form of a slot, and which may be formed by approaching to each other, to a distance of about 1in. more or less two metal plates or sheets. Owing to the large surfaces formed of good conductors of caloric offered by a passage or tube of the shape above described to a given volume of the products of combustion, the passage cools the hot gases or products of combustion to a considerably higher degree than a wider passage, for instance a cylindrical one, having its sides made of the same material. Stoves in which the gaseous products of combustion are caused to ascend through a passage of slot-shaped transverse section cannot however be heated by means of the ordinary solid fuels for several reasons, amongst others the unavoidable obstruction of the passage by soot and ashes. It is true that petroleum may be utilised for heating such stoves, provided that the formation of soot be prevented by suitably constructed lamps; but, on the other hand, this arrangement would render the service of the heater too complicated.

In the improved stove the patentee combines the vertical passage or flue at its lower extremity with a larger chamber open at the bottom and acting as a combustion chamber, and at its upper extremity with a large closed chamber in which the products of combustion collect, and which is provided with a smoke pipe which conveys the cooled gases into a chimney.

In a stove constructed in the above-described manner the sides of the passage will always present identical temperatures at given heights, and from bottom to top the temperature rapidly decreases. Thus for instance, in a stove of this kind, the lowermost portion of the two sides may be heated nearly to red heat, while, in the height of about 3 feet, one may without danger touch the sides of the stove with one's hands. It is a well-known fact that a wide cylindric tube would, under similar conditions, present at the height named nearly the same temperature as at the lower extremity. The improved stove is constructed either of plane plates, or in the form of an annular cylinder, and, moreover, it may be provided with a surrounding casing to prevent annoyance by reason of the heat radiating from the highly heated metallic surfaces.

Fig. 1 is a vertical central section of a cylindrical stove, the surrounding casing being omitted. Fig. 2 is a horizontal section on the line *x x* Fig. 1. Fig. 3 is a vertical central section of a modification. Fig. 4 is a transverse section of the top portion of the stove. Fig. 5 is a horizontal section on line *y*, *y*, Fig. 4.

The stove rests on feet *a* between which the air freely enters the inner space of the heater. By the outer cylindrical side *b* and the inner cylindrical side *c* is formed an annular slot-shaped passage. The distance between the sides is from about ⅛in. to 1⅛in.; but preferably less than ½in.; when formed more than 1⅛in. the calorific effect is greatly diminished. In order to maintain the two sides *b* and *c* at the same distance apart, either or both of them are provided with radial ribs *d*; according to the dimensions of the stove from four to eight or other suitable number of such ribs are provided. The inner cylindrical side *c* is connected at its lower extremity with a conical portion *f*, whereby the annular combustion chamber is formed. Within this chamber is arranged an annular gas pipe *g* provided with numerous burners, the intervals between which are so small that the gas streaming forth from all the burners is gradually lit as soon as the jet of gas near the fire-door *h* is lighted. This door *h* may be glazed or provided with a mica pane so as to make the burning gas flames visible from without.

At its top, the inner cylinder *c* terminates by a cylindrical portion *i* of smaller diameter, and provided with a flange, *j*, that connects it to the outer cylindrical side *b*. In this manner, an annular chamber is formed, where the cooled products of combustion collect before escaping through the smoke-pipe *k*. For the purpose of allowing the gases, which enter the portion of the collecting chamber opposite to the exit pipe *k*, to flow directly to this pipe, a passage or tube *m* is provided inside the cylinder *i*.

It will be readily understood that instead of forming the combustion chamber and the collecting chamber for the products of combustion by narrowed portions of the ends of the inner cylindrical side *c*, they may be formed by providing portions of a larger diameter at either end of the outer tube *b*. Within the cylinder *c*, which is open at its upper and lower extremities, are arranged one or more metal plates or sheets, as shown at *n*; this plate or plates extend from the top of the cylinder *c* to the bottom edge of the conical portion *f*. On being heated, the plate *n* adds to the surface, which imparts caloric to the current of air continually passing through the cylinder. The improved stove is moreover provided with a head or corona, *o*, and a carved lid or cover, *p*.

Fig. 3 shows a modification wherein both sides of the same are kept apart at an unvariable distance by means of vertical ribs formed on or suitably attached to either the one or the other side, or partly to one side and partly to the other side. The improved gas-stoves may be made either of sheet iron or of cast iron, or other suitable metal, and they may be either enamelled or not.

THE "K.M.B." PATENT POCKET-GALVANOMETER.

THE above name has been given to a handy pocket-galvanometer made by King, Mendham, and Co., of Bristol, and shown three arrangements in the annexed illustrations. The instrument is intended for those who require a small measuring galvanometer, that can be carried in the pocket and be used on every occasion for testing with currents up to one ampère. It is therefore so designed, that while it can be used as a practical instrument for simple line and battery testing, it can also be used for the absolute measurement of currents. To the amateur, who may be experimenting with batteries of unknown resistance, or leads of questionable condition, and the electric bell fixer it will be found very useful; for while, with the dial in one position, tests can be made of line wire for continuity or of the battery for approximate efficiency, with the dial turned half-round so as to bring the lower half uppermost, each individual cell can be tested for strength of current, and a faulty cell easily detected and removed from the battery. The galvanometer is made in two distinct parts, in which consists its novelty; the front portion carries the magnetic needle and graduated dial, and is capable of rotation round its centre, its edge being milled to admit of easy movement; the back part or case contains the bobbins, which are wound with copper wire to two measured resistances, and in front of these bobbins the needle swings. One half of the dial is graduated in degrees, while the other portion represents an equally divided ampère, and the dial may be rotated so as to bring either half uppermost, the needle, of course, remaining in a vertical position. That part of the dial graduated in degrees should be used uppermost when it is required merely to test a line wire or a battery, as with an ordinary detector galvanometer. The other portion of the dial should be used uppermost when it is desired to find the strength of the current given by any one individual cell; this is indicated in milliampères, and the instrument will measure currents up to 1,000 milliampères or one ampère. In Fig. 1 the instrument is shown with its two graduations, that part divided into degrees being uppermost. Galvanometers are also supplied in cases, as shown in Fig. 2; this is so arranged that the vertical portion against which the instrument is fixed is removable, and fits down into the tray, which gives it the protection it requires; the galvanometer can thus be carried in the tool bag without fear of being damaged, and tests can be very easily and conveniently made by means of the terminals in the case. Another method adopted for mounting the galvanometer is represented in Fig. 3, and so mounted it can be used as a laboratory galvanometer, connections with the terminals being made through the stem.

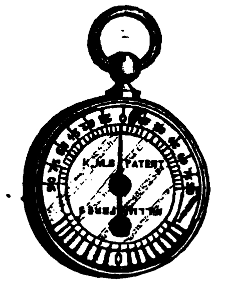


FIG. 1.

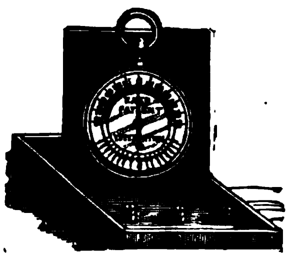


FIG. 2.

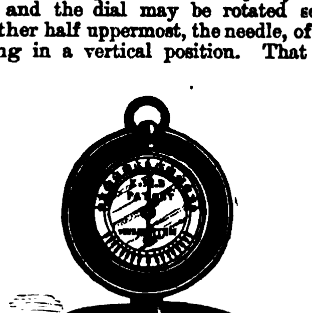


FIG. 3.

HEAT-ENGINES OTHER THAN STEAM.—V.*

As most of you know, gas-engines have received great consideration, both from scientific and from practical men. They have been subjected to experiment in almost every direction, and I suppose there is scarcely any apparatus used by the engineer which, as a fact, has been more elaborately investigated, and about which more has been written. There is no doubt that it is largely due to this, and to the increasing demand for an economical small-power engine, arising from the increasing needs of civilisation, that the gas-engine owes its present advanced position. Further, there is no doubt that it is in such engines, combining within them the theoretical and the practical advantages necessary for a motive-power heat-engine, that the elements of future success are contained. The gas-engine is the product of many minds, and of the long-continued assiduous labour of many men. It is one of the best practical examples of the successful attention of the engineer to minor details. It is true it owes some of its rapid advance to its rival, the steam-engine. The steam-engine has enabled many improvements in the mode of performing mechanical work to be attained, and this has, no doubt, helped the development of the gas-engine.

Although gas-engines differ widely among themselves, yet they are alike in one respect, and that is, they are all "internally fired" engines. In them the working agent is air, which is heated by the combustion of coal or other combustible gas mixed with it in the power-cylinder itself—i.e., in all of them the heat is communicated to the working agent directly, and in the power-cylinder itself, and the boiler, or its equivalent, is entirely absent.

Further than this, the true working agent—the air—is already a gas, and, therefore, none of the heat put into it, by combustion of the fuel with which it is mixed, is absorbed in the form of latent heat, as it is in the steam-engine, where we have the fluid (water), which has to be turned into the gas (steam) before we can use it in the heat-engine, requiring for this transformation a certain amount of "unutilisable"—if I may coin a word—heat. In the gas-engine there is no absorption of heat due to this "latent heat of vaporisation." Theoretically, if we had materials of which we could construct the working cylinders of our gas-engines which did not absorb any of the heat developed, and if we could overcome the consequent difficulty of premature ignition from the hot sides of the power cylinders, and other difficulties, such as I pointed out to you when talking of the ideal heat-engine of Carnot, it should be possible to obtain nearly the whole of the efficiency due to the difference between the temperature of combustion of the mixture of air and coal-gas used in the cylinder—viz., some 3,500° Fahr. absolute—and the temperature of the exhaust, which should then be at least as low as that of the atmosphere—say 530° Fahr. absolute. It is needless for me to tell you such an efficiency as this is not likely to be attained.

Time will not allow of our considering the various theories which have been propounded as to the completeness of combustion of the gases in the engine cylinder, nor can we stop to consider the questions of disassociation of the gases due to the high temperatures of combustion. I shall only refer to these, in so far as they are illustrated by the results which are obtained in practice.

It is true of engineering matters, as it is of almost all other things in this world, that you cannot get something for nothing; and we shall find that, while the economical advantages of eliminating the boiler from the gas-engine is apparent, yet, because we obtain this advantage, we are saddled with certain disadvantages, which to some extent counterbalance this. These disadvantages, which arise from eliminating the boiler, were of much greater importance in the earlier days of gas-engines and of gas-engine construction. I will not delay about these now, but will deal with them as we get further on with this most interesting portion of our subject. Further, I told you last week that air was one of the worst conductors of heat which we know. This, which was a disadvantage in the hot-air engine, we shall find is a practical advantage in the gas-engine.

The earliest gas-engine of which I have been able to get any record is one proposed by a M. de Rivaz, who, in 1807, described an engine which was to be used for driving a carriage on common roads. [Since the above was written, I find, in a paper by M. Edouard Delamare-Deboulleville, read at the meeting of the Institution of Mechanical Engineers in July of this year, that a reference to a gas-engine was published by John Barber on the 31st October, 1791.] Hydrogen gas was the medium by which the heat was to be obtained, for at that time, as you are aware, illuminating gas was not known. From this time forward many patents were taken out, and many suggestions and investigations were made; but it was not until the years 1860-61, when another Frenchman, M. Lenoir, patented and introduced his gas-engine, that any noteworthy practical success was obtained. Lenoir was followed, in 1865, by Hugon, and many engines on both these systems were constructed and put into successful practical work, and some of them are at work even to this day.

The first of Lenoir's patents is dated 1860, No. 335. This engine consisted of an engine similar to an ordinary horizontal steam-engine, having the piston, piston-rod, connecting-rod, and crank-shaft, which these engines usually have. On each side of the cylinder, however, there is a slide-valve, each valve being worked by an eccentric, strap, and rod. These slide-valves are not contained in cases or chests, as is the ordinary steam-valve, but they are held against the faces on the cylinder by springs or adjustable screws. The mixed charge of gas and atmospheric air is brought to the cylinder by means of a pipe, which, in a certain position, of that one of these valves which is the inlet, communicates through an opening directly with the cylinder. The exhaust takes place through the second valve, and the firing of the explosive mixture was done by means of an electric spark.

The engine worked as follows:—The piston moved forward for a certain portion of its stroke, drawing in the mixed charge of gas and air, and then this charge was fired by an electric spark due to a contact made at the right moment by the engine itself, and the expansion of the hot gases propelled the piston to the end of the stroke. Thereupon the exhaust valve opened; the flywheel carried the engine on, and as the piston returned, a mixed charge of gas and air was drawn in on the front side of the piston; this charge was fired; the piston was driven back to the back end of its stroke; the exhaust valve for the front end of the cylinder was opened; the inlet for gas and air to the back end of the cylinder was then opened, as the flywheel carried the piston on, the fresh charge for the back end was drawn in; this was fired, and so on. The Lenoir engine was practically similar to an ordinary high-pressure double-acting steam-engine, with a valve arranged for the admission of an explosive mixture of gas and air at the ordinary atmospheric pressure at each end of the cylinder, and with means provided for igniting this explosive mixture electrically at the proper moment, and with another valve arranged to allow of the exhaust of the exploded gases. The great difference between the steam-engine and the Lenoir engine being that in the latter about one-fourth of each stroke was inoperative for power purposes, the movement of the piston during this portion of the stroke being utilised to draw into the cylinder the charge of explosive mixture.

There was provided around the cylinder of the engine a water jacket, through which cooling water was allowed to circulate, so that the surplus heat generated by the explosion might be carried off from the cylinder, and that thus the surface of the cylinder might be kept cool enough to allow of efficient lubrication.

As I have told you, in this engine of Lenoir's, the explosion was caused—or, to use the commonly accepted term, the "firing" was done—by an electric spark. Great difficulties were experienced with this in practice, as it required careful manipulation and adjustment, and frequently failed to caused explosion, or "missed fire."

[Mr. Graham Harris then went on to describe the most useful of the various devices which have been introduced (but which it is unnecessary to say anything about, as full details can be found in back volumes), and then proceeded to speak of the improved Otto.]

Let us now consider that further improvement made by the inventor of the Otto and Langen free-piston engine, which has rendered the gas-engine the admirable apparatus for its purpose which it is. This improvement consisted in so arranging the "cycle" of operations and the proportions of the length of the cylinder and the stroke of the piston that the gaseous mixture in the cylinder is compressed and stratified—that is to say, in the improved Otto engine (more commonly now known as the Crossley engine) there is, close to the piston when explosion takes place, a layer of the products of combustion from the previous stroke (these products of combustion being, as you will realise, incapable of themselves burning), and that then there is a layer of weak explosive mixture, and the charge gets stronger and stronger of gas, due to the arrangement of the air and gas inlet-valves, till the back of the cylinder is reached, and here, where ignition takes place, the mixture is at its strongest.

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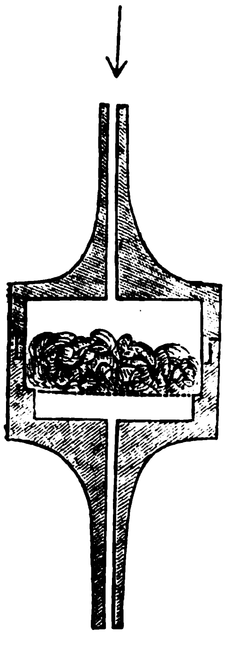
* Extracted from the Cantor Lectures delivered by Mr. H. Graham Harris, M.Inst.C.E., before the Society of Arts.

Further than this, the arrangement of the "cycle" is such that the efficiency and economy of the engine are increased by the fact that, prior to explosion, the inlet-valve has been closed, the stratified charge has been, so to say, bottled up in the cylinder, the piston has come backwards, and the stratified charge has been compressed so that, at the moment of combustion, it has a pressure of, say, 40lb. on the square inch.

This compression will, according to the second law governing the expansion of gases, give you, for an equal increment of heat, a pressure very much in excess of that which would arise if there were no compression; and the stratification will give you a charge of gaseous mixture which will readily ignite at that part where it is richest of gas, and will burn, not with explosion, but only with very, it may be with extremely, rapid burning, and where the power generated by combustion will thus be somewhat gradually applied to the piston, and through it to the crank-shaft.

AN IMPROVED APPARATUS FOR USE IN DRYING COMBUSTION-TUBES.

THE following description of an improved apparatus for drying combustion-tubes is sent us by Augustus E. Dixon, M.D., F.C.S., Assistant Lecturer in Chemistry, Trinity College, University of Dublin. The ordinary method of drying tubes for use in combustion analysis, by heating in a gas or other oven, and withdrawing the contained air at intervals, is tedious and open to the objection that dust is very apt to be introduced. The method of passing the tube backwards and forwards through a large gas-flame, while a current of air is maintained through the former by means of a foot-blower, though rapid and otherwise efficient, is still more open to the objection stated; for the foot-blower is necessarily placed upon the floor, whence it readily picks up the lighter particles of solid matter which are near the valve.



I inclose a rough sketch of a simple piece of apparatus by which the entrance of dust into the combustion-tube is completely prevented, while the advantage of using the foot-blower is retained. It consists of a box of the form shown in the figure, turned out of boxwood, and made in two corresponding pieces, one half fitting air-tight into the other. A disc of wire gauze is inserted near the distal opening, and the space on the proximal side of the disc packed with clean cotton wool. The inlet tube is connected with the delivery tube of the foot-blower, while the exit tube is attached to a clean piece of rubber tubing about 6ft. long. The latter, in turn, is connected with the long narrow glass tube which is used in blowing out the moisture from the heated combustion-tube. These three—fitter, rubber tube, and glass tube—are kept exclusively for the purpose alluded to, and are ready for use at a moment's notice. I have had the apparatus for some time in use, and find that it works very satisfactorily.

[Dr. Dixon says in a note to us that the apparatus is easily constructed, and efficient, and he thinks it may prove useful to some of our chemical readers.]

SIMPLE SCIENTIFIC EXPERIMENTS.*

Experiments with Eggs.

SOME of the phenomena of fluid friction may be beautifully shown by very simple experiments devised by Sir William Thomson. The materials necessary are two eggs—one raw, the other hard boiled; two rubber bands of such size as to clasp an egg firmly when slipped on lengthwise; two thin steel wires, about the size of those sometimes used as E strings on guitars, and a mirror or a large plate, or other smooth surface, with a ledge around it to prevent the eggs rolling off.

From a gas fixture, or other convenient support, the two wires are hung, and to the lower end of each one is fastened one of the rubber bands. Into these loops the eggs are slipped, with their long axes vertical, as shown in Fig. 1. Grasping one egg in the fingers of each hand, they are gently

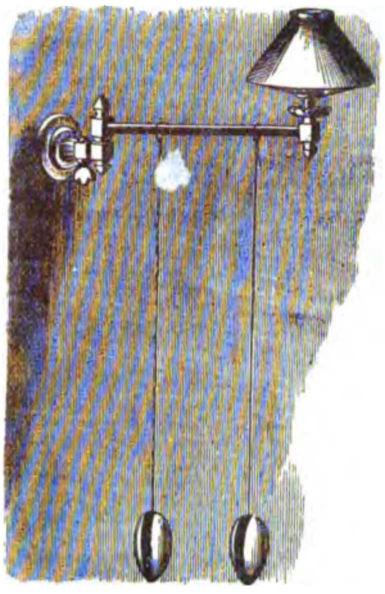


Fig. 1.

turned once or twice round, and then let go. The eggs show a surprising difference in behaviour. The boiled egg keeps twisting to and fro, after the manner of a torsion pendulum, while the raw one comes almost immediately to rest. The explanation is easy. The hard-boiled egg, being rigid throughout, turns as a whole, while the raw egg, being soft inside, has only its shell moved by the torsion of the wire, the contents remaining stationary, because of their greater inertia. The shell is thus made to rub to and fro on its contents, and being very light, is soon brought to rest.

Sir William Thomson has used this experiment to illustrate one of the proofs that the interior of the earth is solid. If the earth consisted of a thin shell or crust of hard rocks surrounding a fluid or pasty nucleus, as has been until recently generally taught, he says that the observed swinging and swaying motions of the earth's axis in precession and nutation would be impossible. Any such motion would soon be stopped by interior friction. Place the eggs on the mirror or plate and try by a sudden twist with the fingers to spin them on end like tops. With the boiled egg one readily succeeds, but the raw egg will hardly make a single rotation before it falls on its side. The finger twist has merely moved the shell, the inside remaining at rest. Prof. Mendenhall has remarked that this experiment furnishes a solution to Columbus' problem—how to make an egg stand on end: first boil the egg hard and then spin it.

The third experiment is the one that occasions greatest surprise. The boiled egg is spun on its side on the glass, and the palm of the hand is then gently brought down upon it for an instant. The rotation, of course, stops at once. But when the same thing is tried with the raw egg, as soon as the hand that stops it is removed, its rotation begins again. In this case, when the shell is stopped, its fluid contents remain in motion, and, rubbing against it, set it in motion when the hand is taken away. It astonishes one to find how long the egg may be held still before this effect stops.

Smoking an Empty Pipe.

A neat adaptation of a familiar chemical experiment is now being shown by travelling conjurers. The performer comes forward with a common clay pipe in each hand, and after exhibiting them and blowing through them one at a time, to show that they are empty, puts them mouth to mouth, as in Fig. 2, and at once proceeds to draw clouds of smoke from them. The merest tyro in chemistry will at once rightly guess that one of the pipes is slightly moistened inside with hydrochloric acid, and the other with ammonia, and that the clouds of smoke are merely fumes of ammonium chloride formed by the combination of the vapours of the two chemicals.

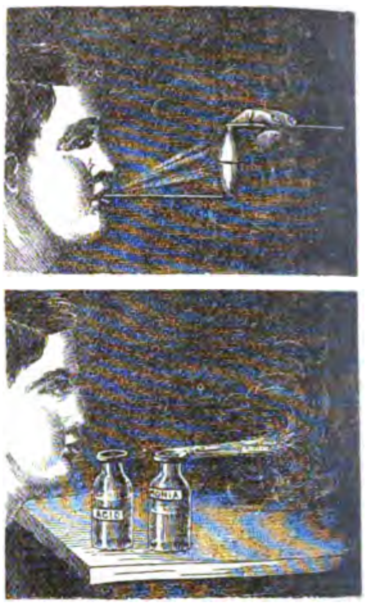


Fig. 2.

An effective way to show the same experiment to a class is to blow across the mouths of two bottles containing strong ammonia and hydrochloric acid, and placed in line with the lips, as shown in the Fig. A large room may thus be filled with dense fumes in a few minutes.

DETAILS OF SWEET'S 16in. ENGINE LATHE.*

THE novel features of the foot-stock are principally in its general form, in the device for swinging it out of the true plane, and in the compression sleeve. The centre in Fig. 34 is the same as that in the head-stock, and is interchangeable. In drilling for the screw and centre, stock is left as shown at *n*, for a nut for the centre to screw into. A steel sleeve, S, is left fitted to the spindle, and the casting is bored large enough to receive it. S is 9in. long, and is conical at each end. These cones fit counterparts in the casting at T T. The sleeve is split in four parts at the ends, to allow contraction of the diameter, and is caused to travel endwise by the nut N, and handle H, Fig. 34, also shown in transverse section A B at N, Fig. 35. The thread in this nut has a pitch of ½in., and is divided into eight parts. A small rotatory movement of the nut thus produces a comparatively large end movement. The compression occurring at points so far apart, gives an exceptionally rigid support, and it is the best device for the purpose that I have seen.

The eccentric device for clamping to the bed of the lathe is similar to many others in use, except that the shaft is placed lengthwise of rather than across the bed. The foot-stock rests on a plate, P, Figs. 34 and 35, which is fitted to the bed. The nut N′, which receives the screw *s′* for the transverse movement, terminates on its under side in a cylinder which fits in a hole, *h*, in the plate P, Fig. 34. By withdrawing the bar B, which extends across the plate, and has half its thickness in the plate and foot-stock, the foot-stock may be turned around through several degrees of arc. The clamping-plate C needs to be removed in this operation. This plate also serves to bring the spindle to its true plane in resetting, by causing pressure on the side of the bar B.

The clamping-block C′, Fig. 36, is shown in section at C′, Fig. 34. The block has a recess on the under side for the nut, and is carried back and forth with plate P by four projecting parts *pp*, which prevent it from catching during end movements of the foot-stock.

In Fig. 38, a longitudinal section of the counter-shaft is presented. The cone C and sleeve S are one casting, the fast and loose pulleys being fitted to it

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* By A. P. B. in the *Scientific American*.

* By Prof. C. I. King, in *American Machinist*. (Concluded. See pp. 345, 386, 410, 478).

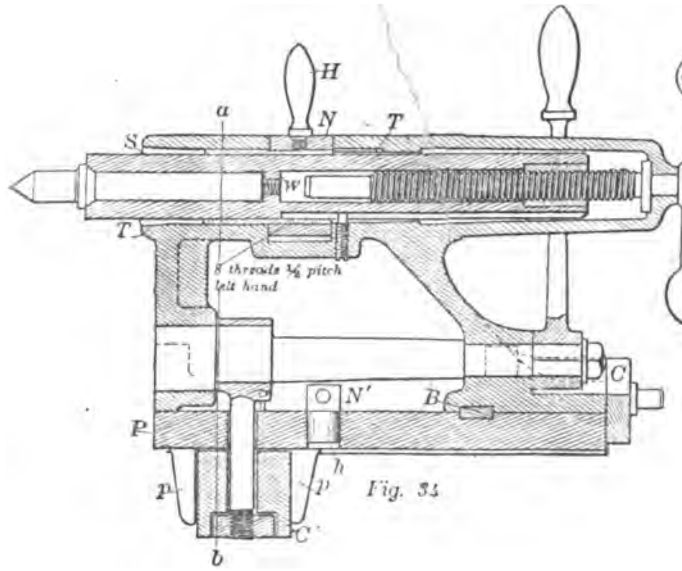

Fig. 34

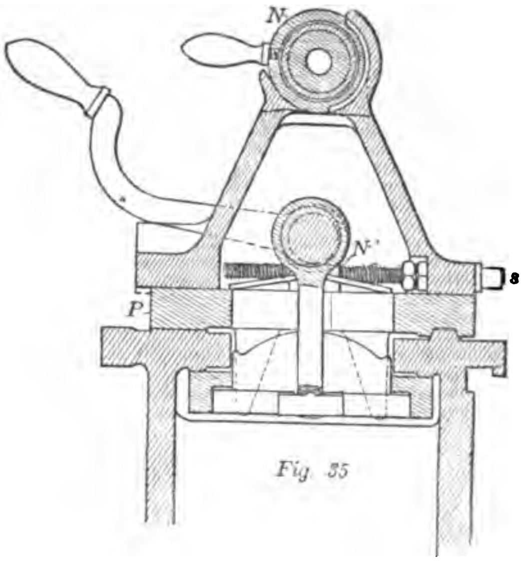

Fig. 35

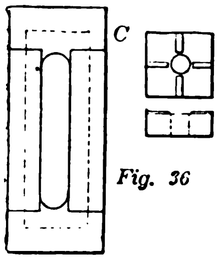

Fig. 36

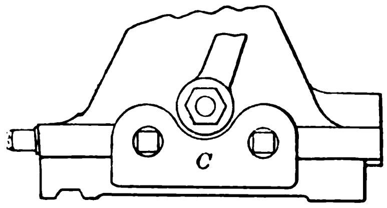

Fig. 37

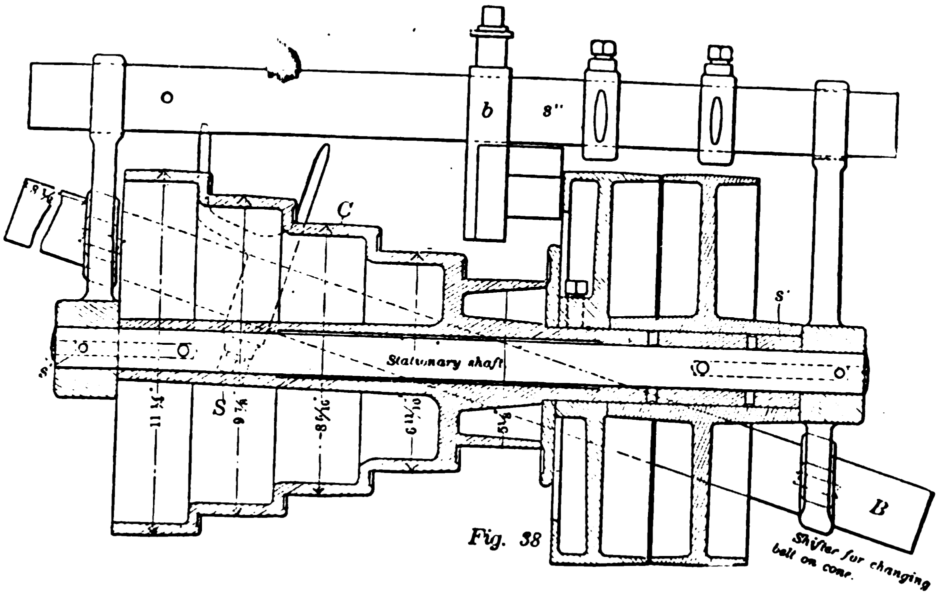

Fig. 38

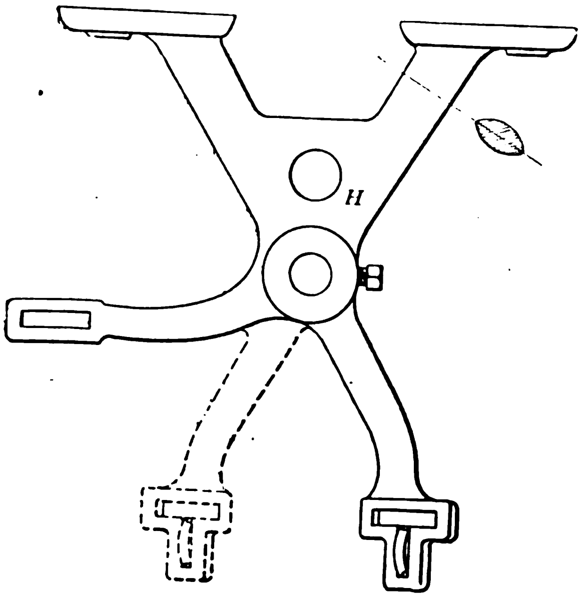

Fig. 39

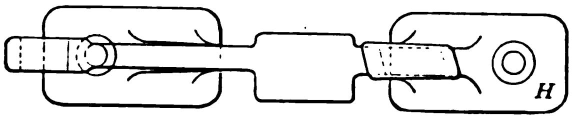

Fig. 40

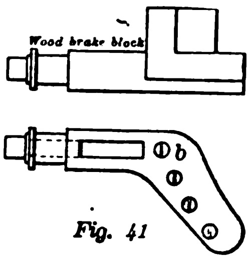

Fig. 41

The shaft S′ is fastened in the hangers by set-screws, and does not turn. Holes for oil reservoirs are drilled into each end of this shaft, and screws are fitted to them at the end, and common oil holes are then drilled through the hanger hub into the reservoir which lead out through the sleeve to the loose pulley on one end, and to the sleeve only at the other end. This distributes the oil thoroughly, and is not likely to fail in its feeding.

The bar B, for shifting the belt on the cone, is shown in dotted lines, where it passes under the cones.

The hanger H is represented in side elevation at Fig. 39, and in plan at Fig. 40.

A brake block, *b*, for stopping the lathe, is shown on the main shifter bar *s*″, and in side elevation at *b*, Fig. 41.

In using the lathe, these points of difference between it and the ordinary lathe present themselves. It is driven by a single belt, and when the belt is thrown off, the brake is put on the counter to stop the lathe by the single motion of the shipping lever. Friction clutches never stick, and when the operator attempts to stop the lathe it stops, and does not run backwards.

When the operator wishes to change the belt on the upper cone he does not have to try four or five times to throw it and then go for a pole. When he wishes to throw in the back gear he only has one motion to make. When he wishes to bore a taper hole any given taper to the foot it is only necessary to set the head-stock to the mark. When he wishes to operate upon a piece less than 4in. thick and up to 24in. in diameter, it will swing in the gap of the lathe, and that without any change in the lathe either before or after. When he wishes to set for any pitch screw he has no gears to select or put on. The lathe cuts 24 standard threads from 3½ to 28, and feeds for turning ⅛ as fast as when screw-cutting, so that 24 fine threads can be cut. In screw-cutting, the slide may be run back and forth by reversing the screw, or the nut thrown out, the slide run back by hand, and the nut thrown in, without stopping the lathe at all.

The forward feed and cross feed are so proportioned that, if both are thrown in at the same time, the cut will be at the angle of 60°, and so the lathe centres turned correctly. If a lot of pieces of unequal length are to be turned taper, the head-stock is set at the proper taper, the foot-stock brought in line with it, and the work done the same as straight work, and that, too, without moving the foot-stock centre out of truth. The foot-stock can be removed from the lathe without disturbing any part of it.

PRACTICAL DETAILS OF BLACKSMITHING.*

THE form of the wrought-iron anvil at present in vogue appears to be as well adapted to its purpose as any that can be devised. Let us examine into its fitness for its uses.

The centre part, where the greatest amount of hammering is to be done, is made solid from face to base. It is intended that mass shall be aggregated here to the full extent of the weight allowed to the anvil, because it is this part that is to furnish much of the inertia, which has by some been considered so essentially a prime qualification for this tool, that it has acquired the name of the anvil principle, and is often so called when its properties are spoken of as used or required in mechanical constructions.

But there is no *kick* in absolute inertia: there is as much inertia in a bag of sand as there is in a mass of iron of the same weight, and as the bag of sand does not manifest any quality which the anvil principle is wanted for, it is easily perceived that inertia is not all that is required; that the true principle in question is not only an indisposition to move from a position, a reaction against action; and it is very plain that not only for its inertia, but also in a greater degree, for its quick acting and ready resilience, that the solid mass of iron extends from the face to the base of the anvil. This is a living and active, always antagonistic principle, and to be brought to manifest its perfect condition in an anvil, the direct lines in which the force of the blow which is struck upon it will act must be so long that its force, spending itself diffusively over the oblique diverging lines, is overpowered by the force of resilience, which concentrates rapidly from all directions, and immediately returns the full force of the blow from the point of impact. The anvil must be so deep as to rebound the full force of the blow, and transmit none to the block below. Then the full force of the blow will be saved and expended on the work, but whatever amount of the blow passes through the anvil to the block is lost, so far as its intended purpose is concerned.

An addition is made to this solid mass on one side, which is called the beak or bick; it is flat on the upper side, and the flat face of the anvil is extended over this. The primary object of the beak is to afford as solid a place as circumstances will permit for hammering on anything which has some projection on it which will not permit the part which is to be worked upon to come on to the middle of the face of the anvil, because it will be obstructed by the body, but which will pass under the beak, and let the part which is to be hammered be supported by that.

The beak is very strongly braced by its form, but not as strongly as it would be if, instead of being of a concave form on the lower side all the way from the lowest point at which it joins the mass, it changed the concave to a convex form soon after leaving the body, and continued this convexity to the end, as shown by the dotted lines in Fig. 1. But as the concave form has the practical advantage of greater facility for working forked pieces, which are narrower in their opening than could be got on the convex form, this advantage is conceded to more than counterbalance that of the superior stiffness which would be given by the other form. The present shape is, for general purposes, undoubtedly the best.

When a piece of iron is laid on the beak, and blows are struck upon it, they do not seem to impress it as much as they do when it is laid on the solid part, and it will appear that the nearer the work comes to being laid over the solid part, the more does it feel the effect of the blows. If it is laid at the end of the face opposite to the beak—that is, close to where the off-set for the horn is made, it is a little beyond the place where the perpendicular lines of percussive force will go through solid metal to the base, as from this poi [illegible] they would strike on the arch of the concave belo [illegible] but nevertheless, every blacksmith has a ki [illegible] intuitive perception that blows struck wit [illegible] ordinary-sized sledge upon iron laid on this [illegible] produce as much effect as they do when it is l [illegible] any position whatever on the anvil, and it w [illegible] noticed that, when the horn is broken off, thi [illegible] does not seem nearly so solid as before. I [illegible] that the part that is gone had no suppor [illegible] from the body which still remains—it o [illegible] out into the air; but even thus, as a me [illegible] ence upon the anvil, it was yet by forc [illegible] ciple a support to this part of the [illegible] principle is the same as that which t [illegible] relies on for the support of one e [illegible] iron which he desires to break at [illegible] m that end; he cuts around the ba [illegible] old chisel, and then shoves it along un [illegible] ace is beyond the anvil, and the sledge [illegible] it on the cut, causing a sudden downwa [illegible] cy at that point, but also a contrary up [illegible] vement of the out-lying end of the bar; t [illegible] l result of this conflict of contrary tenden [illegible] es when the bar breaks.

At the first glance it looks as th [illegible] the blow being downward, there would be no tendency in any part of the bar to rise, but everywhere simply a reluctance to fall; but as we trace the effect of the blow along the whole extent of the bar, we find that its downward tendency started at the cut, and moved along towards the end, and as it went it was resisted with more and more potence by inertia, until it had traversed about two-thirds the distance, and from and beyond this point as a fulcrum, the end of the bar has a tendency to rise, being lifted as the resisting part of a lever of the first kind, pried up over the invisible, but still plainly palpable, fulcrum of inertia by the quick force of the blow, which gave a downward motion to that portion of the bar nearest to the anvil. It is this principle which makes the horn contribute to the solidity of the anvil. If the end of the horn were not made small, if it was continued of the same diameter as at the largest place, the anvil would soon part company with it, for the tendency to contrary movement of so great weight would break it off; but being tapered off as it is, the centre of motion due the blow is very near the largest part of it; the inertia is thus practically distributed throughout, concentrating, however, at the jointure, and moving the centre of percussion on the whole anvil to that side of the centre of gravity where, as before remarked, every blacksmith knows that the anvil feels the most solid.

Some large cast anvils, designed for heavy work, where much execution is needed to be done over a part of the anvil which will admit a part of the work to pass under it, are so made that the thin part of the anvil is in the centre, being constructed on the arch principle, the pillars of which, being the ends of the anvil, go down and unite with the solid base. In this manner a resistance is secured as firm as may be desired. Such an anvil, of the same weight as that shown in Fig. 1, is illustrated by Fig. 3.

There may be something of this kind in the future for the common anvil, when the art of steel-making is sufficiently advanced to cast them of a quality of steel that will meet the requirements of toughness, hardness, and cheapness; but, as things go, it would be too expensive to make anvils of wrought-iron of this form.

It might not be advisable to make such anvils entirely of highly carbonised steel, but substituting pneumatically refined iron for the best gun iron now used, or reducing wrought iron to a fluid state by the Mitis process, they might be made on the Fisher plan, which has produced excellent anvils, by the process of welding the faces on in the mould; by pouring the molten metal on them until they have become sufficiently heated to flux on the side submitted to the burning to such a degree as to enable the metals to thoroughly coalesce.

The adoption of some such method might secure —if it was thought advisable—a well-wrought, thoroughly-hammered, and dense face, high in carbon, and by innate nature hard. There is this to be taken into consideration—that if it was not in its natural temper hard enough for the purpose which the anvil was to be used for, it would be subject to the strain and risk of undergoing an artificial hardening process, and its shape would make this a severe ordeal to pass through. This shape has such variations in the thickness of material, that it would be a very difficult matter to cool it uniformly over the centre and extremes of the arch, and the whole being rigidly bound by the connection at the base, they would be greatly stressed in and by their unequal expansion and contraction.

When a comparison is instituted between the distribution of the material in this and in the common anvil, the point is easily made clear that the common anvil is in better shape to withstand these unavoidable strains of hardening than any form that can be imagined, which has to be of such unequal [illegible] or the thin parts, the beak and horn [illegible] ty to warp as they will, being entirely [illegible] end.

[illegible] gard to the horn, if it is made hot and [illegible] cooled, it is subjected to the same strains [illegible] m contraction, whether it is faced with a [illegible] ng steel or not. If sudden cooling makes [illegible] tle, it is only less able to bear them. The [illegible] s not altered, that it is equally subjected to the [illegible] n, however its hardness may be effected. Its [illegible] e happens to be peculiarly favourable to taking [illegible] without injury.

A hole 1½in. square through the anvil from front [illegible] back, about in the centre (see Fig. 2), would be very convenient sometimes for holding tools, such, for instance, as a small horn for welding tapering ferrules or small bands, or a beak on which to do such work as hammering down the ends of small forked wrenches, or it would quite often come in play for running a bar of iron or steel through for breaking off short pieces; but, although all will acknowledge that it would be convenient for a thousand things, yet they do not consider it of sufficient practical value to go to the trouble of making the hole. Probably, if the choice were offered between one with such a hole and one without it, most blacksmiths would take the one that had it, if the price was the same, but would not be willing to pay much for the advantage. They have always got along without it, and will probably continue to do so. The hole in the beak (see the face of the anvil in Fig. 2) answers very well for all purposes. It will hold cutters, swages, fullers and forging dies by their shanks if they are well fitted in a firm and substantial manner. It is handy to bend or break iron over, to hold heading-tools over, and to punch holes over. Its presence gives, in the simplest and most direct manner possible, all the combination qualities which are requisite. Into it can go contrivances equivalent to tire shrinker, vice, shears, drill-press, or most anything else which ingenuity would attach to the embodiment of solidity. If this hole were not in the anvil, the resources of the blacksmith in the way of tools would be greatly curtailed, and many things which he can now do easily for his customers would cost them a great deal more than the present modest charges. A hole is nothing, but it may be queried whether that insignificant hole in the anvil has not been of more material worth to the world than the invention of movable type; and yet, who ever thought of wondering who punched it first?

The small round hole (see Fig. 2) is a very important thing to have in an anvil also, although not by any means as essential as the square one. It will hold small tools if occasion requires, and is very convenient to punch small holes over. This was perhaps its primary purpose. If it is straight, smooth, and perpendicular to the face, it answers for a heading-tool. Over it, small heading-tools for nails have a good support. It may be squared out. This has been done in some instances as an improvement in its form for holding small tools to keep them from turning around. If squared, with the sides coinciding with those of the anvil, it gives weakness to the corner of the anvil beyond it, and if diagonal to these there is some more trouble in fitting tools to it. It is so near the edge of the anvil that there is little trouble in making lips to fall over the edge of the anvil to keep steady in their place the few tools it is generally desirable to have in this hole. Fig. 4 shows a hardy for nipping drills made in this manner. The fact that tools of this description are so seldom made—scarcely a blacksmith has more than two or three—shows that the hole in the place and form as it is now made is very nearly what it should be, and that, so far as is apparent in these respects, no change can be made that will be likely to meet with general acceptance.

The off-set from the main face down to the face of the square of the horn gives a square inside corner. The horn is set lower than the face, in order that it may not interfere with anything which may be laid lengthwise on the face to straighten or work in any other manner. This off-set is as sharp as it can be made, leaving the end of the face a square outside corner, following a straight line down and terminating at the flat top of the horn in a square inside corner. Sharp inside corners are notoriously weak, and this is made to appear still weaker by decreasing the width at the same line, to make the flat face of the horn considerably narrower than the main face, thus forming also an inside corner on each side. Thus is the opportunity given to the anvil to set constantly before the eye of the blacksmith a good example, to show him how the weakening form in one place can be compensated for in some degree by appropriate reinforcement and corrective proportion in another. These are given in this case by the shape below, which acquires its greatest fulness opposite this place, and does not terminate the outline of the horn at these corners but continues its curve beyond, lengthening to an extent the short arm of the leverage, and so allowing the vibrations to concentrate so absolutely at this point.

The narrow flat face of the horn adds a very useful feature in furnishing a place to work pie[illegible]

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* By R. F. Spalding, in *American Machinist.*

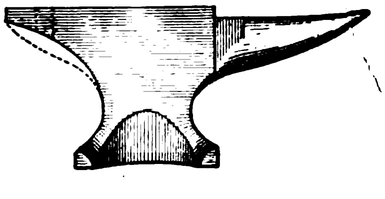

Fig. 1 The Common Anvil

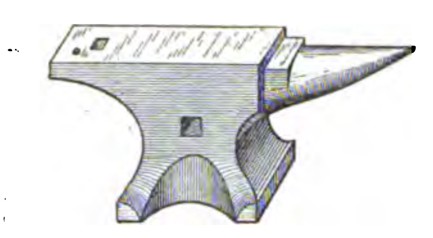

Fig. 2 A Center-hole Anvil

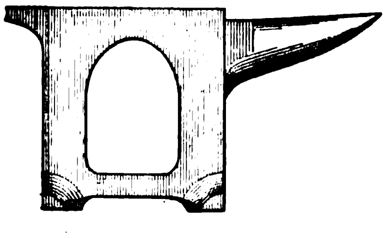

Fig. 3 An Arch Anvil

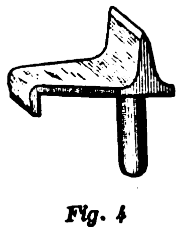

Fig. 4

which are somewhat shorter between two shoulders than will go over the wide face. It is not generally hard, and for this reason is often used to cut hot iron on, the hard steel face dulling the chisel when the too impatient striker drives it too hard through the iron. This is not a good practice, for a better plan is to bend a piece of soft iron, or if very particular a piece of copper, to fit over the square of the horn for this very necessary purpose. It is a good place to hold a piece of iron when fullering down into a shoulder, letting the back side lay up against the off-set, where it rests more firmly than it does when laid up against a stake set in the square hole, when this operation is performed on the main face. When one attempts to enumerate all the uses which this part of the anvil serves, he finds that they are so many, that a considerable knowledge of the trade would be required to understand them, and the fact that they are so many and various shows the necessity for its being as it is. In considering how well the common anvil is adapted to the purposes for which it is made, it has been thought necessary to notice only some of the minor features, which, without some attention, are liable to be passed over without observation. This has been done to show how much their combination with each other adds to the completeness of the whole tool. Nothing specially needs to be said of the face. Its purpose is too plainly obvious. The same is true of the horn. On general work one of these is as important as the other. Neither of them could be taken away without entirely destroying the value of the anvil, except for use on some special work. Nor does it need more than mere mention to call attention to the admirable manner in which the base is formed to secure extended points of support, without placing impediments in the way of using the working parts.

Taken as a whole, it may be said that the anvil, in its evolution from the flat stone or the iron-headed stake of our ancestors into its present fullness of utility and severity of style, has passed through as many beneficial changes as the sixteen horny-toed, sheep-sized, antediluvian brute, with wolf teeth, that has finally developed into the clean-cut, thoroughbred racehorse, and has, like him, by the addition of essentials, stripped of every shred of superfluity, become, as viewed in our present light, a completed and perfected model of symmetry and efficiency. It is quite probable, however, that as the character of the smith's work changes, imperfections will be perceived and improvements continue to be made.

Illustrations of anvils sent forth by anvil manufacturers very properly show the anvil from the blacksmith's side. The cuts used for this 'article represent it as the spectator generally sees it from the sledgeman's side. This remark is rendered necessary by the fact that pictorial sketches, showing the blacksmith at his anvil, cause remarks to be made by the craft, because they almost invariably represent the smith standing on the sledgeman's side of the anvil, a place where he has seldom any business or desire to get. Even cuts put out by steel makers show the anvil with the wrong end towards the forge. This position would bring the blacksmith's right hand over the horn in swedging in a swedge set in the square hole, and would endanger his hand. None but left-handed smiths use the anvil in this position on general work.

ESTIMATION OF OXYGEN DISSOLVED IN WATER.

SIR HENRY ROSCOE and Mr. Lunt have made an important communication to the Chemical Society on Schützenberger's process for the estimation of ozygen dissolved in water. They find that a series of estimations made on the same sample of London tap water gives results which differ 35 per cent. from the mean value, and that the time taken in tritating has a great influence, much higher results being obtained if titration be quickly than if it be slowly performed. The disturbing influence has been traced to the fact that when aërated water is introduced into an atmosphere of hydrogen, as in the usual process, it immediately begins to lose oxygen by diffusion, a fact hitherto overlooked. The result of an oxygen estimation thus depends on the degree of exposure to hydrogen during titration, and results between 0·53 and 7·56 were obtained with the same water by varying the exposure. Under favourable circumstances 20 per cent. of the dissolved oxygen diffuses, whilst in the usual form of the apparatus 50 per cent. of the oxygen diffuses during the estimation. An exposure of three minutes is sufficient to permit all the dissolved oxygen to escape. This explains the return of the blue colour during an estimation carried out in the usual manner, *diffused* oxygen becoming reabsorbed by the reduced indigo-carmine. No return of the blue colour takes place on reducing indigo-carmine when free oxygen is absent, and the action has been proved to be due to the supernatant gas, and not to any action occurring within the liquid as Schützenberger supposed. Diffusion also explains the observation made by Schützenberger, that twice the quantity of oxygen is found when a large amount of reduced indigo-carmine is present. In that case the dissolved oxygen is at once acted on, and so cannot diffuse. Ramsay and Williams, who have investigated the process, do not obtain twice the amount, but only an increase in the ratio 3 : 5. Diffusion also explains this observation, a smaller vessel having been used in their experiments; a larger proportion of the oxygen was found in the usual process—in other words, three-fifths of the whole. The method adopted to eliminate this error, due to diffusion, is to run the aërated water beneath the surface of a liquid containing a measured excess of hyposulphite, and a little reduced indigo-carmine as an indicator. In this way the dissolved oxygen is immediately is immediately acted upon by the hyposulphite, and its diffusion prevented. For the standardisation of the hyposulphite, the two methods hitherto used were found inaccurate, the copper method being fundamentally wrong, owing to a secondary action which occurs between sulphite and dissolved oxygen; the aërated distilled water method, hitherto used with Bunsen's absorption coefficients, the authors show to be inaccurate, giving the values obtained by them which agree closely with observations made by Dittmar. The new method of carrying out the process, and the corrected values for the oxygen dissolved by distilled water, give results for which perfect accuracy cannot be guaranteed, but which are not far removed from the truth, and certainly valuable. The reaction is much disturbed by the presence of free acid or alkali.—*Lancet.*

SOME RESULTS WITH SECONDARY BATTERIES IN TRAIN LIGHTING.*

THE arguments in favour of the incandescent electric light for railway passenger trains are so well understood by the members of the Institute, from their own general knowledge of the subject, as well as from papers previously presented, that it is unnecessary for me to allude to its admitted superiority over either gas, oil, or candles. It is now four years since the Pennsylvania Railroad Company, appreciating the advantages of electric lighting for this purpose, began a series of experiments with the secondary battery, for the illumination of parlour cars. I am unable to give the cost of lighting by any of the batteries referred to, as the expense appears to have been a secondary consideration compared with the necessity of securing the best system of illumination. The first experiments made by the company were with the Faure accumulator, which was brought to this country from France in the spring or early in the summer of 1882, and put on passenger coach No. 397 in August of that year. The car was run for a few days only, but enough was learned in that time to show that the lighting of cars by secondary batteries was perfectly practicable, when a modified form of the battery could be obtained. During the summer of 1884, experiments with the Brush storage batteries were commenced at the Altoona shops of the Pennsylvania Railroad, and continued through the fall and winter of that year. These experiments were made by Dr. Dudley, and proved so successful that eight parlour cars which were being constructed at that time were equipped for incandescent lighting, and put into regular service on the 1st of April, 1885. The Brush cells used consisted of three plates each, two negative and one positive, the amount of surface of the positive plate being equal to that of both the negatives. These plates differed from those now used, there being no paste in their composition. The negative plate was designed to give the greatest possible amount of surface from the least weight of material. The positive plate measured 8 × 9 × 1in., and the negative, 8 × 9 × ½in.

These batteries were rated at seventy ampère-hours, but the hard usage they received soon reduced their capacity, and at the end of a year's time the positive plates were almost entirely destroyed. In fact, I have taken plates out of the cells which had holes in them fully 4in. in diameter, while the deposit in the bottom of the cell would be from 1in. to 1½in. in depth. The plates also had a decided tendency both to buckle and grow, and in a number of cases it was a very difficult matter to remove the plates without injury to the cell. You will understand, of course, that I allude more particularly to the positive plate. The weak points in the Brush battery were the small number of ampère-hours per pound of material—about two, I believe. There was a tendency to buckle and sulphate, and the arrangement for connecting the plates was such that there was oxidation at the junction, causing the plates to break when subject to the motion of the car. This last feature was a source of endless trouble to us, and, as is usually the case, was sure to happen at a time or place where it was impossible to repair the break. While using the Brush battery the cars were wired with the battery boxes, one on each side of the car, coupled together in series, each box holding three trays, and each tray containing four cells, this giving a total of 24 cells to a car, or a current of 48 volts. The lamps used originally were of the Brush-Swan type, with small platinum loops projecting from the base, these hooking into a socket, and held in place by a spiral spring, this socket fitting into another one, to which the connections to the wires were made.

After using this style for some time an improved pattern of Brush-Swan lamp was substituted; but the great drawback to this lamp was its frailty, the breakage per day often averaging four per cent. of the total number of lamps in use on the cars. These lamps required about 45 volts and 1 ampère of current, and each car contained ten lamps—seven in the body, one in the smoking-room, and one in each vestibule, thus using about 10 ampères of current; and as the batteries were rated at 70 ampère-hours, we should have obtained from six and one-half to seven hours good light; but it was very seldom, after the batteries had been used for a short time, that we could get over five and one-half hours'. As will readily be seen, this could hardly be called economical, for to obtain five or six hours' light we were obliged to charge from fifteen to twenty hours with a Brush arc light dynamo giving a current of about 10 ampères. Then taking the weight into consideration, each time the car needed charging, the trays, six in number, and weighing 1,200lb., had to be loaded on the truck, pulled over to one side of the car, and the discharged trays taken out, and the freshly-charged ones put in their place. The remaining three were then taken around to the other side of the car, and changed in the same manner. As the cars invariably stood on a double track, it was necessary to carry half the trays for some distance, over tracks, &c. Then, again, the tracks were usually full of cars, and if there was not sufficient time for them to be parted the batteries had either to be carried under the car or over the platform. Under the present system, this has been done away with to a great extent. During the month of December, 1886, we commenced using one battery of the 7 B type, manufactured by the Electrical Accumulator Company. This battery was a decided improvement over those previously used, giving, as it did, nearly double the number of ampère-hours for the same weight of material.

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* By ALEXANDER S. BROWN. A paper read before the American Institute of Electrical Engineers, New York.

After using this battery for about a year, the positive plates began to give way, and new ones were substituted, the negatives, however, being retained, as they had not deteriorated. In fact, we are still using the negative plates of our original 7 B battery. This battery proved to be so satisfactory that in June, 1887, we added two more of the same type, and two manufactured by the Julien Electric Company. The latter batteries were similar in size and shape to the 7 B type of the Accumulator Company, but did not seem to stand the hard usage so well, as they would crack instead of buckling, and allow a large quantity of the paste to become loosened and fall out. It is proper to state, however, that these plates were made especially for us, to fit the cells we were using, and were not of the regular Julien type. This, no doubt, will account in a great measure for their failure to keep up to the standard of the present type of Julien batteries. After the positive plates of this battery became worthless, and not having any others to put in their place, we decided to make a kind of consolidated affair, and see how Julien negative and accumulator positive plates would work together. The result was extremely satisfactory, and we have had no trouble with them whatever, excepting the occasional buckling of a positive plate.

During the fall of 1887 we began substituting the accumulator batteries for the Brush batteries, and by the end of the year were using them altogether, with the exception of the two Julien I have mentioned. We, however, kept ninety-six of our best Brush cells, to be used in case of an accident to the incandescent dynamos, which are used to supply the current for the railroad telegraph as well as for lighting the passenger station.

After the change in batteries had been made, it was thought best to change the system of wiring the cars, so that instead of its being necessary to put batteries on each side of the car, we need only put them on one side and get the same amount of light. This was done by connecting the two boxes under the car in parallel, and substituting 23-volt Edison lamps for our 45-volt Brush-Swan lamps. After doing this we found that we were able to get as many hours' light from twelve cells as we formerly did from twenty-four. Of course this change reduced the expense of lighting the cars considerably, for where we formerly had a change of battery for each car, or forty-eight cells, we now needed only twenty-four cells per car, with a few extra ones to be used in case the twelve cells would be unable to supply sufficient light for a long trip. This system of lighting proved so successful that it was decided to substitute it for gas in the remaining seven parlor cars. The wiring of these cars was commenced at the Meadow shops, near Jersey City, last September, and has just been completed. These cars are arranged for the 23 C type of the Accumulator Company's battery and 19 B type of the Julien battery. The battery boxes under the cars are larger than the old style, and contain four trays or sixteen cells, the lamps we used taking 23 volts of current. Changes were also made the first of the year in the system of charging, and the batteries are now charged from an incandescent dynamo instead of an arc, thus enabling the batteries to be charged with any amount of current desired. In connection with this description of the four years' work of the Pennsylvania Railroad, I would like to add something in regard to the electric lighting of the Chicago limited express.

In 1887 the Pullman Palace Car Company commenced using the electric light on one of three trains of the New York and Chicago limited express, and the charging of the batteries at Jersey City was given into the hands of the Pennsylvania Railroad Company. The batteries used were the 7 B type of the Electrical Accumulator Company, thirty cells to a car, and usually there are six cars in the train. These batteries would furnish enough light for one trip, and each time the train arrived at either terminus it was necessary to replace them with freshly charged cells. This was not objectionable at Chicago, for the train arrived there in the morning, so that they could be charged during the day; but in Jersey City, where the train did not arrive until evening, the work was very difficult on account of the dynamo being in use for other purposes. After this one train had been running for a short time, another one was fitted up, 19 B type of Julien battery being used. It was thought that this would give us a chance to see which was the better of the two batteries, but they both worked very well, considering the treatment they received. After Mr. Bauer became connected with the Pullman Company he did away with charging the batteries at the ends of the line, and introduced a Brotherhood engine and Eickemeyer dynamo in the baggage car of each train, in order that the batteries might be charged in transit. When the train leaves Jersey City the baggage car is on the rear, and consequently no charging is done until it leaves Philadelphia, where the train is reversed, bringing the baggage car next to the locomotive. The batteries are charged continuously until the train reaches Chicago, and the same practice is continued on the return trip. The steam for driving the Brotherhood engine is taken from the locomotive boiler, and the exhaust is used for heating the train. So far as the Pennsylvania Railroad is concerned, the electric lighting of passenger trains may be considered an assured success, and leading, as it does, to the abolition of kerosene lamps, and incidentally encouraging the adoption of steam heating, the safety and comfort of the passengers are certainly increased.

USEFUL AND SCIENTIFIC NOTES.

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Testing Amber Varnish.—Common amber varnish is made by dissolving amber [illegible] any amber in linseed oil and turps. In [illegible] it is made without the expensive amber, and the analyst is sometimes asked his opinion, whether a sample is genuine—viz., really made with amber. The best way is to try for succinic acid, although even a genuine article only contains small quantities of this substance, as a large quantity volatilises during the heating of the varnish. The detection is, however, difficult, owing to the nature of the article. Neither boiling with hydrochloric acid nor treatment with alcoholic potash extracts any succinic acid. The author's plan is to treat the sample with nitric acid of 1·20 specific gravity. He proceeds as follows: 20grm. of the varnish are put into a flask of about 300c.c. capacity, and heated on a sand bath with 50c.c. of the nitric acid. When action sets in the flask must be somewhat cooled to prevent a too fierce oxidation, when it may be again gently heated for about fifteen minutes. The acid, which holds all succinic acid in solution, is now poured off and the insoluble resinous mass washed with water. The acid is evaporated in the water bath, a little water being from time to time added. When the acid has been completely expelled, the remaining syrup is dissolved in about 10c.c. of water, and this solution shaken with 100c.c. of ether. After distilling off the ether, the residue is put in a watch-glass and put under a desiccator. After about twelve hours, crystals of succinic acid separate out, and the amount gradually increases. The mother liquor being removed by means of blotting-paper, the crystals may now be tried by the usual tests for succinic acid. It is thus possible to answer within twenty-four hours the question whether a sample of amber varnish is really deserving of the name. —*W. Sonne, Zeitschr. f. angew. Chemie, No.* 18; *L. De K.*

The Burmese Jade Mines.—According to a recent official report from Burma the jade producing country is partly inclosed by the Chindwin and Uru rivers, and lies between the 25th and 26th parallels of latitude. Jade is also found in the Myadaung district, and the most celebrated of all jade deposits is reported to be a large cliff overhanging the Chindwin, or a branch of that river, distant eight or nine days' journey from the confluence of the Uru and Chindwin. Of this cliff, called by the Chinese traders "Nantclung," or "difficult of access," nothing is really known, as no traders have gone there for at least twenty years. Within the jade tract described above small quantities of stone have been found at many places, and abandoned quarries are numerous. The largest quarries now worked are situated in the country of the Merip Kachis. The largest mine is about 50 yards long, 40 broad, and 20 deep. The season for jade operations begins in November and lasts till May. The most productive quarries are generally flooded, and the labour of quarrying is much increased thereby. In February and March, when the floor of the pit can be kept dry for a few hours by baling, immense fires are lighted at the base of the stone. A careful watch is then kept in a tremendous heat to detect the first signs of splitting. When this occurs the Kachins attack the stone with pickaxes and hammers, or detach portions by hauling on levers inserted in the cracks. The heat is almost insupportable, the labour severe, and the mortality among the workers is high. The Kachins claim the exclusive right of working the quarries, and there is not much disposition on the part of others to interfere. Traders content themselves with buying the stone from the Kachins. All payments are made in rupees, and Burman or Burmo-Shan brokers are employed to settle the price. The jade is then taken by Shan and Kachin coolies to Namia Kyankseik, one long day's journey from Tomo; thence it is carried by dugouts down a small stream, which flows into the Tudaw river about three miles below Sakaw, and down the Tudaw river itself to Mogaung. The Sawbwa of the jade-producing tract, Kansi, levies 5s. on every load of jade that leaves his country, the local chief at Namia Kyankseik takes another 2s., and the farmer of the duties obtains an *ad valorem* duty of 33⅓ per cent. The Kachins and Chinese-Shan coolies who work in the mines pay to the Sawbwa, Kansi, 10 per cent. of the price they get from the jade merchants. The farming of the jade duty of 33⅓ per cent. *ad valorem*, for the year ending June 30, 1888, sold for £5,000.

SCIENTIFIC NEWS.

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It appears that Comet *d* 1889, discovered by Mr. Brooks at Genova, N.Y., on July [illegible], has been observed by Prof. Weiss, of Vienna, [illegible] already fourfold," the most distant nucleus being very faint, and the whole comet appearing as if enveloped in a nebulous tube (nebelrohr). Accurate records of comets which have broken up in the manner indicated would be interesting, just now especially.

Davidson's comet will require good instruments to pick it up, as when seen at the Algiers Observatory last month it was only of the eighth magnitude, and was decreasing rapidly.

Two more minor planets are announced, but their discovery is not verified. One was found by that adept, Dr. J. Palisa, of Vienna, on Aug. 3, soon after midnight; and M. Charlois, of Nice, reports the discovery of another about half an hour later. If new, they will reckon as Nos. 285 and 286.

Prof. Elias Loomis, whose death is announced from New York, was one of the most distinguished physicists of the United States. Born at Wellington, Connecticut, in 1811, he was educated at Yale College, where he graduated in 1830, and acted for some time as tutor. In 1834, in conjunction with Mr. A. C. Twining, he made the first concerted observations in America on the altitude of shooting stars. Prof. Loomis next made hourly observations for 10 hours per day, extending over 14 months, of the declination of the magnetic needle. He was the first person in the United States to discover Halley's comet on its return to perihelion, in 1835, and he computed the elements of its orbit from his own observations. On his return from studying in Paris he became Professor of Mathematics and Natural Philosophy in Western Reserve College, Ohio, where he remained until 1844 making extensive lunar and other observations. He also observed the dip of the magnetic needle at over 70 stations spread over 13 States, and extending from the Atlantic to the Mississippi river. In 1844 he became Professor of Natural Philosophy in the University of the city of New York, which chair he continued to fill until 1860. During this period he prepared a series of textbooks, embracing the entire range of mathematical subjects taught in high schools and colleges; and they were subsequently extended to include natural philosophy, astronomy, and meteorology. Of this series more than 500,000 copies were sold. The treatise on astronomy has been used as a textbook in England, and with other treatises has been translated into Chinese, Arabic, and other languages. In 1860 he became Professor of Natural Philosophy and Astronomy in Yale College, which appointment he held until his death. For the last 25 years he devoted a large part of his time to original researches, preparing, amongst other things, a very full account of the principles of dynamic meteorology. The titles of his scientific treatises exceed 100 in number. In 1854 Prof. Loomis received the degree of LL.D. from the University of the City of New York, and he was also a member of various scientific societies in Europe and the United States. In 1873 he was elected to the National Academy of Sciences. His best known works are "Practical Astronomy" and "Elements of Astronomy."

Mrs. Lydia S. Bennett, a well-known lady botanist attached to the Fisk University, Tennessee, died recently.

The twelfth annual meeting of the Midland Union of Natural History Societies will be held at Oxford on the afternoon of Monday, September 23. An inaugural address, on heredity, will be delivered by the President, Mr. E. B. Poulton, F.R.S. In the evening there will be a conversazione in the Museum, and the Oxfordshire Natural History Society and Field Club has arranged for exhibitions of objects of interest. On the following day members will drive to Shotover Hill, and a lecture will be delivered by the President on "the geology of the district." Special arrangements will be made for members to visit, on this and also on Monday afternoon, the following places:—Museum, Ashmolean Museum, Radcliffe Observatory, Botanic Gardens, Bodleian Library, and Clarendon Printing Press. The Oxford Society cordially invites members of natural history societies and their friends to the meetings of the Union. Further information may be obtained from the secretary, Mr. H. M. J. Underhill, 7, High-street, Oxford.

At the Jubilee annual meeting of the Royal Botanic Society a resolution was passed requesting the Council to take steps to provide some memorial of Philip Barnes, F.L.S., the founder.

Excursions in America usually involve a good many miles of railway travelling, and it is not surprising, therefore, to learn that the American Association for the Advancement of Science, which meets at Toronto this year, proposes excursions to the Huronian district and to the Pacific Coast.

Under the will of Count Joseph Loubat the Royal Academy of Berlin is going to award a prize for a work published between July 1, 1884, and July 1, 1889, that deals with the European colonisation of North America and the recent history of that continent. Works in English, French, German, or Dutch are eligible for the prize (which amounts to 3,000 francs), and notice of intention to compete must be sent to the Academy before July 1, 1890. Count Loubat's legacy amounts altogether to £1,150.

The Royal Danish Academy of Sciences invites research on the following, among other subjects:—Compounds of alcohol radicals with copper, silver, or gold, and compounds of polyvalent alcohol radicals with metals (all unknown at present). Prize, a gold medal. The fatty acids in the fat of butter; to be isolated and determined and relations indicated, especially between the quantities of oleic acid and those of palmitic acid and their higher homologues. Prize about £32. The Mycorhizæ of the beech. Are they different in different kinds of humus? Does the structure of the mycelium give a basis for classification? Is there a reciprocal symbiosis, the fungus preparing food for the plant, &c? Prize about £32. Memoirs to be sent to Prof. Zeuthen, of Copenhagen, before October 31, 1890, except in the last case, for which the date is October 31, 1891.

An important work on "Fuel and its Applications," by Mr. E. J. Mills, F.R.S., and Mr. F. J. Rowan, is about to be published by J. and A. Churchill. It will be the first volume of a large work on chemical technology, of which Mr. C. E. Groves, F.R.S., will be the general editor, and which will be founded on one written by Richardson and Ronalds, familiarly known as "Knapp's Technology." Messrs. Mills and Rowan's work on fuel is, in reality, a new work, in which the applications of fuel to arts and manufactures as introduced by the most modern discoveries are described.

The herbarium of the late Rev. M. J. Berkeley has been at Kew for several years, and that of Mr. Broome (in many respects covering the same ground) is at the British Museum, to which he bequeathed it at his death. This bequest was accompanied by the scientific correspondence of Mr. Broome, including an extensive series of letters from Berkeley (from 1841 onwards), and a nearly complete digest of the systematic work of Berkeley as well as of their conjoint work.

Dr. W. G. Thompson in a Boston (U.S.) medical paper relates experiments which show that animals can live comfortably in an atmosphere of oxygen until a pressure exceeding three atmospheres is reached; above that pressure various effects are noted, especially a marked decrease in temperature of warm-blooded animals. Experiments were also made for the relief of dyspnœa artificially induced, with the conclusion that inhalation of oxygen does afford relief in some types of dyspnœa. Therapeutically, oxygen was used for the cure of certain general diseases, especially of the blood and circulation, and as a palliative in dyspnœa. He states that about 200,000 or 300,000 gallons are used annually in New York. His own experience was adverse to its employment in anæmia, nor had its use in cardiac disease been encouraging. In certain cases of subjective dyspnœa it gave relief, and he mentions a case of poisoning by coal-gas, where its administration was kept up for three days without any effect on the rate of breathing or cyanosis.

Mr. W. H. Hudleston, the senior secretary of the Geological Society, recently delivered an interesting address as president of the Devonshire Association for the Advancement of Science, in which he discusses the age, origin, and structure of the Dartmoor granite. He fails to find any evidence that will enable geologists to fix the date of this granite more definitely than by referring it to the close of the Carboniferous period.

"Inspector," writing to the *Times* about the neglect of edible fungi in Ireland, with reference to the U.S. Government report (see p. 519), says that in nearly every part of Ireland edible fungi grow in profusion at the very doors of peasants who rarely taste anything more nourishing than potatoes. The fairy ring champignon, the delicious chanterelle, the common mushroom, and the horse mushroom are to be found in the pastures and underwoods, and several other species capable of being dried for winter food abound in all directions. No attempt is made in the national schools, where agriculture is taught to thousands of children, and where they learn, among other things, the "advantages of steam cultivation" and the "relative merits of the three-course and the four-course systems," to point out the difference between harmless and poisonous fungi (these latter singularly scarce in Ireland), and to familiarise them with the value of this most nutritious food. The State authorities at Breslau have issued a warning against the eating of poisonous fungi, adding that all the popular methods of recognising the poisonous character of boiled fungi are deceptive, and that no cookery can render them harmless.

In his report on the Alkali Manufacture, Mr. Fletcher states that it has been asserted that black smoke ought not to be lightly dispensed with; for, that if the combustion in a furnace be so conducted as to prevent its appearance, carbon monoxide would probably be generated and the remedy be worse than the disease. The fact is that the monoxide is invariably present when there are clouds of smoke, and the Legislature acts wisely in pointing out to alkali manufacturers that they are injuring their own pockets as well as the health of the community. As to utilising the waste of the alkali trade, there is good news for the inhabitants of the neighbourhood of Widnes and Runcorn, for a process has been devised which it is confidently stated will enable the sulphur to be extracted, and leave the residue suitable for the manufacture of cement. In spite of all that has been done, there is probably a fortune or two awaiting the successful utiliser of what are now "waste" substances.

Everyone knows that America is the land of invention; it is also the place for discoveries, for we learn that "Benjamin Johnson owns a farm in Rush Valley, U.T., upon which he has just discovered a mine of natural shoe blacking. An analysis of this peculiar material shows that it contains 16 per cent. carbon, 34 per cent. aluminium, and the remainder clay. When taken out the material is moist and soft, and when used as a shoe blacking produces a fine polish, which is not easily destroyed." The "34 per cent. aluminium and the remainder clay" leads to another discovery.

At the meeting of the German and Austrian Anthropological Society in Vienna, Prof. Virchow said that the links proving the descent of man from lower animals had not yet been found, and that a real pro-anthropos had not yet been discovered. We cannot, he said, determine even the descent of single races familiar to us for many hundred years; all human races, as we know, are man-like, and not ape-like. From the examination of skulls and from other craniological studies, it may be concluded that no remarkable change of human types has taken place during the last 5,000 years. Virchow pointed out that the progress of anthropology depended not upon forming hypotheses, but in following the paths of exact scientific research. To-day, he said, we know what we know. Rich material, however, had been stored by anthropologists in the course of the last twenty years, so that it would be possible in the next twenty years to clear up the relationship existing between European nationalities.

One of the latest of the "put-a-penny-in-the-slot" devices is an electric reading lamp, which is being fitted to some of the coaches on the main line of the South-Eastern Railway. The lamp is of five candle-power, and gives light for half an hour for one penny.

Baryta for Rats, &c.—It is a fact not well known that native sulphate of baryta is an active poison to rats, mice, and dogs. It is not easy to explain its action, considering its extreme insolubility; but, mixed with lard, it is readily eaten by them. This being the case, the question suggests itself, whether it might not replace the more dangerous poisons now so much used for this purpose, and do away with the risk attending them.—*Pharm. Jour.*

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

DIRECTION OF LIGHTNING—DATES OF EARTH'S PERIHELION—CRAM: ET DE QUIBUSDAM ALIIS—THE ROTUNDITY OF THE EARTH—A PENDULUM THAT BEATS SECONDS, AND SECONDS THAT BEAT EVERYTHING—LOGARITHMS—RICHTER'S DREAM—MERIDIAN INSTRUMENT (THE DIPLEIDOSCOPE)—JUPITER—METEOROLOGICAL PREDICTIONS—THE COMMISSIONERS OF 1851 TAKING A SITE—THE CHABOT OBSERVATORY IN CALIFORNIA—WHAT DO WE SEE?—THE OCCULTATION OF JUPITER: PARALLAX OF THE MOON—LUNAR SNOW?—RINGED SNAKE—BOTTLED CENTIPEDE—PENDULUM—PARALLAX OF THE SEXTANT—THE LATE PROFESSOR LOOMIS.

[30268.]—As letters on the direction of the lightning flash continue to appear, I perhaps should state, or rather, reiterate, that the late Mr. Proctor never disputed that lightning might strike from the earth to a cloud, as well as from a cloud to the earth. What he did contend was that the duration of the phenomenon was so infinitesimally short, that it was physically impossible for the human eye to detect or appreciate the direction in which the lightning was travelling. After all, though, it is, to a certain extent, a question of *angular* motion, dependent upon the distance of the lightning. Standing close by the side of the line as an express train passes, the impression conveyed is that of a dark amorphous mass crossing the field of vision. Viewing the same train from a distance of a mile the whole form and detail of it is visible enough.

In reply to the question with which "Globe-Trotter's" letter (30227) on p. 502 concludes, the earth was last in perihelion at 4 p.m. on December 31, 1888, and will next be in the same part of her orbit at 7h. a.m. on January 2, 1890.

With reference to what "Vindex" utters anent "Cram" (in letter 30228 p. 502), I can only say that I happen to know something of its operation in connection with the obtaining of commissions in the Army; and I cannot believe that the present race of officers are better-mannered, or, in one sense, better-educated men, than were their predecessors in the days when a man's father needed to be a Bishop or his uncle a Peer, for him to get on rapidly in the service. But, in all my experience, the people who swagger and "put on side," are not the well-born, but the plutocracy. The present system seems to me to be psychologically, what I fancy a severe course of City dinners would be physically—a first-class method of giving its unhappy subject intellectual indigestion.

I must utterly disclaim the compliment paid me by your courteous correspondent, in attributing "encyclopædic learning" to me. As a man of leisure I have been, all my life, an insatiable and omnivorous reader; but I can assure "Vindex" that while I could easily set down all I know on a small sheet of note-paper, a ream of foolscap would not hold all I do *not* know!

Finally, let me assure him that I appreciate Mr. Monck, either as a coadjutor or as an opponent, at least as much as he can possibly do.

Perhaps I may be permitted to quote, for the benefit of Mr. Hampden (letter 30238, p. 506) some beautiful lines of the poet, which I fancy have appeared here in days gone by. They run thus:

Whilst self-inspection it neglects,
  Nor its own foul condition sees,
The kettle to the pot objects
  Its sordid superficies.

I state definitely what I have seen with my own eyes, and, after asking for "some demonstrable data for" my "statements," he goes on to quote an anonymous "passenger on board the *Iberia*," and an equally trustworthy "correspondent," who is "able to affirm" the most childish and ridiculous nonsense. We have all heard of the man who was ready to take his oath to the truth of a certain assertion, but who point blank refused *to bet on it!* I wonder whether these two (seemingly supposititious) authorities would have a similar reluctance to "back their opinions." I made no reference to any tables. I simply stated what I and thousands of other people have witnessed on innumerable occasions. Refraction does make some difference in the distance at which objects can be seen, but not much, and whoever says that he saw the top of the Port Said Lighthouse 90 miles off, or a tower 300ft. high from a distance of 80 miles, is not speaking the truth, whatever may be the interpretation of it. Why, I need only appeal to anyone who has ever stood on the seashore, whether vessels a very few miles off do not get "hull down" as they sail away from the observer, until only the tops of their masts become visible above the horizon; whether the smoke of steamers, themselves wholly invisible, does not rise above it; and whether on a fine clear day ships may not be simultaneously seen, some visible from the truck to the water-line, some hull down, some with parts of their masts only perceptible, and others with their very trucks just disappearing. I am not speaking from hearsay. I have been in the Mediterranean, and stated (in letter 30169, p. 453) precisely what I saw there; nay, I have had a much more instructive experience still. A good many years ago, when the Admiralty and the War Office were discussing the policy of the adoption of Colomb's flashing signals, I was on board of one of Her Majesty's ships with Admiral (then Captain) Colomb on the night when the final trial was to be made. The shore part of the apparatus was fixed on the top of St. Catherine's Down in the Isle of Wight, and we sailed—or, rather, steamed—straight out for Cherbourg, signalling all the way. I verily believe that if Mr. Hampden had been on board with us and watched the top of St. Catherine's Down sink down to the horizon, his common sense (always assuming that he has any) must have convinced him of the earth's rotundity. Perhaps some of my brother correspondents may read these lines at the seaside; if so, may I ask them to watch the shipping in the offing on the first fine day (preferably with a good telescope), and give their experience in these columns. The question has now resolved itself into one of my personal veracity. I shall be glad to know who it is, on whose authority, Mr. Hampden ventures to contradict me, and should like to hear what the captain of the *Iberia* has to say.

Is not the arithmetic of "C. H. R." (in reply 69124) on p. 507, just a little "mixed"? I always imagined that a sidereal day consisted of 23h. 56m. 4·0906s. of mean solar time; and a mean solar day of 24h. 3m. 56·5554s. of sidereal time. If I am right, a sidereal second is only 0·9972696 of a mean solar second. Perhaps your correspondent will work out his own equation, and hence deduce the length of a pendulum to beat sidereal seconds.

"Logarithms" (query 69246, p. 510) has not even taken out his own logs. correctly. His work should stand thus: First to multiply

94·785 × 6·8789
Log. of 94·785 = 1·97674
Log. of 6·8798 = 0·83758

Log. of 652·102 2·81432

Here we say 9 and 9 are 18, 8 and carry 1, and 1 and 1 are 2, as in any other addition. Anything carried from the mantissæ is thus added to the sum of the characteristics. Now for the second example. To divide

0·02132 by 0·098764.
Log. of 0·02132 = $\bar{2}$·32879
Log. of 0·098764 = $\bar{2}$·99460

Log. of 0·215868 $\bar{1}$·33419

In this example we subtract as usual, and say when we get to the first figure of the mantissa, 10 from 13 are 3. Now we carry 1; $\bar{2}$ from $\bar{2}$ leaves 0, and 1 from 0 leaves, of course, $\bar{1}$. Your correspondent had better obtain Law's book on Logarithms, published in Weale's Series. He will learn all he wants to know, and a great deal more, from it. Perhaps I should add that this contains 6-figure tables of logarithms, as well as a full description of their construction and use. If "Logarithms" only needs the latter, he may get Gallatly's "Elements of Logarithms," a little book published by F. Hodgson, London.

Mr. Griffiths (query 69247, p. 500) will find "Richter's dream" in the number of *Knowledge* (79) for May 4th, 1883, and more at length in No. 106 for Nov. 9th in the same year.

If "Meridian" (query 69254, p. 511) will hunt through the earlier volumes of the ENGLISH MECHANIC, he will find his meridian instrument described (under the name of the "Dipleidoscope") over and over again. He may also consult Lord Grimthorpe's book on "Clocks and Watches" in Weale's Series, Britten's "Watch and Clock-Maker's Dictionary," &c.

When I spoke (in letter 30169), on p. 454 of Mr. N. E. Green's valuable contribution to our knowledge of the superficial detail of the planet Jupiter, I very little thought that it would so speedily be followed by so exhaustive a monograph on zenography (or, in strictness, the zenography of 1886-7) as has just appeared. Such, however, is the fact, and there lies before me, as I write, a remarkable monument of the most patient and unwearying observation and measurement of every spot and marking that appeared on the face of Jupiter during the two years referred to, in the shape of a work, modestly entitled "Zenographical Fragments," by that well-known observer, Mr. A. Stanley Williams. The results at which Mr. Williams arrives are of a most remarkable character. To take a single example: By observations of transits of definite spots over Jupiter's central meridian, he deduces from 17 spots in latitude 12° N. a mean period of rotation of 9h. 55m. 36·49s.; from those of 5 spots in latitude 4° N. a mean period of 9h. 50m. 40·06s.; from 21 spots in latitude 8° South a period of 9h. 50m. 22·4s.; while from 3 spots in latitude 30° South he finds that that part of Jupiter's surface rotates in 9h. 55m. 17·1s. The period derived from observations of the famous red spot is 9h. 55m. 40·5s. That different zones of the visible portion of the planet (be it atmospheric or what not), should rotate at such great but varying speed, indicates a condition of turmoil to which our wildest terrestrial hurricanes must be but as the puff of a little child's breath. I do not quote here from Mr. Williams's able and instructive volume for two or three reasons; the first being that it will, of course, soon be in the hands of everyone who has made Jupiter the subject of observation; and next, because it is especially a work of reference to be close to the hand of the zenographical observer, while he is actually at work, and hence does not lend itself to fragmentary extraction from its pages. It is illustrated by no fewer than 51 separate drawings of Jovian detail, in addition to a large chart of the whole of the observed markings during the period covered by the volume. It is simply indispensable to every student of that giant planet, of which it treats in so thorough and exhaustive a manner.

I have in times past more than once invited attention here to the ignominious failures which the predictions then issued by the Meteorological Office so repeatedly proved to be. In common justice, then, I think that equal publicity should be given to the recent remarkable accuracy of the forecasts issued from Victoria-street. It really suggests the hope that the dawn of a *science* of meteorology has begun. Be it well noted, however, that it is to Messrs. Scott and Baillie that we are indebted for this great and manifest improvement. That paltry imposture and excuse for filling the pockets of certain "guinea-pigs," the so-called Meteorological Council of the Royal Society, has had about as much to do with it as I have—there or thereabouts—and were that Council swept away to-morrow, as it ought to be, the forecasts neither could nor would diminish in accuracy in the slightest degree, or the interests of meteorology suffer in any shape or way whatever.

So the Commissioners of the Exhibition of 1851 have begun to hawk their land about as affording (what the advertisements call) "eligible sites for building purposes"; and the quondam scene of the nocturnal gambols of 'Arry and 'Arriet is to blossom into a genteel road 75ft. in width! It seems that the august body to which I am referring did "offer to provide a building for a Museum of Science," and tried to persuade the Government "to establish on" their "estate those institutions ancillary to the teaching of science which are necessary to form a complete system of scientific education for this Metropolis." But alas! charmed they never so wisely, the powers that be preserved strictly the attitude of the deaf adder, and would not listen to their blandishments. Perhaps some member of the Government itself may have possessed sufficient scientific knowedge to be able to appreciate what, as it is, passes at South Kensington for science (falsely so-called), and to decline to be a party to the provision of fresh billets for a new army of cadgers. Be this, though, as it may, the "Museum of Science, et cætera," fell through; and now yet another addition is to be made to the stuccopolis of Brompton, and Chawles and Jeames will loll under porticoes and against railings, where erst the London "cad" smoked his penny Pickwick, and the girl from the pickle factory displayed her fringe and "dress-improver" while watching the fountains lighted by the electric light. Well, well, every dog will have his day, and some fine day John Bull will wake up (long-suffering beast that he is) to the consciousness of the humbug of associating all this kind of thing with the sacred names of Science and Art. Then may, and probably will, the whole of the unoccupied part of the property be built over with houses suited for, more or less smart people, and the Albert Hall be converted into the circus or music hall which is its only legitimate end.

After laying down this precious Report of the Commissioners, it is quite refreshing to pass to the perusal of a very different one indeed: I mean that of Mr. Charles Burckhalter, the head of the Chabot Observatory at Oakland, in California, on the work done there from June 30, 1888, to June 30, 1889. From this interesting document I learn that there were no less than 1,821 visitors to the Observatory during the period specified, who took the liveliest interest in what they saw. These included students from the High School under Prof. Mead, whose attendance is regular. Now, considering the great effect the Chabot Observatory has had in implanting, fostering, and stimulating a taste for astronomy in California, it seems most desirable that some such institution should be established on English soil. I do not know any observatory in this country to which the public are, or, in fact, very well could be, admitted. Prof. Pritchard has certainly done admirable service to education by his lectures and demonstrations at the University Observatory, Oxford; but these are, I fancy, confined to undergraduates, and do not extend to the general public. It is much to be desired that some wealthy and munificent Englishman would found a similar Observatory to the Chabot one, for the use of the people at large, being of course, careful to place it under such competent supervision as should insure its educational value and prevent it from degenerating into a kind of glorified peep-show.

Premising that what I said (in letter 30220) anent metaphysics and logomachy, must not be taken *au grand sérieux*, I would merely remark, in connection with what Mr. Monck says (letter 30239, p. 522), that unquestionably the optician *does* regard the picture on the retina as the thing seen, inasmuch as it is only to the perfecting of that picture that his art can be directed. Upon a cognate principle, to revert to my former illustration, the maker of aural apparatus so constructs it as to set the tympanum in more violent vibration. It is the only link in the chain that he can get at. I have but little to add on the question of inversion, inasmuch as I fail to understand how there can be such attributes as up and down in the mind, save in connection with the sense of touch. If, as I have said before, I have to raise my head and eyes to see part of an object, I call that the upper part of it. If I have to depress them, then I feel, intuitively, that I am regarding the lower part of the object which is impressing my vision. My tactual or muscular impression, so to speak, helps me to interpret my visual ones.

Has it never occurred to Mr. Canning (letter 30244, p. 522) that parallax would displace the moon with reference to Jupiter as viewed from his station, quite irrespectively of the mere local difference of time?—the only factor operating in the observation of such a phenomenon as the eclipse of a satellite.

I will answer the question addressed to me by Mr. Peal (in letter 30247), on p. 523, by saying that I wholly fail to see why the deposits of snow should be *littoral* "on any globe which was approaching a stage of glaciation." Such deposits, I should fancy, would begin on the mountain ranges, and extend downwards until everything was, more or less, covered with them.

"R. G." (query 69293, p. 532) should get some little frogs or, if they are quite unprocurable, earthworms, for his snake.

"Insect" (query 69307, p. 532) need only fill his bottle up again with spirits of wine.

I do not thoroughly understand the reference of "Tempus" (in query 69319), on p. 532, to the figure in Young's "General Astronomy," nor whence he gets his figure of 68; but, as a matter of course, the relative lengths of the steel and zinc rods vary inversely as their coefficients of expansion; so that, assuming 68 to be correct, the result should be 28·65214. The total length of steel to be dealt with is obviously that of the rods *independently expanding in the same direction*, which, in the case of the pendulum figured by Young, would be the sum of the lengths of the outer suspending frame and of the rod passing into the bob. This, I think, but am not certain, is what "Tempus" means.

I must refer "S. W." (query 69333, p. 532) to pp. 107 and 108 of Vol. II. of Chauvenet's "Spherical and Practical Astronomy" for the method of determining the parallax of a sextant, and the application of the quantity thus determined to the correction of observations of near objects. This is too long for extract here. But in my own practice I have generally found that I could get a distant object, vertically over one that was too near, and could measure the angular distance of that from my second point instead.

The death of Professor Loomis must appear almost like that of a personal friend to the thousands to whom his "Practical Astronomy" has formed such a constant book of reference for the last thirty years. While for the purposes of the more advanced mathematician Chauvenet's splendid "Spherical and Practical Astronomy" must always remain as the standard English treatise on the subject of which it treats, Loomis's more compendious précis is unsurpassable as a vade-mecum for the observatory table.

A Fellow of the Royal Astronomical Society.

THE OCCULTATION OF JUPITER.

[30269.]—I OBSERVED the occultation of Jupiter at Wells on the evening of August 7th. At 6.45 I found the planet easily with a 2in. telescope, power 65. At 7.4 by the cathedral clock Jupiter came in contact with the moon. The curve of the moon's limb was clearly defined as she passed over the planet's disc. Jupiter disappeared at 5min. 20sec. past 7 o'clock. The angular diameter of Jupiter at the time was about $\frac{1}{30}$th of that of the moon. The planet made its reappearance on the bright side of the moon at 7.58, and at 7.59 and 20sec. the whole of Jupiter's disc was visible. The fourth satellite, which was nearly at its greatest eastern elongation, reappeared about 7.43. The disc of Jupiter was covered with belts, which appeared very dark; but this may have been the effect of contrast with the bright surface of the moon.

When the moon was about to leave Jupiter, I was struck by the appearance of a slight haze on the disc of the planet nearest the moon, which seems to indicate that the moon has a slight atmosphere. I am not the only one who observed this phenomenon. "S. S." in his letter (30245, p. 523) observed the same at Southampton, and says:—"As reappearance advanced, the surface of the planet was more dull at the immediate side of the moon than at its own off edge, resulting no doubt from the contrasting and unequal light of the contiguous bodies."

Since the above observations were made, I have been looking over the "Memoirs of the Royal Academy at Paris," and I find that a similar phenomenon has been observed by astronomers at the occultations of *Venus* by the moon.

The observations made on the morning of July 27th, 1753, at the Royal Observatory, by M. de Thury, are as follows:—"As Venus approached the illuminated limb of the moon, the concave edge of her crescent, which was turned to the convex limb of the moon, became tinged with red, and of a quite different complexion from that of the convex edge, and that this tinge increased as Venus advanced nearer to the moon."

This phenomenon was observed at the same time and place by M. Maraldi and M. le Gentil. The former writes:—"Some seconds before the horn touched the moon, a red colour extended from the moon's limb to the illumined and concave part of Venus."

The latter says:—"About a minute before Venus was hid by the moon, the hollow edge of her crescent was tinged with a lively red. This phenomenon, before taken notice of by several astronomers, is worthy of consideration." It would be interesting to hear from others whether they observed the slight haze observed by "S. S." and myself, and state their opinions regarding it.

Bristol, Aug. 19th. **J. Webb.**

[30270.]—This was well seen by me from a high station in Switzerland. Not having an accurate time-measurer at hand, no account was taken of the moments of disappearance, nor of the time occupied in the transit of the moon's limb across the planet's disc, which was about a minute and a quarter; but as far as a small telescope of 1in. aperture could show there was no distortion of form during the disappearance at the dark limb. The curvature of the moon could be clearly traced on the diminishing disk, and the planet could be seen until reduced to a mere point. Upon the reappearance, however, there was apparently great flickering and irregularity in the form of the emerging planet, with a decidedly oval shape to the disc when first finally free from the moon. How much of this appearance was due to irradiation and to the smallness of the telescope I cannot say. Very likely the whole was thus produced, but the possibility of the existence of a slightly refracting medium of some point raised from the lunar surface by the solar heat, but absent upon the face turned away from the sun, was a natural deduction. I regretted not having a larger instrument at hand, and shall be glad to read the accounts of those who were thus fortunate. The sky was perfectly clear, and the air steady. **F. B. Allison.**

DAVIDSON'S COMET.

[30271.]—WHILST sweeping the western heavens on the 15th inst., I picked up a "suspicious object" at about R.A. 15h. 34m., and N. decl. 14½°. I could not identify it in my list of nebulæ, so immediately wrote Mr. Denning, our director (comet-sweeping section of the L.A.S.). He writes me: "The object seen on the 15th in the head of Serpens is Davidson's comet."

I saw on the 16th your position, given in "Scientific News" for this comet, and as the observed position on the 15th is very near your predicted position, I conclude the "suspicious" object was Davidson's comet.

My reason for writing is to put possessors of small apertures on their guard, as I picked it up with a 3¼in. refractor, power 30. It is pretty large, bright, and with a tail pointing from the sun, and fan-shaped. As the moon was up at the time I observed it, the real shape of the tail was missed, no doubt. Circumstances have not been favourable for reobserving this object here since the 15th inst.

Leeds, Aug. 19th. **David Booth.**

ζ BOOTIS, ETC.

[30272.]—I HAD not the slightest idea in letter (30200) of casting any doubt on Mr. Sadler's knowledge. He has forgotten ten times more astronomy than I shall ever know. I am not alone, however, in thinking ζ Böotis closer than the estimated distance, and also the angle larger. I presume ζ Coronæ in Mr. Sadler's letter is a misprint for η; but the same error has crept into the Star Guide. I thank him for further measures quoted.

Mr. Peal—letter 30247—will excuse me objecting that as to heat, atmosphere, etc., of Mars and Venus, that what he puts in is not evidence, but only deductions from theories themselves unproved. M. Flammarion draws very different inferences as to habitability of these two planets, and thinks upon sufficient grounds. I differ from both in simply thinking we know nothing about it. But really Mars is, apparently, much covered with clouds, and three-fourths of the supposed maps are due to these clouds in combination with bad seeing. I think South's 11¾in. achro. which dichotomised a star on emerging from occultation by Mars, had a large residuum of uncorrected spherical aberration. I do not see why we should suppose snow to be of a different constitution on Mars to what it is here. If so, it is not snow. Perhaps it is pyrogallic acid. As to his question *re* lunar surfacing, I am not the promulgator of a theory as he is—I think we do not know enough to come to a conclusion; but my inability to frame a satisfactory theory in no way proves his to be correct. How can snow stand fourteen days' continuous sunshine?

Edwin Holmes.

LUNAR REFLECTIONS.

[30273.]—THE striking reflections of the Lunar disc from adjacent vapour which appeared on the 13th inst. were clearly seen at Portland, and from many places on the S.W. coast. Mr. C. Grover thus describes the phenomenon as seen from Sir Hy. Peek's observatory: "About 10 o'clock on the 13th two bright mock moons were observed, one on each side, and about 20° distant from the real moon, the three lying nearly in a horizontal line in the E.S.E. The northern one was particularly brilliant, and beautifully tinted with rainbow colours. A bright and long vertical ray was seen passing through the moon at the same time."

Aug. 19. **W. R. Waugh.**

OBSERVATORY.

[30274.]—MY attention has just been called by a friend to the query of "G. G. B." (69051) on page 422 of the current volume, and I must crave indulgence for not replying sooner, as I do not often (much to my regret) see the ENGLISH MECHANIC now.

With regard to building an observatory at the top of a house, perhaps my experience may be of some service to "G. G. B.," seeing that for something like 15 years my *only* observatory was on the housetop, in the centre of a large manufacturing town, with its usual complement of traffic, dust, and smoke. I am quite aware that amongst astronomers there is a consensus of opinion as to the utter unsuitability of such situations for telescopic work; and, had I been influenced by what is written in the ordinary textbooks, I should, in all probability, never have pursued the study of the "sublimest" science at all. As it is, I have used here a number of telescopes, refractors and reflectors, from 2in. to 11¼in. aperture, during that period, and I can safely say that some of the happiest hours of my life have been spent in this elevated retreat. The greatest obstacle to my comfort was the close proximity of a chimney-stack on the south-west; but, by watching my opportunities, this particular nuisance was to a large extent circumvented. As to tremors arising from traffic in the streets (for the house was a corner one, at an important crossing), I cannot, of course, say how it would be in London; but here the heavy business traffic was over by 8 p.m., and I was only troubled by occasional passing cabs or light vehicles after that hour. Considering that the streets were rather narrow just here, and that the paving was granite setts, the tremors were not so violent as might be imagined, and they soon subsided. I was often struck with the fact that, whilst using a simple telephonic connection to my sidereal clock (for taking transits), I could *hear* the rumble of a distant vehicle long before the vibration affected the star. I may say that after a great number of alterations to suit the gradual development in size of the telescope, I finally adopted the "Berthon" form of observatory, and prefer it to any other. It is quite safe against storms, even in an exposed situation like this, and mine has never suffered accident yet—notwithstanding an additional danger of fire, as the canvas roof is within a few feet of the aforesaid chimney. One of my earlier arrangements to cover the 11¼in. reflector (before I had any shelter in the shape of a roof) was a travelling carriage running on rails; which, when not wanted, was run through a movable part of the wall, and out on a pair of light wood girders—this was very convenient to use, and effectually sheltered the telescope, though it left the observer in the open. For years I did my observing all out on a plain platform, with merely a wall around; but the shelter of a simple observatory is infinitely preferable, for the comfort of the person, in every way—nor did I ever discover the slightest prejudice to the performance of the instrument by its being under cover; indeed, I thought the reverse.

As to material, I should certainly not recommend brick, and corrugated iron I don't like—especially in frosty weather. Woodwork is, in my opinion, the best—certainly the easiest to fix, and if well painted at regular intervals it will last long enough for most people. Take care to insulate the telescope stand as far as is possible from the floor of the observatory; it will be appreciated when using high powers.

Now about the roof. The revolving form is, of course, the most convenient, though in this case it might not be so applicable as a sliding one, the space not being square, and 8ft. 10in. would seem too small for a reflector to work comfortably in.

"G. G. B." has omitted to say anything about aperture and focal length of his telescope, factors which ought to be taken into consideration. If the "Berthon" roof be chosen, then I can suggest an improvement over canvas as the covering, and that is sheet zinc, which a friend of mine adopted (in an observatory at the top of his house, some 60ft. above street-level) with complete success. It is safer against fire, which, in the immediate presence of chimneys, is a matter not to be neglected. If I have not been sufficiently explicit I shall be happy to supplement these remarks by any further information that "G. G. B." may desire. Before concluding, I cannot refrain from noticing the reply of "C. M." (p. 443), in which he says than any power over 60 would be useless in such a situation as that described. "C. M." may think so, but I can assure him that I have frequently used powers of 400 and 500 diameters with advantage in my housetop observatory! **W. S. Franks.**

FLATS FOR REFLECTORS.

[30275.]—IT may be convenient to your numerous readers, who are the architects of their own telescopes, to be in possession of two neat and convenient formulæ for finding the right place of a flat of given size, and also the size of a flat for given aperture and distance from focus. (1) The semi-minor axis of the flat is determined by

$$\frac{b\,(m-a)}{d}+a$$

Where a = radius of solar image at focus (which may be found by multiplying ·00465 by the focal length of the mirror); b = distance at which it is proposed to place the flat from the focal plane; m = semi-diameter of the mirror; d = focus of the mirror. (2) To find the distance from the focal plane at which a flat of given size is to be placed, the formula is—

$$b = \frac{(c-a)d}{m-a},$$

c being the semi-minor axis of the flat.

This formula was brought to my notice by Mr. Linscott, but may directly be deduced from the reasoning in my paper on this subject in the Liverpool Astronomical Society's *Journal* for May last.

John Bone, F.R.A.S.

S. Thomas' Vicarage, Lancaster, Aug. 19.

THE FULLER CELL — INDUCTANCE (SELF - INDUCTION) IN MAGNET COILS, &c.

[30276.]—IN Mr. Allsop's "Practical Electric Bell-Fitting" the description of the above cell is somewhat misleading. When the cell is wanted for immediate use, the porous pot is charged with dilute sulphuric acid, otherwise water alone may be used (or zinc sulphate sol.); but it must be borne in mind that sulphuric acid is ultimately formed there.

A cone-shaped zinc with insulated wire passing up through the liquid is *never* used; there is always a rod as well. The principal object of the cone is to act as a foot, so that the rod shall stand upright in the porous pot, also that the mercury in which the foot stands (to the depth of about ¼in.) may have every facility in its climb up the rod. In large cells, a "lump" of zinc is sometimes suspended in the porous pot, the top being hollowed to hold the mercury.

In a Daniell, it is well known that metallic copper is deposited on the exterior of the porous pot at those points where the zinc may be touching interiorly. Just the same occurs in the Fuller (chrome alum crystals being deposited) if the zinc is allowed to touch the sides of the pot. This deposition causes the porous pot to crack—clearly a very serious thing in most double cells, except the Leclanché, where it is rather an advantage, as lessening the internal R. It is essential that the porous pot be paraffined, especially at the bottom, where Mr. Allsop would have it unprotected. I gave very full reasons as regards this some time ago; but I cannot exactly say in which number. However, they will be found quoted by Mr. Bottone in his book on "Electric Bells," apropos of which the author has wrongly illustrated the Fuller cell, the unfortunate zinc cone and insulated copper wire being there depicted.

In working the Fuller the following notes may be found useful. Whenever the porous pot solution becomes bluish in colour it is an indication that solution has entered from the outer cell—a bad thing for the zinc rod. Some of the liquid should be removed with a syringe, and fresh water added. The bichromate or chromic-acid solution should always give a deep orange colour (this test and the foregoing is made by merely inserting a strip of white paper); if otherwise, it is an indication that the solution is weak, and requires resuscitation in the form of fresh crystals or compound. If chromic alum crystals (dark red) form on the carbon plate, the solution is supersaturated, and water must be added.

This cell is in great favour with the P.O. and with the principal railway and cable companies, having gradually ousted the Daniell on account of its high E.M.F. I have had to correct a correspondent this week, who would credit the Fuller with only 1·5 volt.

The term *inductance* is now used instead of self-induction. The inductance, self-induction, or spurious resistance of a circuit, is measured in secohms; the ohmic or true resistance in ohms. The total resistance, i.e., the sum of the inductance and the true resistance (secohms + ohms) is called the *impedance* of a circuit, but I believe there is as yet no definite unit of impedance.

If "H. C. H." will examine a proper Wheatstone's bridge diagram, he will find that there are two keys, one in the battery circuit, and the other in the galvanometer circuit, the function of the latter being to nullify these observed effects of inductance in question. In practice the two keys are combined in one, the depression of which closes the battery circuit first, and the galvanometer circuit immediately after; on raising the key the galvanometer circuit is of course opened first.

This "bridge key," as it is called, may be tapped down as sharply as one likes, yet the extremely small space of time which intervenes between the closing of the two circuits is amply sufficient for the inductance to occur and die away. Obviously these keys are essential for accurate work.

W. Perren Maycock, A.I.E.E.

HELIX ACULEATA.

[30277.]—Whilst staying at Truro I found five H. aculeata in a lane under some dead leaves. The locality was about half-way between Truro and Rosedale, and about a mile from either. This is, I believe, the first recorded find in Cornwall.

Frederick H. Harvey.

41, Hugh-street, S.W.

SHOES FOR HORSES.

[30278.]—I have read with interest the views of your correspondents as to the best shoes for horses, but think they are on the wrong tack. Why are our horses to be shod at all? Is a horse's hoof less perfect than the various other parts of his structure? I think not.

The late Rev. J. G. Wood was a strong advocate for using horses barefoot, and he wrote a book—"The Horse and His Owner," I believe—on the subject. "Horses and Roads," by "Freelance," is written in the same strain, and is, if possible, more convincing, as the writer seems to be a man of large experience with horses.

Being persuaded that their ideas were correct, I have applied them to a pony, which has now gone barefoot for a year, and the experiment is thoroughly satisfactory. He never gets tender feet, never stumbles, and his hoofs are in perfect condition. I do nothing to the hoofs, but let them wear as nature intended. The pony has been driven almost every day, and over the roughest and worst roads round here, the result being to me proof of the needlessness of shoeing his kind.

Dorset. **H. S. S.**

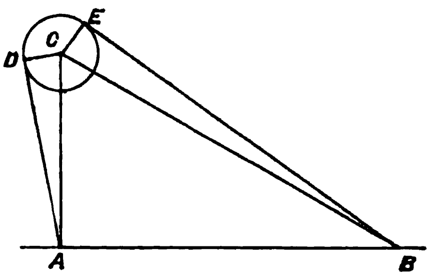
WHAT DO WE SEE?

[30279.]—We see the outward projection of the reversed minified centralisation felt by the retina. By a reversed minified centralisation is meant a focus. A focus is the narrowest point of the fascicule stack or pile of rays where a larger area is twisted and reconstituted into a smaller one. An eye is a converging instrument, since it embraces in a small space a view that might extend miles in area. That view miles in area is projected upon the retina, minified by a converging lens. A converging lens does not focus till the point of reversion is past. If an eye did not receive a minified image it would have to be as large as the landscape. It would be a mirror. The landscape could be reduced by a concave lens, but that would be seeing the larger area smaller, whereas by a converging lens the minification is inverted, but it remains outwardly upright and its own size. The brain needs no training to see erect with an inverted image, because it is a physical fact that an image projected through a convex lens is inverted—the reason for placing slides in a magic lantern upside-down. The question should be formulated, What does the eye feel, and not what does it see?

Author of "Is Bad Sight on the Increase? The Philosophy of Sight."

A FLAT-EARTH PROBLEM.

[30280.]—The following problem, one of my own, which appeared some years ago in a leading Newcastle paper, may interest those few readers of the "E. M." who hold to the belief that the surface of the earth is a plane. The solution, as will be seen, involves nothing more difficult than elementary trigonometry. To render the figure clear, I have exaggerated the diameter of the sun.



Question.—Assuming (1) that the surface of the earth is really a plane, A and B being points on that plane 1,213 miles apart; (2) that the sun is a globe with its centre, C, in the zenith of A, and at a height above A of 700 miles—the height given by the philosopher "Parallax"; (3) that the sun's apparent disc subtends at A an angle of 32 minutes. What angle must the sun subtend at B?

Solution.—Join A C, B C, and from A and B draw tangents to the circle which represents the sun, touching that circle in the points D and E respectively, and join C D, C E. Then the angles A D C, B E C are right angles; the angle C A D measures 16 minutes, since it is half the angle subtended by the sun at A; and we have to determine the angle C B E.

Now CD, the sun's radius, = A C × sin. C A D = 700 × sin. 16′ = 3·258 (miles) nearly. Also B C = $\sqrt{AC^2 + AB^2}$ = 1,400, and sin. C B E = C E ÷ B C = 0·00233 = sin. 8′, very nearly. Hence, twice the angle C B E, or the angle subtended by the sun's disc at B, is 16 minutes. That is to say, the sun subtends at A twice as great an angle as it subtends at B. It follows from this, that to an observer at A the sun's disc appears—or, at least, *ought* to appear, were the assumptions here made correct—four times as large as it does to an observer at any point B, distant 1,213 miles from A.

Charing. **J. R. C.**

AMERICAN ORGAN v. HARMONIUM.

[30281.]—Would it not be as well to have some definite idea of what is meant by "expression" before this discussion closes? As the matter stands, some correspondents have implied that expression cannot be obtained on the American pattern of the free-reed instrument, and on the other side another correspondent has pertinently asked "why?" So far I have seen no answer. As one familiar with the construction of both the American organ and the harmonium, I am at a loss to know what can be meant, for surely what is possible on the harmonium must also be possible on the A. O. In the harmonium the wind goes direct from the feeders to the well, or wind-chest, and thence enters the reservoir, the springs of which tend constantly to force it past the reeds. When the expression stop is drawn, the connection with the reservoir is closed, and the wind goes direct from the feeders to the reeds, which are thus brought, so to speak, in direct contact with the player's feet. In the American organ the wind is exhausted, or drawn through the reeds by the so-called feeders into the reservoir, and there is no difficulty whatever in preventing the reservoir closing, any more than there is in preventing the harmonium reservoir expanding. It is certainly the fact that in the A. O. you cannot get more than the pressure of the atmosphere (air rushing in to fill a vacuum), while in the harmonium you can put a good deal of pressure on the reeds, *à la* Harry with his concertina; but is that any special advantage? What is meant by "expression"? If I have not much misunderstood Mr. Audsley's articles on the organ, he obtains "expression" by means of "swells," and if "expression" means the ability to give every note in a register in staccato, then I say that can be done on the American organ quite as well as it can be done on the harmonium. Mere swelling (crescendo and diminuendo) I do not understand as "expression," but the ability to accentuate any and every note. I have heard many who fancy they can play talk loudly of this "expression," but when tested all the "expression" they could get out was simply a sort of jerky kind of sounds, which they doubtless considered music, but which were anything but "music" to the listeners. I have no doubt that those who have written on this subject in your widely-circulated pages are "past masters" in the art of "expression"; but I should like to hear them before I praise or condemn. I have known players with a jerky, jumpy, tiddle-um-dee sort of touch talk very loudly about "expression"; but as to giving the idea of the composer, they were as far off as I am from the moon, and I am quite sure I am not a lunatic.

Mus. Bac.

[30282.]—My opponents have now fairly admitted all my contentions except the main fact as to whether the A.O. has or has not expression; but as one correspondent admits that people who buy American "organs" do not care for expression, *cadit quæstio*. I have never perceived either expression or "pipe-like tone." It is not for me, but for my opponents, to state why the expression stop is not applied. All that I have to do with is the fact that in the hundreds that I have seen and tried not one contained it. I presume that since the mechanical difficulties are *nil*, it is inadmissible, because at the first attempt at power or passion the mawkish dribble of sound would merge into the strident but virile harmonium tone.

American "organs" are not dearer than harmoniums. My semi-professional connection with music causes me to be flooded with circulars offering them to me at 50 per cent. discount and even more. That, and advertisements, constitute the whole cause of the commercial success of these machines. Here is a specimen from a London paper last week: "American Pipe-Organ for sale, stops, full organ," &c. This is our friend, a "combination of pipes and reeds," I presume, with a "pipe top." I suppose we must call Bach, Mendelssohn, Best, &c., mere "pipe-organists" now, in deference to the American "organ."

Denbigh, 15th August. **Thomas Casson.**

[30283.]—Your correspondent G. Fryer once more asks why I don't reply to the letter of "Organon," and I once more reply that I have no back numbers, and have not seen the letter. It is hardly worth while to enter into a controversy with a writer who refers to the knee-swell as a "substitute" (?) for the expression stop. The knee-swell gives the power of playing loudly or softly, but gives no power whatever of true expression, and, therefore, it can be no substitute.

998.

DIPLEIDOSCOPE.

[30284.]—The base of an ordinary dipleidoscope (see letter 30261) is a trapezium of which the W., N., and E. sides are at right angles to each other, and the fourth side slopes about 37° to west of south. the N. side measures about 2″, and the E. and W. 3·3″ and 1·8″ respectively.

The "two images of the sun" are not both "reflected from the internal surfaces of the prism." One of them is, but the other is reflected from the outer surface of the front glass. I obtained at Dent's some 5 years ago a pamphlet descriptive of the instrument, with all directions for fixing, and this I will lend to "Meridian" if he will send his address to me at Davis's Library, King's College-road, N.W. **J. K. P.**

TECHNICAL GAS ANALYSIS.

[30285.]—As some of our readers may have to make periodical tests of coal gas and other products, I thought it would be of interest to bring a few of the latest researches before their notice. It is well known that in technical analysis of gases carbon dioxide is absorbed by caustic potash, carbonic oxide by cuprous chloride, heavy hydrocarbon by bromine or fuming sulphuric acid, oxygen by alkaline pyrogallate. Benzene is usually absorbed by fuming nitric acid, and marsh gas by combustion. The absorption solutions are the same whether Orsat's, Hempel's, or other apparatus is used.

Carbonic oxide is usually absorbed by acid cuprous chloride, and Hempel has pointed out that the volume of gas is sometimes increased instead of decreased. He suggested that ethylene is sometimes absorbed, and then liberated by a fresh volume of gas, but Duschmidt has shown that the phenomenon may take place in the absence of ethylene or other heavy hydrocarbon, and maintained that the explanation is given in the state in which CO is held by cuprous chloride. He also noticed that the phenomenon is more noticeable in a hydrochlric acid solution than an ammoniacal one. Duschmidt has latterly shown that an ammoniacal solution is the best for absorption of CO.

Clemens Winkler's researches on the estimation of heavy hydrocarbons and benzene show that fuming sulphuric acid quickly and completely absorbs ethylene and benzine. Fuming nitric acid absorbs ethylene nearly as well as fuming sulphuric acid. Bromine acts rapidly on the heavy hydrocarbons, but not completely. I may say here that bromine as a reagent for heavy hydrocarbons has never given good results in my hands. Finally, fuming sulphuric acid is the best reagent for absorption of ethylene and benzene. It cannot be used to estimate their respective amounts. Treadwell and Stokes (*Ber.* 21, 3131—3133) have clearly proved that red fuming nitric acid absorbs carbonic oxide and carbonic acid quantitatively. Berthelot has, however, described a method of estimating benzene in coal gas (*Bull. Soc. Chem.*, 1888, 660—662.) Winkler (*Zeit. Annal. Chem.* 28, 269—289) describes a new pipette for estimating methane by passing a current of electricity through the gas mixed with an excess of air. The pipette is similar to Hempel's tubulated one, but contains a cork with two holes for the insertion of two brass rods, with which a spiral of platinum wire is connected. CO_2 is absorbed by KHO. Heavy hydrocarbons by $H_2S_2O_7$. Oxygen by alkaline pyrogallate, and carbonic oxide by ammoniacal cuprous chloride. The hydrogen is then burned by passing over platinised asbestos. The marsh gas is then burned by the above apparatus, and the CO_2 produced estimated by absorption. In conclusion Winkler describes a test capable of detecting $\frac{1}{100}$ millegram of CO.

Cuprous chloride is dissolved in saturated solution of common salt, and the gas passed through. The solution is then diluted four or five times, and a drop of sodic palladious chloride added, which will give a black spot if 0·01cc of CO were present.

The Laboratory, **J. A. Wilson.**
near Bury, Lancashire.

SOME LITTLE KNOWN PLANTS OF THE FLORA MEDICA.

[30286.]—Podophylleæ.—The original nomenclature of Anapodophyllum (literally "Duck's Foot Leaf") has been changed and abbreviated. P. peltatum of the United States (May apple) has long supplied the drug podophyllin, that well-known hepatic and cathartic medicine spoken of as "vegetable calomel" by the American practitioners. Over half a century ago that illustrious Oriental botanist, Dr. Wallich, discovered P. Emodi at an elevation of 10,000ft. in the north-west Himalayas. Subsequently specimens were forwarded to the Indian Committee, but the quantity was too small for requisite experiments. Then P. hexandrium was discovered by Dr. Falconer, in a different locality, at 12,000ft. elevation. Recently the following report has been published, and an unlimited supply is promised:—"Dr. George Watt, C.I.E., has made a discovery which seems likely to provide the hill tribes of the higher Himalayas with a lucrative trade, and to supply the medical profession with an abundance of podophyllin, a drug which, as many Anglo-Indians have good reason to know, is a valuable specific in disorders of the liver. Hitherto America has enjoyed a monopoly of the podophylln plant (Podophyllum peltatum), but the researches of Dr. Watt and the analysis by Dr. Hooper, Quinologist to the Madras Government, demonstrate that the Himalayan variety (Podophyllum Emodi) yield three times as much of the valuable resin as the American root, and that it possesses the same medicinal properties. This valuable plant grows wild in the higher, rich and shady temperate forests from Sikkim to Simla, Cashmere, Hazara Thibet, the Kuram Valley, and Afghanistan. It is fairly plentiful on the northern forest-clad slope of the familiar Shalai hill, seen from Simla; on the almost equally well-known Nagkanda hill; and in the Chumba State there are many mixed foreests with their glades almost exclusively covered with this peony-roselike herb. In his notes on the subject Dr. Watt remarks that it is surprising that the natives of India, who have discovered so many drugs, should hve failed to detect the properties of the podophyllum root."

Eos.

UPON THE BEHAVIOUR OF A SPHERICAL MIRROR USED ASTRONOMICALLY.

[30287.]—I have found the above worth consideration, and the results I have obtained may interest others. I began by desiring to calculate the diameter of the circle of least confusion of the rays crossing near focus; but the idea struck me that it would be much easier, and probably quite as exact, to make a sketch of the ray paths from different zones on a greatly enlarged scale. I determined to inquire into the results for a 10in. mirror of 80in. focus, and to enlarge the focal crossings 160 times. My sketch, then, is of a mirror 1,600in. diameter and 12,800in. focus. Any small error in drawing is thus 160 times greater than in a 10in. mirror, and the results applied to a 10in. are 160 times more accurate than if drawn to scale.

I calculate that the aberrations on this scale extend to 6¼in. altogether; but without going into that, I propose simply to state results. What follows applies to a 10in. mirror of 80in. focus. The circle of least confusion is situated $\frac{1}{36}$in. within the central focus, and is $\frac{1}{850}$in. diameter; but I found a considerable condensation of light at a point $\frac{1}{33}$in. within central focus. This would be an apparently better focus $\frac{1}{1700}$in. diameter, but surmounted by stray light $\frac{1}{560}$in. diameter; but I found again, still nearer the central focus, a point of greater density in centre surrounded by a larger circle of nebulosity. I find this latter point $\frac{1}{80}$in. distant from central focus and diameter of dense part $\frac{1}{5120}$in. If one were observing a close double star, it is certain this would be selected as best focus, since small discs would be obtained, and the stray light of the surrounding zone not very noticeable. Now, this $\frac{1}{5120}$in. is a near approximation to the actual diameter of spurious disc of a star in a perfect parabolic 10in. mirror, and it would thus appear that a totally uncorrected spherical mirror would divide a close equal double, nearly, if not quite, as well as the most perfect mirror would. The difference would be, that one would be free from stray light and the other have a good deal. If star examined was not bright, this stray light would hardly be noticeable. But when we come to an unequal pair, the stray light would obliterate the small star, and round bright ones the surrounding diffraction rays would be obtrusive, because in the diffused portion surrounding the focal point the conical shells of light are so nearly parallel they interfere and produce alternate circles of light and darkness.

I had now learnt much more than I expected at starting; but it so happens that I had been trying a mirror whose behaviour puzzled me. I could get beautiful little discs and strong diffraction rings to stars, and divide close pairs well—if equal—but see a faint star very near a large one I could not. It seems to me I have found the explanation. I have been trying a mirror either a perfect sphere or not very far removed from one, and have obtained exactly the results to be anticipated. I got the stray light also; but the clean rings sharp and bright, even when air was much short of steady, were the greatest interference to seeing unequal pairs. It is evident that all I have stated applies, in a proportionate degree, to partially-corrected mirrors, just as they approach to or deviate from the sphere.

Edwin Holmes.

Peanuts.—According to a correspondent of the New York *Evening Post*, 3,200,000 bushels of peanuts are consumed in this country every year. They come chiefly from Virginia and North Carolina, although Tennessee also produces a small crop. "Peanuts are planted at corn-planting time. Each kernel produces a running vine, like crab grass, and each root produces about twenty pods. When ripe, the plough is run through the loamy soil, on a dry day, just before frost. The nuts are dried and shocked up like corn to keep dry before housing. When marketed they go to a cleaner, where they are put through steam power machines and polished, after which they are graded according to size and variety. This year there is but two-thirds of a crop, and they are higher in price than since 1884. The crop begins to come into the market about the first of September. The Virginia nut is the largest and finest. The Wilmington is a smaller sort, and the Spanish nut, a still smaller variety, is one whose kernels peel perfectly clean, thus making it valuable for confectionery."

Rolling Liquid Metal.—Among the interesting and successful of recent inventions is a rolling mill for producing sheet metal direct from the molten state, instead of rolling it from a billet or bar. A machine of this character has been at work for several months at the can factory in Maywood, near Chicago. It is used for making sheet solder 6in. or 8in. wide, and $\frac{18}{1000}$in. thick, which it produces at the rate of 400ft. a minute. The apparatus consists of hollow rolls with cold water running through them. The water is introduced through the axles, and the rolls are of sufficient size to at once change the jet of melted metal into solid form as fast as it is fed. The powerful compression exerted by rolls upon the molten metal in forcing it between the two surfaces, and at the same time changing it to a solid body, tends to give to the sheet an even and highly finished surface. The inventors of the machine believe that the principle could be successfully applied to the rolling of Bessemer steel, as well as to softer metals. Mr. O. W. Potter and other officers of the North Chicago Rolling Mill Company recently examined the machine, and expressed themselves as being favourably impressed with its work.

A skilful cork-cutter can produce from 1,500 to 2,000 corks a day, his only tools being two sharp knives with broad blades. Machines have been out which turn out about 2,000 corks an hour; but they are useless for the cutting of the finer varieties.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64616.]—**Mill Bills.**—The question as to how to temper mill-bills has often exercised some of your readers; but here is at least an authoritative decision which I found in the Answers to Correspondents column of a well known and rather ancient family paper. Henceforth there is no room for argument! "The art of producing steel picks of the right temper is one to be gained only by long practice and experiment. There is no royal road to it, and we should be deceiving you were we to give you formulæ, &c., for tempering solutions. A skilled man will do exactly what he wants with fire and water alone; and an unskilled one will fail with the most elaborate means. One thing is absolutely certain, and that is, that it is not possible to bring back burnt steel. It has undergone chemical and physical changes, and nothing short of remaking, or, in other words, treating it as so much raw material, is really efficient. As to tempering, hardness depends on rapidity of cooling—hence the substance of greatest capacity for heat or greatest conducting power will prove the best hardener. Water has great capacity for heat, and is for all purposes the best thing to use. Mercury, on account of its great conductivity, if used in sufficient quantity, will cool more quickly than water, and produce even harder and more brittle steel; but for practical purposes it is out of the question on account of its cost and the deleterious effects that would speedily ensue from its use in a workshop for such a purpose. To get at the proper temper, we should proceed somewhat as follows:—Forge, heat, and harden a pick in ice-cold water—a mixture of crushed ice with a little water well stirred, and in bulk a gallon for every pound weight of the forging—scour clean with a little vitriol and sand, and then wash well and dry. This should then be tempered by heating to about 430°-460° Fahr. This is best done in a metal bath melting at the desired temperature; such a bath is given by a mixture of 17lb. of lead with 8lb. of tin. This should be put into an iron pot and carefully melted, but not overheated. Plenty of the metal should be used—ten or twenty times the weight of the forging; a little tallow or heavy petroleum-oil, vaseline, or paraffin-wax should be allowed to lie on the top of the melted alloy to prevent it from oxidising. When melted, stir well with a stick, remove from the fire, or damp the latter with ashes and introduce the forgings; let them lie in the bath, continuing to stir for five or ten minutes; then take out and cool. Now test the pick; and, if it is too hard, add a little more lead to your bath—if too soft, add a little tin. The right proportion will be somewhere between 14lb. of lead to 8lb. of tin, and 28lb. of lead to 8lb. of tin. We think the proportion we have given (17-8) will not be far out. Having once got this metallic tempering-bath right, use good steel; and do not burn it. If you do, throw aside and start afresh, and you will soon produce picks of uniform quality." E. P.

[68798.]—**To Clean Shells.**—First wash them clean, using hot water, and for those strong enough to bear a good rubbing, use a well-soaped brush. Having procured a small bottle of muriatic acid, and another nitric acid, pour a few drops of each upon the shell—you of course understand that a delicate shell must be treated with a very small quantity: these acids quickly begin to bubble and eat away the outward skin. Watch, not to let the operation go too far, and keep the brush and soapy water at hand for frequent rinsings, as the shell becomes clean. When enough, give a final washing and dry with a linen cloth, placing the shells in a warm place till all moisture is removed. Whorled shells must be stuffed with a soft rag and stood upright to drain for some hours. Shells like mother-o'-pearl have a natural polish which you bring out by light, quick rubbing—an old pocket-handkerchief being useful for this purpose. Oil is very, very seldom needed, nor any other nostrum. I speak from experience of many years' residence on a shelly sea-coast. P.S.—Don't burn your fingers with the acids. H. O'B.

[68903.]—**Pigs in Clover.**—I should say that it would be worth while for Mr. Maycock, p. 527, to try before he ventures to reply again. Naturally the centrifugal tendency sends the pigs to the outer rim at first; but as they can't get out, they conveniently retire into their den. Mr. Maycock has forgotten that a lapidary's table also produces a vortex motion. S. T. G.

[68928.]—**Leaky Boat.**—I should advise "Leaky Boat" to use whitelead and whiting; the whiting powered fine and mixed with the whitelead, and put it on the shakes with a putty knife. If that does not stop them, put on a tin plate over the shake with a piece of felt and tar.

W. H. Knight.

[69008.]—**Cubical Contents.**—The volume of a cone is $0{\cdot}2618 \times D \times h$, where—

D = diameter of base
h = perpendicular height.

The volume of the frustum of a cone is $0{\cdot}2618\,h\,(D^2 + d^2 + D\,.\,d)$, where D and d are the diameters of the ends, and h the perpendicular height. Thus in the particular case you give, the volume of the frustum is—

$$\cdot2618 \times 10\,[(14{\cdot}5)^2 + (7{\cdot}5)^2 + (14{\cdot}5 \times 7{\cdot}5)] = 982{\cdot}4\text{c.in.}$$

Brockley. H. C. H.

[69038.]—**Poor Rates and other Municipal Taxes.**—There are no such things as municipal taxes—all demands are rates, and those rates must be paid before a certain time to qualify for a vote. The query is ridiculous, because "Alpha" could have easily obtained an answer by applying to the local authorities or their representatives. G.M.

[69045.]—**Position of H.M.'s Ships.**—The position of any of H.M.'s vessels (so far as it is known), can always be ascertained by addressing a note to the Secretary, Admiralty, London, S.W. R. N.

[69055.]—**Blue Salts.**—To "Principia."—Will tungstic or titanic acids give a blue solution with alkalies? They are metals, although they act as acids with bases. True Blue.

[69056.]—**Black Needles.**—To "Principia."—Osmium is reduced by mercury, and I get a great many of the reactions of osmium, but not all. I do not get the bad smell spoken of in most chemical works; the only smell I get is exactly like the heel-ball sold by shoemakers, used sometimes for taking rubbings from brasses. I do not know the composition of it. Since writing, I have obtained the needles (?) as long red threads, quite 2in.

True Blue.

[69058.]—**Moths in Mattress.**—Bake the mattress as it is; but it is better to send to the cleaners, who have facilities for sending sulphurous acid gas through every particle of it. M.

[69059.]—**Gas and Hot-Air Engines.**—All the particulars that "A. H." needs he will find in back volumes, and the principles in a series of articles now appearing under the title "Heat Engines other than Steam." Selim.

[69062.]—**Pyrometer.**—The title of this query gives the answer. "E. M." wants a pyrometer. If he can't get one anywhere else, he can at Bailey's, of Salford. R. S.

[69069.]—**Zinc Casting.**—Keep the zinc clean by means of a layer of salammoniac on the molten metal, and pour into clean moulds. C. K. L.

[69070.]—**Clock Gun.**—Don't see much difficulty in a clock gun to go off every hour. It can be worked by electric means, or the clock can be made to trip a trigger mechanically. But the thing is an absurdity for "driving away birds." P. T.

[69072.]—**Celluloid Cuffs.**—"Bachelor" asks a very pertinent question, and asks it so very innocently that it is almost a pity he cannot be answered. Does not "Bachelor" understand that if there were any means of "restoring tarnished celluloid" that the makers of the cuffs, &c., would be the first to utilise it, as such an invention would increase the sale of their goods enormously. Try the effect of benzoline or a little ether, rubbing smartly with a bit of cloth or baize. Nun. Dor.

[69075.]—**Plastic Metal Bearings.**—A plastic metal bearing must be something curious. Where did "Brass Caster" find any mention of it? Bearings are lined up with white metal commonly known as Babbit metal, and I think the querist might look through another 20 volumes without finding anything about Richards's "plastic" metal.

The Motion Bar.

[69124.]—**Pendulum.**—"C. H. R." has mis-stated the formula for the length of a pendulum, which is—

$$L \text{ in feet} = \frac{T^2\,.\,g}{\pi^2}.$$

Hence sidereal seconds pendulum—

$$L \text{ in feet} = \left(\frac{31558149}{31556929}\right)^2 \times \frac{g}{\pi^2},$$

which in inches for latitude of London = 39·1421, as against the solar seconds do. = 39·1392.

Liverpool. W. S.

[69132.]—**Cripple's Carriage.**—I hesitated to reply to this, anticipating that someone better qualified than myself would do so; but as the only reply describes an indoor chair, and as I imagine from the query the carriage desired is one for outdoor exercise, I venture to offer a few suggestions. The best hand-tricycle, movable if necessary without aid from the feet, is Mr. Charsley's Velociman, made by Messrs. Singer, and "Parish Priest" cannot do better than try to obtain one of these second-hand. It is a rear-steerer, driven by levers, and steered by a tiller ending in a movable back-rest, so that steering is effected by swaying the body. Though awkward at first, it quickly becomes easy, the necessary movement of the body being less than seems necessary at first. Failing this, an efficient machine could, I think, be made as follows: Buy a second-hand rear-steerer (which, as the pattern is obsolete, may be done very cheaply), preferably the "Cheylesmore." Cut out the crank portion of axle so as to leave about 1in. projecting from the bearings, or better, if not in the way of a leg-rest, replace the cranked axle by a straight one. In either case key on, close up to the bearings, a grooved wheel, about 6in. or 8in. diameter, according to the strength of the rider. Attach to the periphery of each wheel a cord ending in a handle, of such a length that when wound once round the wheel the handle is just within reach of the rider's hand when his arm is at full stretch. A fair-leader should be fixed to the frame to keep cord in position, and a spring fitted, which should tend to keep the cord wound in the groove. Thus, on the cord (which should lead upwards between the grooved pulley and the rider) being pulled, the tricycle is driven forward, and on being slackened is wound up by the spring ready for another pull, the tricycle running forward by its momentum the while. The seat must be put back by reversing the L pin which supports it, so that the pull may not be too vertical. By having two pulleys with their cords on each side the rider gains, though at the expense of some complication, the advantage of two speeds, which, in such a case as this especially, would be very great. The "Monarch" is another clutch-driven machine which would be suitable for conversion, though not so much so as the "Cheylesmore," for the axle, being 2ft. from the ground, would be awkward to mount. The "Merlin" and the "Omnicycle" also are clutch-driven, and might be picked up cheap, but, being front steerers, they would be still less suitable. I think clutch-driving is preferable to lever for this purpose, because it permits great variety in the length and rapidity of stroke, and because, when the machine is running by gravity alone, the levers work to and fro with great rapidity, threatening a severe blow to a careless rider. As against this, the machine cannot be back-pedalled or stopped by a clutch action, but must depend for this solely on the brake. I believe, however, that in practice, except perhaps in a crowded street, this incapacity is not of much consequence. If, however, lever action is preferred, it may be managed thus:—Fasten about mid-way on the backbone of any rear-steerer (avoid, by the way, a single driver) a fitting, from which hang a pair of swinging rods, about a foot long. Hinged to the lower end of each should be one end of an arm, shaped like an L prostrate—thus, ⊣, the hinge being at the head of the L, whose angle would rest upon, and be bolted to, a pedal, and whose toe would be fitted with a handle. Do not make the handle too high, or the pull will tend to draw the rider off his seat, especially as he cannot counteract it with his legs, as a rower does. The steering would be best like the Velociman. I do not know whether this is patented; but, if so, possibly Messrs. Singer might, under the circumstances, allow it to be used for a nominal fee. I hope "Parish Priest" will be able to make this out without a sketch; but I shall be happy to send one if necessary. It would be interesting to know what result he arrives at. Faber, C. T. C.

[69156.]—**Relaxed Throat.**—Simple remedies often prove best. Here is one tested by use many times during the last half-century:—Pound very fine a lump of saltpetre the size of a walnut, and pour on to the powder one gill (½-pint) of boiling water; when cold, pour the clear liquid into any convenient vessel which you can cover to keep out dust, &c. Place this in your bed-chamber where you will see it—last thing at night, and first thing in the morning—take one mouthful, and gargle your throat well, throw the mouthful back again into the throat (as far down as you can without swallowing it) a second or third time. You will do this readily after a few trials. If the one jugful be not sufficient, let three or four days pass, and then make a second supply; but one generally cures.

H. O'B.

[69179.]—**Sand and Water-Trough.**—In some stoneyards I have seen, an arrangement on the injector principle was used to convey the sand to the saw. The sand was jerked down the vertical part of an inverted T-shaped pipe, while water flowing along the cross-piece carried it to the "saw." The jerk was imparted by a species of cam. Perhaps that would suit you.

A. F. Shakespear.

Lüttichaustr. 14, Dresden.

[69205.]—**Electric-Light Battery.**—I notice that in the reply given to this query at p. 528 it is stated that "3 cells will do it exactly; but I should advise the use of four. A Fuller gives 1·5 E.M.F., with 0·6 ohm of internal resistance:

$$\frac{1{\cdot}5 \times 3 = 4{\cdot}5}{0{\cdot}6 \times 3 = 1{\cdot}8} = 2{\cdot}5 \text{ ampères, and a 5c.p. lamp}$$

takes from 2· to 2·5 ampères." [illegible] leaves out of consideration altogethe[illegible] lamp, whi[illegible] that this be the case, then the equation becomes:

$$\frac{1{\cdot}5 \times 3 = 4{\cdot}5}{0{\cdot}6 \times 3 = 1{\cdot}8 + 6} \text{ or } \frac{4{\cdot}5}{7{\cdot}8} = 0{\cdot}57 \text{ of an ampère;}$$

so that, supposing that the 6-volt lamp takes from 2 to 2·5 ampères to light it properly, it is quite evident that the current is four times too small. As a matter of fact, there are some 6-volt lamps made which can be run with at from 0·7 to 1·0 ampère of current. S. Bottone.

[69205.]—**Electric Light Battery.**—Mr. F. W. Mason, F.S.S., is in error. The E.M.F. of a Fuller cell is practically 2 volts.

W. Perren Maycock.

[69222.]—**Discharge from Ear.**—Owing, no doubt, to my indistinct writing, I am in this reply made to say "nitrated form of gold," this should be triturated form of gold, triturated being a medical jargon from the verb *tero* (I rub), meaning ground-up—i.e., by means of a pestle and mortar.

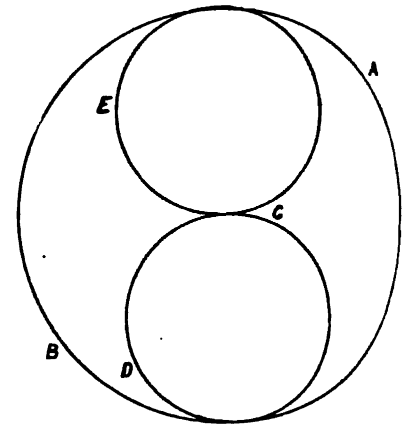
The Lydney Dispenser.

[69239.]—**Emptying Tank.**—A 12in. pipe will empty quickest, as two 6in. pipes are only equal to an 8½in. pipe. Blacksmith.

[69239.]—**Emptying Tank.**—Perhaps "W. T. K." will be surprised to learn that one 12in. pipe will run as much water out of his tank as four 6in. pipes; therefore the 12in. pipe will run his tank dry in half the time as two 6in. pipes.

J. H. Rowney.

[69239.]—**Emptying Tank.**—If the pipes are cylindrical, and sections of them be taken, and arranged as in the figure, it will be seen that the superficial area of the larger pipe is greater than that of the two smaller pipes together. Hence, in equal lengths, the cubical contents of the 12in. pipe is greater than that of the two smaller pipes. So that, taking no account of friction, &c., "W.T.K." will empty his tank in half the time that he would otherwise do, if he uses the 12in. pipe.



A B represents the 12in. pipe.
C D, C E respectively the two 6in. pipes.

R. A. V.

[69244.]—**Electric Lighting.**—For 48-volt lamps at least 24 cells would be required (giving 48 volt), and, consequently, the dynamo would have an E.M.F. of something like 55 volt. This is probably what Mr. Bottone intended last week.

W. Perren Maycock.

[69245.]—**Marking-Ink.**—That made of nitrate of silver, and used with pounce, needs no process of blackening beyond a few hours' exposure to sunshine. When using a hot iron to fix any of the other inks, be careful to have a piece of clean tissue paper under the iron, in order to prevent the [illegible] away of the linen or cambric, which so often takes place without this precaution. H. O'B.

[69245.]—**Marking-Ink.**—It would be interesting if Mr. Percy W. Stanley (p. 529) would give us all the information that he can as to the nature and manufacture of the new "marking-ink of the future"; and would he or Mr. J. West kindly say, if they can, what is the composition of the ink which is used for stamping names on shirt-collars by the manufacturers? It stands the laundress's attacks better than any other that I see. J. C.

[69246.]—**Logarithms.**—Using your figures the first part of your query works out thus—

$$\begin{array}{lr} \text{Log. of } 94{\cdot}785 = & 1{\cdot}97674 \\ \text{Log. of } 6{\cdot}8798 = & {\cdot}83752 \\ \hline & 2{\cdot}81426 \end{array}$$

The number corresponding to this logarithm [illegible] product required. Now, in the second [illegible] the logarithm $\bar{2}{\cdot}33025$ may be written $\bar{3} +$ [illegible] from which subtract $\bar{2}{\cdot}99460$, and the rem[illegible] $\bar{1}{\cdot}33565$ is the logarithm of the required quot[illegible] which can be fo[illegible] the tables. I think [illegible] have stated the logs. wrongly, as I find, upon reference to my tables, that the logs of the numbers you give differ from yours. You had better use a table of logs to seven places of decimals. When multiplying, you simply add the logs together, as you would ordinary decimals, and the sum is the log. of the required product. When dividing, you subtract the log. of the divisor from the log. of the dividend, and the remainder is the log. of the quotient. You must treat the signs as in algebraical addition and subtraction, and you can adopt similar conventions as in the second example, in order to keep the mantissa positive. There is a chapter in Todhunter's "Elementary Trigonometry" which would just give you the information about the nature and use of logs. which you seem to require. Inter B.Sc.

[69246.]—**Logarithms.**—If your correspondent wishes to become practically acquainted with the use of logarithms, without wading through the theory—which, by the way, forms a portion of algebra and not of trigonometry—he cannot do better than purchase "Chambers's Mathematical Tables" (published by Chambers). The introductory chapter gives all the rules for the application of logarithms to calculation, with examples of their use in every particular case.

Charing. J. R. C.

[69247.]—"**Richter's Dream.**"—Is to be found in Mitchell's "Orbs of Heaven," page 195. If "Griffiths" cannot obtain that, I will write out a copy for him if he writes me, or advertises his address.

Queen's-road, Portsmouth. T. Radmore.

[69247.]—"**Richter's Dream.**"—Richter wrote a number of "dreams"; but the most famous are those in the "Siebenkäs." A translation called "Flower, Fruit, and Thorn Pieces" is published by Tauchnitz, and Sampson Low and Son, in London. The best translation of the "Dream of Atheism" (from the "Siebenkäs") is to be found in the second of Thomas Carlyle's "Essays on Jean Paul Richter," published in the second or third volume of his miscellaneous essays. Doubtless it was from this that Sir Robert Ball quoted, as it contains many effective passages. Vindex.

[69247.]—"**Richter's Dream.**"—"Richter's Dream" is given in full on pages 195 and 196 of "The Orbs of Heaven," by O. M. Mitchell (London: Routledge, Warne, and Routledge, Farringdon-street. New York: 56, Walker-street; edition 1860). This is the only occasion on which I have ever seen it, never having read Carlyle's second article on Richter (mentioned by Mr. Langden on p. 529 of the "E. M."), nor Proctor's "Universe and the Coming Transits," suggested by Mr. Gore on the same page. I shall be pleased, if necessary, to send Mr. Griffiths the "Dream" on his giving me his address.

Autolycus.

[69247.]—"**Richter's Dream.**"—There are several versions of "Richter's Dream of the Universe," one by Carlyle in Vol. III. "Miscellaneous Essays," this seems to me very brief and poor. There are two by De Quincey, one on pages 304 and 305 of Ward and Lock's "Books for all Time," De Quincey, 2nd series—this is better. But there is another by the same author, which is very much better, in an essay on the Great Nebula in Orion, which is illustrated by a curious representation of the nebula, slightly altered from Sir John Herschel's drawing, and resembling a despairing half-human profile, and which is suggested by the author as being possibly a representation of Satan. It is about twenty years since I saw this essay, but I was so impressed with the magnificent passage beginning "God called up from dreams a man," that I copied it out. Proctor's version resembles this, but is, I think, slightly different, and is given in one of the early numbers of *Knowledge*.

A. Woolsey Blacklock, M.D.

Gateshead, Aug. 19.

[69249.]—**Indian Railway Problem.**—Thanks to the five correspondents who have sent solutions. I cannot quite understand the first sentence of that of "A. M.," although he manages to get a correct result. It is clear, from the various replies, that we may either use partial diff. coeffs., or split the problem into two, and use complete diff. coeffs., so that it is a curiosity in its way. Problems with two independent variables sometimes give such mysterious results that I should like to have the following original question explained, and there need not be much room taken up. I confess to having been puzzled over it. Two straight roads, A B, A C, are at right angles to each other, meeting at A; length of A B = a miles, and A C = b miles. In going from B to A, I can go for n pence per mile, and in going from A to C I go for p pence per mile. Wishing to go from B to C, I require to know what is the position of a diagonal line, along which I can pass in a boat from one road to the other, the charge for the boat being m pence per mile, so that the cost of the journey from B to C is a minimum. If m is less that n or p, of course, the journey would have to be on the line joining B and C; but I require a result which will give a minimum when this restriction is removed. To save printing in the replies, I may as well state the preliminary steps, which all will agree to. Call the distances from A to the ends of the diagonal on A B and A C, x and y respectively, then the cost of the journey will be—

$$n(a - x) + m\sqrt{x^2 + y^2} + p(b - y).$$

Differentiate this for x and then for y, equate the results to O, and we get two equations; but these equations can only hold good when $m^2 = n^2 + p^2$; also the length of the diagonal disappears. Now, what is the answer to the problem?

Bath. M.I.C.E.

[69252.]—**Hard Water, How to Soften.**—Place some lime or carbonate of soda in the water. See "E. M." July 19th, 1889, "Water Softening," by G. E. Davis. The water evidently passes through a limestone or chalky soil, and no object would be gained by driving the well deeper. B. S. C.

[69255.]—**Ventilation of Mines.**—"Perplexed" must understand that, in order to answer this question, it will be necessary, in the first place, to ascertain the H.P. of the furnace, or the number of foot-pounds the furnace is capable of performing.

$$\text{H.P. of furnace} = \frac{15{,}000 \times 5{\cdot}2}{33{,}000} = 2{\cdot}36\text{H.P.}$$
$$= 78{,}000\text{ft.-lb.}$$

Now, since the H.P. of a furnace is the product of the difference of the weight of a cubic foot of air in the two shafts multiplied by the depth, and again by the amount of air passing, and divided by 33,000, it will be very easy to work back to the difference of the weight of a cubic foot in each shaft.

$$\text{Thus, } \frac{78{,}000}{400 \times 15{,}000} = 0{\cdot}013 = \text{diff. of the weight of a cubic foot in shafts.}$$

You now find the weight of a cubic foot of air in the downcast by the following formula:

$$\frac{1{\cdot}3253 \times 30}{459 + 40} = 0{\cdot}079677.$$

Having now got the weight of a foot of air in the downcast, you have only to subtract 0·013 from 0·079677 to find the weight of a foot of air in the upcast. Thus, 0·079677 − 0·013 = ·066677. Then by proportion you get the temperature of the upcast. Thus, ·066677 : 079677 :: 499 : 596. You now subtract the coefficient of expansion—viz., 459—from 596, leaving 137° Fahr. I have assumed that Fahrenheit thermometer is meant in the query. If there is any part of this reply not sufficiently plain to "Perplexed," I shall be happy to help him if he advertises his address in the "E. M."

J. H. Rowney.

[69266.]—**Lager Beer.**—Fourteenth line from bottom col. 1, p. 531, read "store vats" for "stone vats." W. J. Sykes, M.D., F.C.S.

[69266.]—**Pilsener Lager Beer.**—I have read with great interest the explanation which Mr. W. J. Sykes, M.D., F.C.S., gives in your esteemed paper of August 16th, about the brewing of Pilsener lager beer; it is the best, in my opinion, I ever read from an English pen. I may, however, be permitted to add that the beer, after it is run into large stone vats, is led into large store wooden vats, the size of which is generally about 15-20 hectolitres, equal to 10—15 barrels. These vats, as well as the smaller vats, into which it is casked again after a certain time, are pitched inside. The beer, which is led from the stone vats into the large wooden vats, is stored in these vats for about three to five months before it is casked off again into the smaller casks, and this is the reason it is called lager beer; the word *lager* is equal to the English word store. When Dr. Sykes writes that the lager beer is invariably Pasteurised, he is surely under the impression of lager beer which is sent to the Colonies or to other hot climates, because good lager beer, which is directly imported from the Continent and sold in England after it has been bottled here, does not require Pasteurising: it keeps, when placed in a cool place, in good condition without any sediment for four to six weeks. After this time there is a little sediment, but this does not at all affect the quality of the beer, and when carefully poured out of the bottles, the beer is in splendid condition then. Being an importer of Pilsener lager beer myself, I shall be very pleased to see Dr. Sykes, as well as some other Englishmen who take interest in it, at my place, in order to let them try my Pilsener lager beer on the spot, when they may convince themselves of the excellent quality of this special kind of lager beer, which is not only a very nourishing beverage, but also an appetising tonic, agreeable even to the weakest digestion.

1, Vine-street, Minories, E.C. Louis Koehne.

[69275.]—**Harvest Spider.**—During the present season this pest has been really most unbearable on the sandy soil of my residence, the upper surface of one's feet, ankles, and wherever the clothing fitted close to the skin being favourite localities for the insect's scene of operations. Paraffin oil, applied with a feather, gives immediate and durable relief to the irritation the insect causes to

The Lydney Dispenser.

[69284.]—**Lamp for Battery.**—Twelve cells will give nearly 24 volts; hence, you may fairly expect to light any 20-volt lamp not taking more than 1 ampère of current. If using single wires as leads, No. 16 will do very well. If a "cable," 7 strands of 24. S. Bottone.

[69285.]—**Cells and Wire for Bell.**—Something will depend on the delicacy of the electro-magnet of the bell; but if fairly good, one cell should be enough, and two cells more than ample. No. 18 wire is a good size, but for such a short distance No. 20 will do. If not used for more than a minute each day, the battery should run from three to twelve months before requiring recharging. It may, however, need the addition of a little water.

S. Bottone.

[69287.]—**Coil.**—You will not be able to obtain much of a spark with the dimensions you have. Use 20 B.W.G. for primary, and 40 B.W.G. for secondary. Read my article on "Coil-Making." You will find there all particulars.

F. W. Mason, F.S.S.

[69287.]—**Coil.**—You will not get a very long spark from so small a coil. From $\frac{1}{8}$in. to $\frac{3}{16}$in. will be as much as you can reasonably expect. Put on two layers of No. 24 silk-covered as primary; insulate well with paraffined paper, then get on as many layers (probably ten to twelve) as you can of No. 40 silk-covered. Each layer must be laid on with scrupulous care to avoid kinks, and insulated from the subjacent layer by thin bank-post paper soaked in paraffin wax. Condenser, five sheets of tinfoil 3in. by 3in.; battery, one pint cell chromic acid battery. S. Bottone.

[69288.]—**Hospital.**—If E. Wyn will advertise his address in the Address Column of "Ours," I shall be most happy to not only tell him all about it, but help him with models and drawings, whereby to make something very perfect. Bionomist.

[69288.]—**Hospital.**—According to the report of the ceremony of the presentation, by Mr. Tate, of his Hahnemann Hospital to the Corporation of Liverpool, that institution is one which E. Wyn would find an admirable model in most respects. It possesses many novel features, notably in the methods of heating, ventilation, water supply, etc. No. 21 of the Homœopathic League Tracts (Bale and Sons, Great Titchfield-street, London), price 1d. each, "The British Homœopathic Hospitals" gives a sketch of the Liverpool one, which cost £20,000, has 50 beds, and a medical staff of some 10 physicians, one or other of whom would, I feel certain, afford inquirers every information and a survey of the whole building.

The Lydney Dispenser.

[69291.]—**Bunsen Cell.**—I would point out to "Chasseur" that a Bunsen cell ceases to be such if any other depolariser than nitric acid is used.

W. Perren Maycock.

[69291.]—**Bunsen versus Chromic-Acid Cells.**—A well-made Bunsen cell, pint size, charged with my new depolariser—to wit, chromic acid, sulphuric acid, and chlorate of potash with water—will give, at the start, an E.M.F. of 2·2 volts, which soon falls to 2 volts. The internal resistance at first is very low, so that a current of from 10 to 12 ampères is frequently obtained. A good soft porous cell will empty itself in 36 to 48 hours. The bichromate cell soon runs down. The smallest E.M.F. and current to run an effective arc lamp is 35 to 40 volts, 10 ampères. The light would be equal to 500 c.p. S. Bottone.

[69293.]—**Ringed Snake.**—In reply to "R. G." (query 69293, p. 532), the food of the common ringed snake consists almost entirely of frogs, and its drink water. I should imagine that this harmless snake finds the latter in sufficient quantity, and of the requisite purity, in the body of the frog itself, to need any other drink. "Lane and Field," by the late Mr. Wood, gives a first-rate illustration of this snake, and a concise description of its habits. Bread and milk are, I think, entirely out of its line.

Autolycus.

[69294.]—**Photography.**—According to my experience, the hydroquinone has not the same tendency as the pyro developer to stain the plate. The only way to settle the question is to try again. I should be more inclined to suspect a trace of hypo. Obviously, the only remedy is to take another negative. Sm.

[69295.]—**Extracting Scent.**—There are plenty of so-called herbalists' books published if "Pansy" likes to go in for this *quackery*. The herbs and plants that are of any use in healing—in fact, that the medical profession accept—will be found in any leading Materia Medica. Scent is extracted by the so-called distillation method.

F. W. Mason, F.S.S.

[69296.]—**Ginger Wine.**—To make four gallons of ginger wine your querist will require a clean four-gallon cask, an earthenware pan of five gallons capacity, and the following ingredients:—4oz. crushed unbleached ginger, 8lb. raisins, from 6 to 10lb. of sugar (according as the wine is required, dry or sweet), ½oz. cream of tartar. Chop the raisins, and pour over them two gallons of water at a temperature of 100° Fahr.; mix well, and let stand overnight. Next day strain off the liquid from the raisins, and pour on another two gallons of water in which the ginger has been boiled and the tartar dissolved, and which has cooled down to the above temperature. After well rousing, and being allowed to stand for a few hours, strain this off to the first solution, place the whole into the earthenware pan, add the sugar, stir until dissolved, and add water until the solution, or technically "must," amounts to four and a half gallons. Set aside in a warm place, and fermentation will commence in from twelve to twenty-four hours. Allow to ferment for a couple of days, then transfer to the cask. The small quantity you have over put into a bottle. The cask must be filled quite up to the bung and placed in a cool cellar. Fermentation will go on for some weeks; examine every few days, and as the liquid lowers in the cask keep filling up from the bottle. When fermentation appears to be nearly over—i.e., few bubbles of gas escape—bung up tight, put in a vent-peg, and every week or so remove vent-peg to let the gas formed escape, or your cask may burst. Let stand for three or four months until perfectly bright and clear, then bottle. Do not on any account put in any brewer's yeast, or you will spoil the flavour; there are plenty of spores (or seeds) of wine yeast on the raisin (grape) skins to start and carry through the fermentation, and the raisins also furnish the albuminous matter necessary for the growth of the yeast. There is much excellent information on the manufacture of domestic wines in the article "Wine" in Muspratt's "Chemistry," but the ideas there expressed on fermentation are now out of date—our knowledge on this subject having increased wonderfully during the last few years.

W. J. Sykes, M.D., F.C.S.

[69298.]—**Telephones.**—To Mr. Bottone and Others.—You will get better results if you use permanent magnets instead of your soft iron rods, especially for such a short distance. Put about 60 grains of No. 36 wire on each bobbin. Ferrotype plate is the best thing for the diaphragm, but its use is an infringement of patent. A parchment diaphragm, with a small iron disc attached by cement to its centre, is nearly as good, and is no infringement. If you make receiver and transmitter alike, you will need no battery for the distance named. If you cannot refer to my articles on the "E.M." Telephone in this paper, you will find a chapter dedicated to this subject in my "Electrical Instruments for Amateurs," which you will find advertised in Sale Column. S. Bottone.

[69299.]—**Chamber Organ.**—In reply to "Rus in Urbe," *in re* the "two manual" specification, I reply, assuming the keys to be CC to G^3 (56 notes).

FIRST SCHEME.

Great.

Open diapason, metal	56	notes.
Claribel, wood	56	,,
Stopped bass dulciana	44	,,
(Grooved into bass of claribel)		

Swell.

Violin diapason, tenor C	44	,,
Stopped diapason CC	56	,,
Gemshorn CC	56	,,
Oboe, tenor C, or preferably GG		

SECOND SCHEME.

Great.

Open diapason	56	,,
Dulciana, wood bass	56	,,
Flute, wood	56	,,

Swell.

Salicional	44	,,
Vox celeste	44	,,
Stopped diapason	56	,,
(Its bass to act for salicional bass)		
Dulciana principal	56	,,

THIRD SCHEME.

Great.

Open diapason	56	,,
Dulciana, wood bass	56	,,
Flute harmonic	56	,,
(To be harmonic from tenor C).		

Swell.

Gamba	44	,,
Stopped diapason	56	,,
(Its bass to act for gamba bass.)		
Lieblich flute	56	,,
Oboe, GG or tenor C		

FOURTH SCHEME.

Great.

Open diapason	56	,,
Dulciana, wood bass	56	,,
Wald flute	56	,,

Swell.

Horn diapason	44	,,
Stopped diapason	56	,,
(Its bass to act for gamba bass.)		
Dulciana principal	56	,,
Pedal organ	30	,,

Bourdon for lowest 12 notes; the remainder to be an open diapason wood for broad effects, or a violoncello for what one might call "chamber-music effects," and by supplying the super-octave of pipes we have the effect of two complete pedal stops. The composition pedals to be constructed to work jointly for effects on both manuals, because each manual has so few stops that it would be only throwing money away to put even one on the great organ. I've just got the opinion of a respected client who was induced to go to the expense of a "series of composition pedals," to first push out the dulciana, and go gradually on to the full organ. All were double-acting, so that by working the pedal on the opposite side it restored the power to the uniformity it was at before, and then he had a "grand jeu." Well, he had all he wanted, and the only advantage he had was a "grand time of it," struggling about over six double-acting pedals.

Couplers.

Swell to great unison.	Swell to pedals.
,, ,, super.	Great ,, ,,
,, ,, sub.	

The ordinary proportion of bellows will be quite enough, but parallal feeders throw twice the amount of wind into the reservoir, and, as a rule, the old diagonal feeders were good so far as even up to 3in. wind to supply the soundboards; but where octave coupling and borrowing are used, they are insufficient for the purpose. As to price, it is hardly a subject I can vouch for, as I've known such a variation of cost to almost frighten one; but I should say the organ could be fairly built of good materials and thorough workmanship for from £180 to £200. A question such as "price," is more a private than a public matter, and I would prefer such inquiries to be sent to me personally, at my residence, or not at all.

Wm. Robinson.

[69301.]—**Electric Conductors.**—The dynamos are coupled in series, their free terminals being joined to the two outer conductors. The middle wire is joined up to the point of connection of the two machines. The lamps are arranged on either side of the middle conductor, between that and the outer wires. The voltage between these latter is double the voltage of the lamps. When the number of lamps on either side is equal, no current flows down the middle conductor; when the number of lamps alight is greater on one side than on the other, the middle conductor carries the excess current either to or from the machines, according to which side of the wire (+ or –) the larger number of lamps may be. For full particulars see *Elec. Rev.* Jan. 10, 1885; Prof. Geo. Forbes' Cantor Lectures; also Kapp's "Electric Transmission of Energy," p. 211; also *Proceedings* Inst.C.E., p. 61, Vol. LXXIX.

W. Perren Maycock, A.I.E.E.

[69301.]—**The Three-wire System of Conductors.**—The following brief description of the three-wire system is from Bromley Holmes's "Practical Electric Lighting":—"On this plan the negative terminal of the first dynamo is connected to the positive terminal of the second dynamo, and these conducting cables are attached respectively to the positive terminal of the first dynamo, to the connecting wire between the two dynamos, and to the negative terminal of the second dynamo. The lamps are arranged to bridge over on both sides of the central conductor to the two outside conductors. The central conductor acts as a return for the first dynamo, and as a lead for the second. When the number of lamps between each pair of conductors is equal, no current passes along the central conductor, to or from the dynamo, and the cable might be detached, simply leaving the two dynamos in series, and also the two groups of lamps. When the lamps in one group exceed in number those in the other, the central or compensating conductor will carry the necessary difference of current." S. Bottone.

[69307.]—**Preserving Centipede.**—Good, clear methylated spirits of wine (not "finish") will do very well. S. Bottone.

[69307.]—**Preserving Centipede.**—The best liquid in which to preserve a centipede or any other specimen is a 3 per cent. solution of carbolic acid.

J. Jones.

[69309.]—**Rate of Interest.**—Total amount paid £720—i.e., £320 for interest = £32 per annum, or £8 per cent. Figure.

[69316.]—**Pipeclay.**—Yes; pipeclay can be obtained at almost any of the potteries, and also from the London oilmen, the latter supplying it in the dry state; but it can be easily softened by the addition of water. Articles made of pipeclay, if carefully dried for a day or two before putting into the fire, can be baked in an ordinary firegrate. I have frequently made small porous cells in this way.

S. Bottone.

[69318.]—**Filter for Soapy Water.**—Since soap is soluble in water, it is impossible to remove it by filtration. You must precipitate the soap by means of lime; then you can filter it off. Sx.

[69318.]—**Filter for Soapy Water.**—I am afraid a filter will be of no use for this purpose. I once saw a filter-maker put soap-suds through his filter as an illustration of efficiency before the jury at an exhibition, and he could not have done a worse thing. About one-third of the soap appeared to come through with the filtered water. I know a gentleman who had a similar trouble to yours with 5,000 gallons of soapy water per day. He precipitated the soap with the reagents used in sewage purification, and the water then passed along a broad open channel to the river. This channel was filled with some coarse cheap medium; the effluent was then passed by the authorities. If "Georgetown" will advertise his address, I shall be pleased to give him any further information I can on the subject. Chas. E. Gittins.

[69320.]—**Zinc Depositing.**—If the wire were fed from between two metal rollers connected with the negative terminal of dynamo, the anodes being connected to the other, deposition of zinc would take place if the vat were charged with a zinc cyanide solution of the following strength—viz.—Water, 100 parts by weight; zinc cyanide, 1 part by weight; potassium cyanide, 8 parts by weight. The number of wires that can be done at a time will depend greatly upon the gauge; if No. 1[illegible], probably 100 at once. S. Bottone.

[69321.]—**Taper Camera Bellows.**—Full instructions regarding the materials, cutting and folding of camera bellows, both square and truncated, are given in the "E. M." of Dec. 16, 18[illegible]. To blacken the inside and brass-work, the following may be used:—Well mix with a palette knife a thimbleful of lampblack with four or five or more drops of gold size till of the consistence of putty, then add to this mixture about twice its bulk of turpentine, thoroughly incorporate them, apply with a camel's-hair brush. G. G. B.

[69324.]—**Dynamo for Lighting a Lamp.**—A dynamo of the size given, wound throughout with No. 22 s.c.c. wire, connected up in shunt, and driven at 2,500 to 3,000 revs. per minute, will easily light an Edison 10-volt lamp. S. Bottone.

[69325.]—**Acoustical.**—"Mu. Nu." overlooks the fact that the window is, in one case, near his ears, and, in the other, some distance away. This is quite sufficient to account for the difference in audibility. Sx.

[69330.]—**Medical Coils.**—The secondary coil should not have been connected to the primary; they should be quite distinct. S. Bottone.

[69331.]—**Sulphate of Mercury Cell.**—You have got hold of the insoluble sulphate; use the bisulphate. W. Perren Maycock.

[69332.]—**Steel Spring.**—To take the temper out of ribbon steel is to heat it until it becomes cherry red, otherwise what is called a soaking heat, and then bury it in lime until cold. To temper it again, heat the steel until cherry-red, and plunge it into oil, then smear it with tallow and hold it over a hot fire until the grease burns off with a yellow flame. When it does, cool out in oil again. You will then find that you have a temper on the steel that will answer most purposes. G. Orbel[illegible].

[69335.]—**Defective Vision.**—If "H. J." with his left eye looking at arm's length at three parallel equidistant lines he will [illegible] drawn on the back of a visiting card, and the white interspaces between the lines when held vertically appear whiter and brighter than when horizontal or vice versâ, this would accuse the presence of astigmatism. An elongated [illegible] causes apparent diplopia. A concave cylindrical lens of a power to be determined, with axis [illegible] slightly right or left from the horizontal meridian—or maybe a convex one, axis reversed—[illegible] sharpen the definition, and consequently [illegible] simple refraction, if the double refraction he complains of is traced to astigmatism.

The Author of
"The Philosophy of Sight."

The smokeless gunpowder that was tried so successfully at the military manœuvres which the Emperor of Austria attended near Spandau, is the invention of an Austrian chemist, Herr Falkenstein, in Vukovar. Herr Falkenstein first offered his invention to the Austrian War Office, in the time of Count Bylandt, but it was rejected. The Emperor of Austria, who was greatly pleased with the effect of the smokeless power, experienced considerable chagrin, it is said, when he learned that this invention was accepted at Berlin after having been originally intended for his own army.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

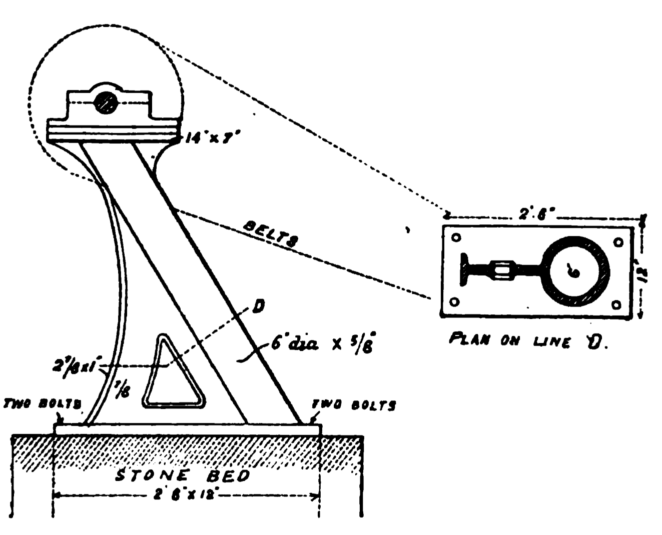
68850. Astronomical, p. 331.
68871. Telescopes, 335.
68872. Guarnerius and Amati Violins, 335.
68880. Gramme, 335.
68889. Curious Railway Management at Birkenhead, 335.

69035. Spring, p. 421.
69050. Gas-Engine, 422.
69068. Injection Water and Loss by Vacuum, 422.
69080. Worsdell's Two-Cylinder Compounds, 422.

QUERIES.

[69340.]—**Magnetic Inclinations and Declinations.**—Would some reader inform me the inclinations and declinations (magnetic) for the last five years, including 1889?—P. B. L.

[69341.]—**Line Shaft.**—I have to erect a line shaft, 110ft. long, on cast iron supports bolted to concrete or stone foundation. There are no means of staying it near the top of brackets. The line shaft is 9ft. from floor. Can any of "ours" oblige by saying if the sketches of side elevations and plan allow sufficient margin of strength? Diameter of shafting 3in.—Eureka.

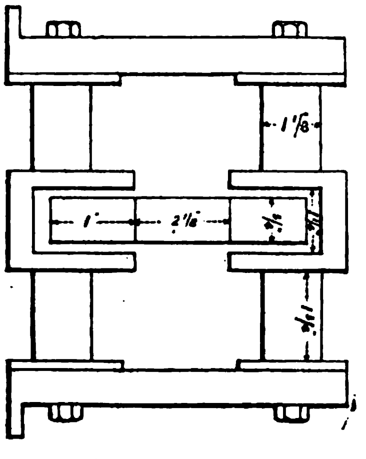


[69342.]—**Chipped Glass.**—Will you please tell me how chipped glass is made? I do not mean white or ground glass. The glass has a kind of feather-like or frosted appearance.—E. Schweitzer, 448, W. Indiana, Chicago, Ill., U.S.

[69343.]—**Gold Colour.**—I would feel obliged to any reader for a recipe for gold colour. I have used it, but do not know how to prepare it.—T. Daniel.

[69344.]—**Gazogene.**—I have a gazogene which leaks where the metal mounting is joined to the glass. I have tried white lead, but it will not stand the pressure caused by the gas. If any of "ours" would suggest a cement for this purpose it would greatly oblige.—Thos. Daniel.

[69345.]—**Victoria Dynamo.**—To Mr. Bottone.—I have carcase of four-pole Victoria dynamo, as per sketch. I should feel much obliged if you would favour me with the quantities of wire to put on armature and F.M. to get as high an E.M.F. as possible. Commutator has 24 parts, armature core built up of laminated iron, F.M.'s malleable cast iron. Also the number of lamps it would maintain. It is desired to have E.M.F. as high as possible. —E. N.



[69346.]—**Loco. Firebox.**—We have built a loco., and it has only been at work three months, and this week we find the fire-door ring is cracked right through. It is a strong ring, 3in. by 1¾in., best iron. It is broken through one of the rivet holes on the right hand bottom corner, and right opposite to the weld, which is at the top. The boiler pressure is 150lb. per square inch. I should be extremely obliged if any kind friend can tell me what is the cause of it breaking, as it was perfectly sound when put in, and now the steam blows through very bad. I should be glad if he can tell me if it can be repaired without taking it out, by caulking or otherwise, so as to hold. —Loco.

[69347.]—**Pyrotechny.**—I am much obliged to Mr. W. H. Browne for his reply to my query last week respecting the mortars. May I trouble him to give me the rule for calculating the blowing charges required for the different sized shells, and the kind of powder used for the various sizes? The larger the shell the coarser the powder required, is, I presume, correct, but should like to have full particulars.—T. Pearce.

[69348.]—**Gun Flints and Flint Arrow Heads.** Will readers, who have the opportunity, compare the descriptions of the flint manufacture on pp. 483 and 490 of Vol. XXIX. English Mechanic. One says the modern practice at Brandon, in Suffolk, is to rest the stone on a wooden stake, and strike it with a hammer. The other claims that pressure with a stick is sufficient to detach the flakes. I do not see how this can be, but should be much obliged if anyone can corroborate the latter statement, and, if possible, give a sketch showing position of hands, stick, &c.—Glatton.

[69349.]—**Radiation.**—Will any reader tell me how to estimate the time required for a solid body to cool from, say $t_1^\circ\ t_2^\circ$ Fahrenheit, if I know the time required for another body of similar shape, but smaller dimensions? Environments supposed to be identical. Is the following correct? Quantity of heat ∝ specific heat × volume. Rate of loss by radiation ∝ surface × some function of the temperature. The specific heat and temperature being supposed the same for both bodies, the time required will vary as $\frac{\text{volume}}{\text{surface}}$. The volume varies as the cube of linear dimensions. The surface varies as the square of the linear dimensions. Therefore, time of cooling will vary, as $\frac{(\text{dimensions})^3}{(\text{dimensions})^2}$, or simply as the dimensions. I do not feel sure that the above is correct, and shall be much obliged for any corrections. If the expression could be added to, so as to compare the ratio when temperature, range of temperature, &c., varies, as well as the size of specimen, the information will be of value.—Glatton.

[69350.]—**Final B.Sc. (London.)**—Will some correspondent give me some advice as to a course of work for the physics of the above exam.? My difficulty lies in selecting the most appropriate textbooks, and in arranging a course of practical work, so as to become well acquainted with all the leading principles. As I am at a distance from colleges and science classes, I am obliged to work entirely by myself.—Inter B.Sc.

[69351.]—**Mushet, Basic, and Styrian Steels.** —Would any reader kindly give information as to the use, nature, and properties of these three special kinds of steel?—M. B. S.

[69352.]—**Piano Pedals.**—I wish to put organ pedals to my piano. Will some reader kindly give full details how to make a reliable pedal action?—Diapason.

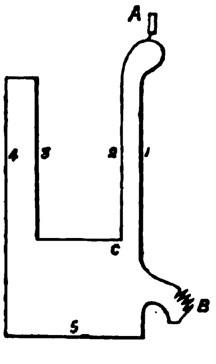
[69353.]—**Metal Polishing.**—Will someone kindly tell me how to polish brass, block tin, and pewter surfaces a foot square, to give it a polish same as one sees on metal teapots?—G. R. S.

[69354.]—**G.N.R. Engines.**—Will some reader favour me with a working drawing and dimensions of a Great Northern railway engine, with side tank, used for passenger traffic? Also one of the same company's express engines, with their numbers.—S. Watmuff.

[69355.]—**Spray Producer.**—I want to make a spray producer, as used by hairdressers. Will some reader inform me how, and in what position, to place the tubes in order to produce a nice fine spray?—Shaver.

[69356.]—**Electric Clock.**—Will some reader kindly give sketch of a good contact maker, and also size of the two solenoids, and number of wire? Pendulum rod, with heavy brass bob is 32in. long, round permanent bar magnet 5in. long, and ⅝in. in diameter. The clock I am going to alter is a very small one.—A Four Years' Subscriber.

[69357.]—**Heating Apparatus.**—Will someone kindly state the probable cause of the defective circulation in the hot-water heating apparatus of a small chapel in the country? Sketch shows the plan of the pipes (about 220ft. of ¾in.). At A the pipe passes over a doorway, and through the wall on to the gallery stairs, where an air chamber is fixed, but without an air-pipe. The water is poured in here, and passes down length No. 1, and enters at the top of a square coil, boiler B down below. We can get the pipes fairly hot as far as C on length No. 2, and then the heat decreases, until on length No. 5 it is scarcely perceptible. It was suggested that an air-pipe should be attached to the chamber with the end open. This was done, with the result that the water boiled over at this point, and the fire had to be put out. The apparatus is about 20 years' old. Does it require renewing, or what? Please help.—Mallor.



[69358.]—**Induction Coil.**—To Mr. Ernest Baugh or Others.—Will you oblige me with a method of winding the sections of a disc-wound coil? It was given by "Inductorium" some years back; but I have not got the identical number, nor can I procure it. I am uncertain as to the manner in which the sections are joined in pairs, and the best method of winding them. The dimensions of the coil I am constructing are as follows:—the core, 1ft. long, by 1¼in. thick, wound with two layers of No. 14s.s.c.c. wire, over this an ebonite tube 1ft. long, and ¼in. thick. I have for the secondary 4lb. No. 36 s.s.c.c. wire, and 2lb. No. 35 s.s.c.c. wire. Would this quantity be sufficient, or would it be advisable to add, say, another pound of No. 35? I intend to wind it in 56 sections, making the body of the secondary 8in. long. The centres of the terminal discs are 6in. above the baseboard. Can you tell me a way of making the spring for the break (Apps' form), and the size the hammer should be. I believe this is rather a delicate part of the apparatus.— C. E. G.

[69359.]—**Camera.**—Will any reader give me instructions and rough outlines how to make a box camera, 5in. by 4in., one that can be reversed—that is, that you can have 5in. upright or 4in. upright—and what is the longest distance you can have it expand, and what size lens will it take?—A Blacksmith.

[69360.]—**Big Bloomer.**—Will any of your readers inform me when McConnel first introduced the Big Bloomer single-wheel passenger engines on the L. & N.W.Ry.? Of the origin of the name "Bloomer"; and also furnish a description of one—if possible, that which was made for the Exhibition of 1862. Was the original design of these engines adhered to, or altered latterly?— H. F.

[69361.]—**Wine in Extract of Beef.**—To "G. M." and Others.—How can I detect, and quantitatively determine, the amount of wine contained in a semi-fluid extract of beef? Will the following method answer? Make the extract up to a measured volume with water, distil off ⅓, and (for qualitative test), determine whether the distillate reduces chromate; and for quantitative determination, make distillate up to original volume, and take sp. gr.? How can I determine whether the wine be port, sherry, etc.?—Beef Tea.

[69362.]—**Telephony.**—Will Mr. Mason tell me how I can fix a bell telephone receiver in same case as call bell? I have four receivers, so I want to fix one in case for speaking into, and another for putting to ear and receiving answer. I suppose both ends would be alike. Please send sketch for connections for same.—Engineer.

[69363.]—**Galvanising Steel.**—Can a thin sheet of steel be galvanised, that is, coated with zinc by being dipped into melted zinc, without loss of strength; and by whom?—J. K. S.

[69364.]—**Vibration of Violin Strings.**—I shall be obliged by information as to the number of vibrations of each of the four strings of the violin respectively when at their full length?—K. L. E.

[69365.]—**Slitting Metal.**—I have to cut a large number of very fine slits one inch long in rolled metal ⅛in. thick. How can I do this expeditiously? I have been using a jeweller's watch-spring saw; but it is very slow and tedious work. Are there equally fine small circular saws about an inch in diameter; and if so, how could I rig up one in a cheap foot-lathe?—C. T.

[69366.]—**Coil Regulator.**—To F. W. Mason, or S. R. Bottone.—Have you seen Dr. Spamer's Portable Induction Apparatus? Can you explain how the regulator is made? And what of? Also how it works? There is a hole in what seems to be wood; the hole is ⅝in. dia., 3in. long. A rod slides in the hole, and increases the current as it is pushed in. A piece of string hanging in the hole keeps the rod in any position. The rod looks like carbon, and is covered with paper. The spring is not in connection with a wire.—P. Sykes.

[69367.]—**Gold Colour.**—To F. W. Mason.—What are the brass fittings on medical coils coated with, which makes them look like old gold? They are not gold-plated. The coating rubs off with emery paper. When thus coated they do not tarnish as soon.—P. Sykes.

[69368.]—**Gummed Labels.**—I have some labels which I wish to gum on the back. I have tried ordinary gum; but I cannot make it answer. Is anything added to the gum?—P. Sykes.

[69369.]—**Bookbinding.**—Will someone be good enough to give directions for rounding the backs of books previous to putting on the covers? As the number of the "E.M." containing the article on "Bookbinding" is out of print, I feel sure that if directions sufficient to enable a person to bind periodicals, &c., strongly, and with a fairly good appearance, were given, with a list of the necessary tools that can be made or procured at a moderate cost, they would prove very useful to many readers of the Mechanic.—Dixey.

[69370.]—**Smith's Forges.**—I am about to put up some smiths' forges for myself, and I want to do the work well and right the first time. I have water-tue irons with 1½in. holes, and purpose having blast. Now, what I want to know is, what is the very best blast fan to buy. My work is both light and heavy: that is why I have 1½in. holes. I have been told that the Capell patent fan is a good one, also the Sturtevant fan; but whatever make it is, it must be very powerful. I can take my heats all right if I have plenty of blast. Kindly give hints on fixing. There will be four fires. Should I reduce the main pipe from fan. Should I also reduce more still, the pipe going into the tue-irons; also should I caulk the pipe at tue-iron? What speed should the fan run? If any of your correspondents can assist me in this, I shall feel greatly obliged; but let the fan be as silent a one as possible.—Engine Smith.

[69371.]—**North London Locomotives.**—Will some correspondent give description and dimensions of the following North London locomotives:—passenger engine, outside cylinders, such as Nos. 2, 8, 11, 13, 21, 56. Passenger engine, inside cylinders, Nos. 109, or 118. Goods engine, Nos. 62, 77, 78, or 80.—F. V.

[69372.]—**Thought Reading.**—Would readers who have had any experience, and who take an interest in thought reading, thought transference, and other kindred subjects, say if it is bad for one to do too much in experimenting in, and with the art of mind reading? Does it cause fainting fits, trance, catalepsy, or death? Is clairvoyance imposture?—Thought Reader.

[69373.]—**Bicycles—Rotary v. Pedal Motion.**—Would some readers who have tried both the ordinary rotary and the pedal motion (as in the Facile) kindly give opinions as to the latter? It would appear that there is some drawback to the pedal motion, if we may judge from the comparative scarcity of this type of bicycle. I was thinking of getting one of this kind, and I should be glad to know the opinion of practical bicyclists on the point.—F. F.

[69374.]—**Silvering Looking-Glasses.**—Will some experienced man be so kind as to give me a good practicable recipe for silvering looking-glasses?—J. Rose.

[69375.]—**Loco. Work, &c.**—I shall be much obliged to any of "ours" who will give me any information with regard to the following? Are the gradients heavy on the South Wales section of the G. W. line? Is not an hour to Reading, and 8¾ hours to Milford (express) rather slow running? Are the G.W. locos as good as those on the Brighton and South Coast? I have heard that the Severn Tunnel is only expected to last a few years. Is this so? and why? Is the road from London Bridge to Portsmouth heavy? and the South Coast Co's service to the Isle of Wight as good as the South Western's? Are the expresses on the "Portsmouth direct" equal to those on the South Coast? Is the latter Co.'s service to the Continent good?—Guage.

[69376.]—**Cycle Fittings.**—I frequently require parts (brackets, etc.) for frames, of patterns not obtainable at the agencies. I have hitherto had them forged, but find this an expensive method, and the forgings are not always sound. Could I get them cast in steel, or would it break? As I don't want a large quantity, I can't get them stamped.—A. F. Shakespear, Dresden.

[69377.]—**Phosphor Bronze v. Steel.**—Will phosphor bronze hubs wear as well as steel? Gunmetal is useless, as spokes pull out sooner or later. I refer to the ball hubs of safeties. My objection to steel is, that a special stamping is required, which would want special machinery for turning up. The hubs are intended to last an indefinite period (so long as the spokes don't pull out), the bearings being easily replaceable.—A. F. Shakespear, Dresden.

[69378.]—**Swans.**—I have a pair of swans, which are continually flying away. I have cut the feathers off one wing; but they fly away as soon as the feathers have grown again. They have a good piece of water to swim on. Can any kind reader tell me an effectual method of preventing them flying without disfiguring them? What do they do with the swans on the Thames and other places?—Nemo.

[69379.]—**Fret-Work Machine.**—Will someone kindly inform me how to construct a fret-work machine, and where to get the material? I have the bottom part of a sewing machine. Would that be of any use?—J. Mackay.

[69380.]—**Vertical Engine.**—Would T. C., Bristol, or any other friend tell me about the power of a small vertical engine I have; but I have never had it under steam yet, as I have no boiler. The engine sits on a bed-plate 1cwt., with 4 turned bright colums, with 2 cylinders 3 1-16in. bore, with 4½in. stroke, the 2 cranks on the quarter, with a flywheel 27in. dia., and 93lb. weight. I bought it to drive my lathe, 7in. centre, 6ft. bed, screw-cutting. Also what height and diameter of boiler should I have to engine (must be vertical)?—J. Q.

[69381.]—**Joints of Steam Boilers.**—What are the largest diameters of steel rivets and iron rivets used in the largest marine boilers? What is the usual allowance of length for forming the heads of largest size rivets? What are the pitches of rivets used, say in one or two particular cases of large boilers for triple-expansion engines? Give sizes of rivets, thickness of plates, and as many particulars of the riveted joints in the said one or two cases as possible. Are steel rivets used now for steel plates?—E. Meredith.

[69382.]—**Brewing.**—Would Dr. Sykes please say if an iron boiler would do for boiling wort in? As I find a difficulty in getting brewer's yeast, could he inform me how to make it.—Wm. Timpson.

[69383.]—**Self-Inking Bookbinder's Arming Press.**—Would you kindly inform me how to work the above? It will be used for blocking cloth covers, the border in black ink, and the title of book in centre in gold. Are the cloth covers prepared or sized in anyway to receive the ink or gold? I suppose the press is used cold for the ink, and heated for the gold. What kind of ink or size is used? How can I make the brass block stick to the press, &c.?—X. Y. Z.

[69384.]—**Silvering Glass.**—Can any fellow reader give me information about silvering glass, as I have a piece of plate glass 12in. by 14 which I want to silver myself. About what would it cost?—W. E.

[69385.]—**Bicycle Vibration.**—I have a safety bicycle, the front wheel of which, when passing over pavement, vibrates very much, consequently making my hands very sore; in fact, the soreness is such that sometimes I cannot apply the brake. I am thinking of getting some other make of a machine. Will some kind reader aid me in the selection of a machine, by saying which make will correct the above?—Rough Roads.

[69386.]—**De Meritens Dynamo.**—How are the connections made between the field magnets, and to connect up to brushes? The machine is to be excited by a single light Gramme. A sketch of connections would greatly oblige, and any particulars respecting this machine. Am in a fog, as I have had nothing to do with this class of dynamo before.—Magneto.

[69387.]—**Hydraulic.**—Will some reader kindly tell a 20-year subscriber the best liquid to charge a hydraulic punch cylinder with, as I find that water alone rusts the cylinder and works very much when the punching bear has been standing idle for a few weeks.—R. Hayward.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, August 21, and unacknowledged elsewhere:—

H. Stubbs—Phos—Stero—W. A.—A Young Hand—C. F. D. Marshall—Practical Cutler—Bailey—Coil—J. Devey—Lens—Gray's Inn—One in a Fix—A. N.—T. W. M.—Catgut—Chlorine—A. W.—D. L.—Geo. W. Warry, C.E.

Safety. (There is no necessity to make a model before taking out a patent, as the Patent Office does not require models—drawings being sufficient. If for your own satisfaction, or in order to test some movement, you require a model, it is easy to get the parts made by different mechanicians. Make working drawings of the parts required, and send them to widely separated parts of the country if you feel so inclined; but surely the machine, or whatever it is, can be so sufficiently described in your provisional specification as to prevent anyone else taking it.)—Steam. (Whatever methods of utilising exhaust steam are known are described in back volumes; but we cannot form any definite opinion from your vague references as to whether you refer to Honigmann's "soda boiler" or to some of the crack-brained schemes periodically introduced by dreamers. Neither "chemical correspondents nor physicists" can explain the "principles and action" of apparatus unless they have some idea of the nature of the apparatus, and that, unfortunately, you have forgotten to supply.)—F. J. G. (We scarcely understand you. Are there not sufficient directions for making shocking coils in back volumes—even in recent numbers? or is it some special information you want? As to any "detrimental consequences" following the taking of shocks from a coil, how can anyone answer without more definite data? Some people can stand so much more than others. Have you looked through the index of the last volume, for instance?)—E. Hubbard. (If anyone commits murder in this country, and the crime is brought home to him, it will not matter of what nationality he is; the law will be carried out. You are apparently thinking of the law of extradition, for it would be impossible to try a foreigner here for a crime committed in his own country.)—Anxious to Learn, F.C. (See a textbook or the back volumes. Must be very "anxious" when the matter, or all that can be said definitely, is fully explained in any textbook.)—Dione. (In asking for information it is essential that the questions should be put in a definite form. You seem to have dropped into rhyme, and it would be necessary for many readers who could answer your query off-hand, if put plainly, to reperuse your lines perhaps twice in order to get at the dimensions or data given. And what is more—you not only want an answer, but a diagram which would probably be of no use to anyone but yourself, and not much to you. What the bee and the rose have to do with the displacement of steamers we fail to understand.)—Interested. (How can anyone say whether you could make a "medical coil and induction combined," without knowing something of your capabilities? We should think you would most likely fail; but there is nothing like trying, and there is plenty of information in back numbers, or in the usual textbooks or manuals.)—Apprentice. (Have not a sufficient number of dynamos been given that you should send a sketch of a very ordinary pattern, and expect us to engrave it? Look at your back numbers, and you will find all the information needed.)—Cyanide. (Your query is not sufficiently definite; but as you doubtless know whether you mean works on metallurgy or electro-metallurgy, we would suggest that you procure the catalogues of the booksellers.)—Countryman. (See indices. Are there any works of the kind?)—Birra. (Simply a preparation of rice we believe, useful in making beer, because it contains starch. It is advertised in this country, and an advertisement in the Sale Column would, no doubt, procure you an answer—perhaps an agency for Italy.)—Organist. (We do not think the specification of the large organ for Sydney has been published at present; but you will find some details in back numbers.)—W. Godden. (The so-called sunspot period is correctly given as "about eleven years," but no definite connection between that and the weather has been established. The records for 1879 are available; but weather is a very indefinite article, for it may be fine in London, rainy at Workington, and stormy at Hastings. The sunspots have very little control over the weather—that is certain.)—D. L. (You can obtain Mr. West's engravings of locomotives by addressing the author, T. West, Darlington. There are several sheets of engravings.)—O'M. (The ferrous oxalate developer has been described many times; but we do not see how anyone is to answer your query headed "Broken bottle." There must be more particulars; but no doubt a little search in back numbers will procure the information required.)—G. Neal. (See Hints No. 4 above.)—X. Y. Z. (See recent back numbers and the indices of the volumes already completed.)—Amateur. (Watt's "Electro-Metallurgy" will no doubt suit, but see indices.)—F. B. C. (For what purpose is the boiler required? A furnace suitable for a locomotive would not be the most economical for a Cornish boiler.)—Clock Towers. (Answered hundreds of times. See indices.)—A Gauge. (You must really look up back volumes. The arguments for and against smoking have long ago been stated, and we cannot return to the subject. We believe there is no doubt that tobacco is injurious to some men, and that its effects at the best are only tolerated by all—just as those of tea and coffee are.)—Anxious. (Consult a local directory or newspaper. We cannot ask for local addresses, except in the Address Column.)

The Thousands of Men and Women who have tried the effect of wearing HARNESS' ELECTROPATHIC BELTS are delighted with the speedy, natural, and comfortable means of cure afforded in cases of Nervous Weakness, Rheumatism, Sciatica, Lumbago, Brain Fag, Sleeplessness, Dyspepsia, Liver and Kidney Disorders, &c. All in search of Health and Strength should send at once for Book of Testimonials or call and see these genuine electric appliances scientifically tested at the Electropathic and [illegible] Institute, 52, OXFORD-STREET, LONDON, W. (corner of Rathbone-place). Sole Proprietors, the Medical Battery Co., Ltd. Mr. C. B. Harness, President. Consultation and advice free, either personally or by letter.

At a recent meeting of the Genevan Society of Physics and Natural History, M. Mallet exhibited two balls of almost perfect spericity, about ¼in. in diameter, one black, and of vegetable origin, the other white, and of mineral origin, but both produced by a mechanical movement. The black ball had been found with another in a piece of oak which had long served as the shaft of a mill-wheel. A cavity having formed in the wood, through disease or the work of some insect, the dust of the wood, with acquired moisture, had been rolled into this spherical form, growing in size, like a snowball, a slow process of many years probably, as the wheel was very old.) The white ball, a calcareous pebble, was found with many others in a grotto traversed by a torrent which flowed into the Rhone.

The American paper *Science* describes the results of some experiments recently at the Massachusetts Agricultural College to discover a method of hastening the fruiting of trees where the soil is moist and rich, and where fruit trees consequently grow largely to wood and foliage, and fail to produce fruit until they reach a considerable age and size. A row of crab-apple trees was selected. Three were girdled by cutting out a ring of bark one-eighth, a quarter, and a half inch wide at the ground; three more were girdled to the same widths just below the main branches, and others on one or more of the main branches. All the girdles made near the ground healed readily and completely; those on the main trunk healed less completely, but sufficiently to insure a good growth of tree; those on the branches healed less completely still, and in two instances the new growth failed to meet, and the branch died in the spring. All showed a marked increase in fruitfulness over those not girdled, and little difference was observed in the effect of the various widths. But no definite conclusion can be drawn yet as to the consequence of this treatment on the permanent health of the tree. Observations for many years can alone determine this point. A series of experiments made at the same place ten years ago showed that by removing a ring of bark early in July from fruit trees the ripening was hastened one or two weeks, and that the increased size and early maturity were not obtained at the expense of the quality.

555. Clean ?

JUN 26 1941